UNIT-I- ECOSYSTEMS

1.1 MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

1.1.1 INTRODUCTION

- The word environment is derived from the French word **'environner'** which means to **'encircle or surround'.**
- Thus our environment can be defined **as "the Social, Cultural and Physical conditions that surround, affect and influence the survival, growth and development of people, animals and plants"**
- This broad definition includes the natural world and the technological environment as well as the cultural and social contexts that shape human lives.
- It includes all factors (living and nonliving) that affect an individual organism or population at any point in the life cycle; set of circumstances surrounding a particular occurrence and all the things that surrounds us.

1.1.2 SEGMENTS OF ENVIRONMENT

Environment consists of four segments.

1. Atmosphere- Blanket of gases surrounding the earth.
2. Hydrosphere- Various water bodies present on the earth.
3. Lithosphere- Contains various types of soils and rocks on the earth.
4. Biosphere- Composed of all living organisms and their interactions with the environment.

1.1.3 MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

- The Environment studies is a multi-disciplinary science because it comprises various branches of studies like chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering etc.
- It is the science of physical phenomena in the environment. It studies about the sources, reactions, transport, effect and fate of physical and biological species in the air, water, soil and the effect of from human activity upon these.
- As the environment is complex and actually made up of many different environments like natural, constructed and cultural environments, environmental studies is inter disciplinary in nature including the study of biology, geology, politics, policy studies, law, religion engineering, chemistry and economics to understand the humanity's effects on the natural world.
- This subject educates the students to appreciate the complexity of environmental issues and citizens and experts in many fields.
- By studying environmental science, students may develop a breadth of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.

1.1.4 SCOPE OF ENVIRONMENTAL STUDIES

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

- **Natural resources**- their conservation and management
- **Ecology and Biodiversity**
- **Environmental pollution and control**
- **Human population** and environment
- **Social issues** in relation to development and environment

These are the basic aspects of environmental studies which have a direct relevance to every section of society. Several career options have emerged in these fields that are broadly categorized as:

(i) Research and development in environment:

Skilled environmental scientists have an important role to play in examining various environmental problems in a scientific manner and carry out R&D activities for developing cleaner technologies and promoting sustainable development.

(ii) Green advocacy:

With increasing emphasis on implementing various Acts and Laws related to environment, need for environmental lawyers has emerged, who should be able to plead the cases related to water, air, forest, wildlife, pollution and control etc.

(iii) Green marketing:

While ensuring the quality of products with ISO mark, now there is an increasing emphasis on marketing goods that are environment friendly. Such products have ecomark or ISO 14000 certification. Environmental auditors and environmental managers would be in great demand in the coming years.

(iv) Green media:

Environmental awareness can be spread amongst masses through mass media like television, radio, newspaper, magazine, hoardings, advertisements etc., for which environmentally educated persons are required.

(v) Environmental consultancy:

Many non-government organizations, industries and government bodies are engaging environmental consultants for systematically studying and tackling environment related problems.

1.1.5 IMPORTANCE OF ENVIRONMENTAL STUDIES

- The importance of environmental studies is that, the current trend of environmental degradation can be reversed if people of educated communities are organized, empowered and experts are involved in sustainable development.
- Environmental factors greatly influence every organism and their activities.

- At present a great number of environmental issues, have grown in size and complexity day by day, threatening the survival of mankind on earth. These issues are studied besides giving effective suggestions in the environment studies.
- The environment studies enlighten us, about the importance of protection and conservation of our natural resources, indiscriminate release of pollution into the environment etc.

Environment studies have become significant for the following reasons:

1. **Environment Issues being of International Importance:**

   It has been well recognized that environment issues like global warming, ozone depletion, acid rain, marine pollution and loss of biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

2. **Problems Cropped in The Wake of Development:**

   Development, in its wake gave birth to Urbanization, Industrial Growth, Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed world. The North, to cleanse their own environment has, fact fully, managed to move 'dirty' factories to South. When the West developed, it did so perhaps in ignorance of the environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.

3. **Explosively Increase in Pollution:**

   World census reflects that one in every seven persons in this plant lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

4. **Need for An Alternative Solution:**

   It is essential, specially for developing countries to find alternative paths to an alternative goal. We need a goal as under:

   (1) A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.

   (2) A goal common to all citizens of our earth.

(3) A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the "developed" world.

5. **Need To Save Humanity From Extinction:**

   It is incumbent upon us to save the humanity from extinction. Consequences to our activities cause destructing the environment and depleting the biosphere, in the name of development.

6. **Need For Wise Planning of Development:**

   Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to be synchronized with the ecological cycles in any plan of development. Our actions should be planned ecologically for the sustenance of the environment and development.

1.1.6 NEED FOR PUBLIC AWARENESS

1. **Growing Population:** A population of over thousands of millions is growing at 2.11 per cent every year. Over 17 million people are added each year. It puts considerable pressure on its natural resources and reduces the gains of development. Hence, the greatest challenge before us is to limit the population growth. Although population control does automatically lead to development, yet the development leads to a decrease in population growth rates.
2. **Poverty:** India has often been described a rich land with poor people. The poverty and environmental degradation are mixed with one another. The vast majority of our people are directly dependent on the nature resources of the country for their basic needs of food, fuel shelter and fodder. About 40% of our people are still below the poverty line.
3. **Environment degradation** has adversely affected the poor w ho depend upon the resources of their immediate surroundings. Thus, the challenge of poverty and the challenge of environment degradation are two facets of the same challenge.
4. **Agricultural Growth:** The people must be made familiar with the methods to sustain and increase agricultural growth without damaging the environment. High yielding varieties have caused soil salinity and damage to physical structure of soil.
5. **Need to Increase Ground water:** It is essential of rationalizing the use of groundwater. Factors like community wastes, industrial effluents, chemical

fertilizers and pesticides have polluted our surface water and affected quality of the groundwater. It is essential to restore the water quality of our rivers and other water bodies. Suitable strategies for conservation of water, provision of safe drinking water and keeping water bodies clean should be developed.

6. **Development and Forests:** Forests serve catchments for the rivers. With increasing demand of water, plan to harness the mighty river through large irrigation projects were made. Certainly, these would submerge forests; displace local people, damage flora and fauna. As such, the dams on the river Narmada, Bhagirathi and elsewhere have become areas of political and scientific debate. Forests in India have been shrinking for several centuries owing to pressures of agriculture and other uses. Vast areas that were once green, stand today as waste lands. These areas are to be brought back under vegetative cover. The tribal communities inhabiting forests, respects the trees, birds and animals give them sustenance. We must recognize the role of these people in restoring and conserving forests. The modern knowledge and skills of the forest department should be integrated with the traditional knowledge and experience of the local communities. The strategies for the joint management of forests should be evolved in a well planned way.
7. **Degradation of Land:** At present out of the total 329 mha of land, only 266 mha possess any potential for production. Of this, 143 mha is agricultural land nearly and 85 suffers from varying degrees of soil degradation. Of the remaining 123 mha, 40 are completely unproductive. The remaining 83 mha is classified as forest land, of which over half is denuded to various degrees. Nearly 406 million head of livestock have to be supported on 13 mha, or less than 4 per cent of the land classified as pasture land, most of which is overgrazed. Thus, out of 226 mha, about 175 mha or 66 per cent is degraded to varying degrees. Water and wind erosion causes further degradation of almost 150 mha This degradation is to be avoided.
8. **Evil Consequences of Urbanization:** Nearly 27% of Indians live in urban areas. Urbanization and industrialization has given birth to a great number of environmental problems. Over 30 percent of urban Indians live in slums. Out of

India's 3,245 towns and cities, only 21 have partial or full sewerage and treatment facilities. Hence, coping with rapid urbanization is a major challenge.

9. **Air and water Pollution:** Majority of our industrial plants are using outdated and pollution causing technologies and makeshift facilities devoid of any provision of treating their wastes. A great number of cities and industrial areas have been identified as the worst in terms of air and water pollution. Acts are enforced in the country, but their implement is not so easy. The reason is their implementation needs great resources, technical expertise, political and social will. Again the people are to be made aware of these rules. Their support is indispensable to implement these rules.

1.1.7 INSTITUTIONS IN ENVIRONMENT

Managing natural resources require efficient institutions at all levels i.e. local, national, regional and global. Among the large number of institutions that deal with environmental protection and conservation, a few well-known organization include government organizations like the BSI and ZSI, and NGOs like the BNHS, WWF-1, *etc*.

- **The Bombay Natural History Society (BNHS)**, Mumbai
- **World Wide fund for nature- India (WWF-1), New Delhi**
- **Centre or science and environment (CSE), New Delhi**
- **C.P.R Environmental Education Centre, Madras**
- **Centre for Environment Education** (CEE)
- **Bharati Vidyapeeth University, Institute of Environment Education & Research, Pune**
- **The Salim Ali Center for Ornithology and Natural History (SACON)**
- **Wild life Institute of India (WII),** Dehradhun
- **Zoological survey of India (ZSI)**
- **The madras Crocodile Bank Trust (MCBT)**
- **Botanical Survey of India (BSI)**

UNIT-II-NATURAL RESOURCES

1. INTRODUCTION

- Natural resources can be defined as 'variety of goods and services provided by nature which are necessary for our day-to-day lives'.
- Eg: Plants, animals and microbes (living or biotic part), Air, water, soil, minerals, climate and solar energy (non- living or abiotic part).
- They are essential for the fulfillment of physiological, social, economical and cultural needs at the individual and community levels.

2.TYPES OF NATURAL RESOURCES

They are of two types of resources namely Renewable and Non-Renewable Resources.

1. **Renewable resources:** The resources that can be replenished through rapid natural cycles are known as renewable resource. These resources are able to increase their abundance through reproduction and utilization of simple substances.

   Ex: Plants, (crops and forests) and animals.

- Some examples of renewable resources though they do not have life cycle but can be recycled.

  Ex: Wood and wood-products, pulp products, natural rubber, fibers (e.g. Cotton, jute, animal wool, silk and synthetic fibers) and leather.

- In addition to these resources, water and soil are also classified as renewable resources.
- Solar energy although having a finite life, as a special case, is considered as a renewable resource in as much as solar stocks is inexhaustible on the human scale.

2. **Non renewable resources:** The resources that cannot be replenished through natural processes are known as non-renewable resources. These are available in limited amounts, which cannot be increased. These resources include fossil fuels (petrol, coal etc.), metals (iron, copper, gold, silver, lead, zinc etc.), minerals and salts (carbonates, phosphates, nitrates etc.).Once a non-renewable resource is consumed, it is gone forever.

- Non-renewable resources can further be divided into two categories, viz.
  A) Recyclable and
  B) Non-recyclable

  A) Recyclable: These are non-renewable resources, which can be collected after they are used and can be recycled. These are mainly the non-energy mineral resources, which occur in the earth's crust (Ex: Ores of aluminum, copper, mercury etc.) and deposits of fertilizer nutrients (e.g. Phosphate sock and potassium and minerals used in their natural state (asbestos, clay, mica etc.)

  B) Non-recyclable: These are non-renewable resources, which cannot be recycled in any way.

  Ex: Fossil fuels and uranium, which provide 90 per cent of our energy requirements

3.NATURAL RESOURCES AND ASSOCIATED PROBLEMS:

- The main problem associated with natural resources is unequal consumption.
- A major part of natural resources are consumed in the 'developed' world. The 'developing nations' also over use many resources because of their greater human population. However, the consumption of resources per capita (per individual) of the developed countries is up to 50 times greater than in most developing countries.
- Advanced countries produce over 75% of global industrial waste and greenhouse gases.
- Energy from fossil fuels consumed in relatively much greater quantities in developed countries. Their per capita consumption of food too is much greater as well as their waste.

* FOREST RESOURCES

A forest can be defined as a biotic community predominant of trees, shrubs or any other woody vegetation usually in a closed canopy. It is derived from latin word *'foris'* means *'outside'*. India's Forest Cover is 6,76,000 sq.km (20.55% of geographic area). Scientists estimate that India should ideally have 33% of its land under forests. Today we only have

about 12% thus we need not only to protect our existing forests but also to increase our forest cover.

FUNCTIONS OF FOREST

1. It performs very important function both to human and to nature.
2. They are habitats to millions of plants, animals and wild life.
3. They recycle rain water.
4. They remove pollutant from air.
5. They control water quality.
6. They moderate temperature and weather.
7. They influence soil condition and prevent soil erosion.

USES OF FOREST

8. Commercial uses
9. Ecological uses

1. Commercial uses:

i. Wood – used as a fuel
ii. Supply wood for various industries – Raw materials as pulp, paper, furniture timber etc.
iii. Minor forest products – gum, dyes, resins
iv. Many plants – Medicines
v. Supply variety of animal products – honey. Ivory, horns etc.
vi. Many forest lands are used for - Mining, grazing, for dams and recreation.

2. Ecological uses: Forest provides number of environmental services.

i. **Production of oxygen:** Photosynthesis produces large amount of oxygen which is essential for life.
ii. **Reducing global warming:** Carbon dioxide is one of the main green house gas. It is absorbed by plants for photosynthesis. Therefore the problem of global warming caused by CO_2 is reduced.
iii. **Soil conservation:** Roots of trees bind the soil tightly and prevent soil erosion. They also act as wind breaks.
iv. **Regulation of hydrological cycle:** Watershed in forest act like giant sponges and slowly release the water for recharge of spring.

v. **Pollution moderators:** Forest can absorb many toxic gases and noises and help in preventing air and noise pollution.

vi. **Wild life habitat:** Forest is the home of millions of wild animals and plants.

REASON FOR DEFICIENCY OF FOREST:

In India the minimum area of forest required to maintain good ecological balance is about 33% of total area. But at present it is only about 12%. So over exploitation of forest material occurs.

OVER EXPLOITATION OF FOREST: Due to over population, there is an increased demand for medicine, shelter, wood and fuel. Hence exploitation of forest materials is going on increasing.

Cause of over exploitation:

1. Increasing agricultural production.
2. Increasing agricultural activities.
3. Increase in demand of wood resources.

DEFORESTATION: It is process of removal of forest resources due to naturalor manmade activities (i.e.) destruction of forests.

Causes of deforestation:

4. **Developmental projects:** Developmental projects causes deforestation through two ways.

- Through submergence of forest area.
- Destruction of forest area.

Ex: big dams, hydro electric projects, road construction etc.

5. **Mining operations:** It reduces forest areas. Ex: Mica, coal, Manganese and lime stone.

6. **Raw materials for industries:** Wood is an important raw material for various purposes.

Ex: Making boxes, furniture and paper etc.

7. **Fuel requirement:** Wood is the important fuel for rural and tribal population.

Shifting cultivation: Replacement of natural forest ecosystem for mono specifictree plantation.

Ex: Teak

8. **Forest fires:** Forest fire destructs thousands of acres of forest.
9. **Over grazing:** Over grazing by cattle reduces the cultivation land

Consequences of deforestation (or) impacts of deforestation:

1. Economic loss
2. Loss of biodiversity
3. Destructs the habitats of various species
4. Reduction in stream flow
5. Increases the rate of global warming
6. Disruption of weather patterns and global climate
7. Degradation of soil and acceleration of the rate of soil erosion.
8. Induces and accelerates mass movement / land slides.
9. Increases flood frequency, magnitude / severity.
10. Breaks the water cycle
11. Breaks the nutrient cycle

PREVENTIVE MEASURES (OR) AVOID OF DEFORESTATION (OR)METHODS OF CONSERVATION OF FORESTS

10. New plants of more or less of the same variety should be planted to replace thetrees cut down for timber
11. Use of wood for fuel should be discouraged.
12. Forest pests can be controlled by spraying pesticides by using aero planes
13. Forest fire must be controlled by modern techniques.
14. Over grazing by cattle must be controlled.
15. Steps should be taken by the government to discourage the migration of people into the islands from mainland.
16. Education and awareness programmes must be conducted.
17. Strict implementation of law of Forest conservation Act.

Case study:

Deforestation in the Himalayan region, involves clearing of natural forests and plantation of monoculture like Eucalyptus. Nutrient in the soil is poor; therefore soil losing their fertility, hence,

Himalayan area facing the serious problem of desertification.

MAJOR ACTIVITIES IN FORESTS

TIMBER EXTRACTION

Wood used for engineering purposes like building houses, making furniture is called timber. The products derived from timber have been important to many civilizations, and thus it has acquired value within these civilizations. Timber extraction results in deforestation and in the fragmentation of the last remaining forests. It harms valuable species of trees, birds and wild animals. In spite of this, it is sometimes necessary to extract timber, so as to meet the needs of a developing country. During the extraction of timber, cutting, felling and handling should be done selectively, carefully and in a planned manner, in order to save the remaining forests and biodiversity.

Effects of Timber Extraction

The major effects of timber extraction on forest and tribal people include:

1. Poor logging results in a degraded forest.
2. Floods may be intensified by cutting of trees or upstream watersheds.
3. Loss of biodiversity.
4. Climatic changes such as less rains.
5. New logging roads permit shifting cultivators to gain access to logged areas and cut the remaining trees.
6. It results in forest fragmentation which promotes loss of biodiversity because some species of plants and animals require large continuous areas of similar habitat to survive.
7. Exploitation of tribal people by the contractors.
8. Soil erosion especially on slopes occurs extensively.
9. Sedimentation of irrigation systems, floods may be intensified by cutting of trees on upstream.

Case Study-Chipko Movement

The world famous **Chipko Movement**, pioneered by **Dasohli Gram Swarajya Mandal** in Gopeshwar brought about a general awareness about conservation of forests.

The first Chipko Movement dates back to 1731, when a village woman named Amrita Bai led the Bishnoi women against the Maharajas men to prevent them from cutting trees. In this attempt to save the trees, she sacrificed her life along with the lives of her husband, three daughters and 363 people. The movement was given this name because the village women embraced or hugged the trees to stop them from being cut. In 1972, in Uttar Pradesh, the Chipko Movement was led by Bachnoi Devi of Advani who protected the hill forests from the contractors axe men.

DAMS

Today there are more than 45,000 large dams around the world, which play an important role in communities and economies that harness these water resources for their economic development. Current estimates suggest some 30-40% of irrigated land worldwide relies on dams. Hydropower, another important the use of stored water, currently supplies 19% of the world's total electric power supply and is used in over 150 countries. The world's two most populous countries – China and India –have built around 57% of the world's large dams.

Dams problems

Dams are the massive artificial structures built across the rivers to store water for much beneficial purpose.

Dams are considered a "Temples of modern India". Dams destruct vast area of forest area. India has more than 1600 large dams.

Effects of dams on forest:

10. Thousands of hectares of forest will be cleared.
11. Killing of wild animals and destruction of aquatic life.
12. Spreading of water borne diseases.
13. Water logging increases the salinity of the soil.

Ex: Narmadha Sagar project it has submerged 3.5 lakhs hectares of forest.

Effects of dam on tribal people

1. Construction of big dams lead to the displacement of tribal people.
2. Displacement and cultural change affects the tribal people both mentally and physically.
3. They do not accommodate the modern food habits and life style.
4. Tribal people are ill treated by the modern society.

5. Many of the displaced people were not recognised and resettled or compensated.
6. Body condition of tribal people will not suit with new areas and hence they will be affected by many diseases.

Case study- Sardar Sarovar Project:

The World Bank's withdrawal from the Sardar Sarovar Project in India in 1993 was a result of the demands of local people threatened with the loss of their livelihoods and homes in the submergence area. This dam in Gujarat on the Narmada has displaced thousands of tribal folk, whose lives and livelihoods were linked to the river, the forests and their agricultural lands. While they and the fishermen at the estuary, have lost their homeland, rich farmers downstream will get water for agriculture. The question is why should the local tribals be made homeless, displaced and relocated to benefit other people? Why should the less fortunate be made to bear the costs of development for better off farmers? It is a question of social and economic equity as well as the enormous environmental losses, including loss of the biological diversity of the inundated forests in the Narmada valley.

MINING

The process of extracting mineral resources and fossil fuels like coal from the earth is called as mining.

Types of mining

14. Surface mining: Mining of minerals from shallow deposits
15. Underground mining: Mining of minerals from deep deposits

Steps involved in mining

1. Exploration
2. Development
3. Exploitation
4. Ore processing
5. Extraction and purification of minerals

The extent of damage by underground mining is more than that of surface mining, which needs enormous amount of land area for its operation and management.

Effects of mining

1. Pollute soil, water and air.
2. Destruction of natural habitat.
3. Continuous removal of minerals leads to the formation of trench where water is logged which contaminates the ground water.
4. Vibrations cause earth quakes.
5. Produces noise pollution
6. Reduces shape and size of the forest.
7. Increased risk of landslides.
8. Spoils the aesthetic beauty.

WATER RESOURCES

Water claims to be an important resource. An important use of water in our country is for irrigation. Besides, water is also required in large amounts for industrial and domestic consumption.

USES

- Is essential for all forms of life.
- Many uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually, all of these human uses, require fresh water.
- No plant or animal species can survive without water. If water in our body drops by 1% we feel thirst, if it drops by 10% we face death.

HYDROLOGICAL CYCLE:

Water from various water bodies

↓

Evaporated by solar energy

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Enters in to the atmosphere as clouds

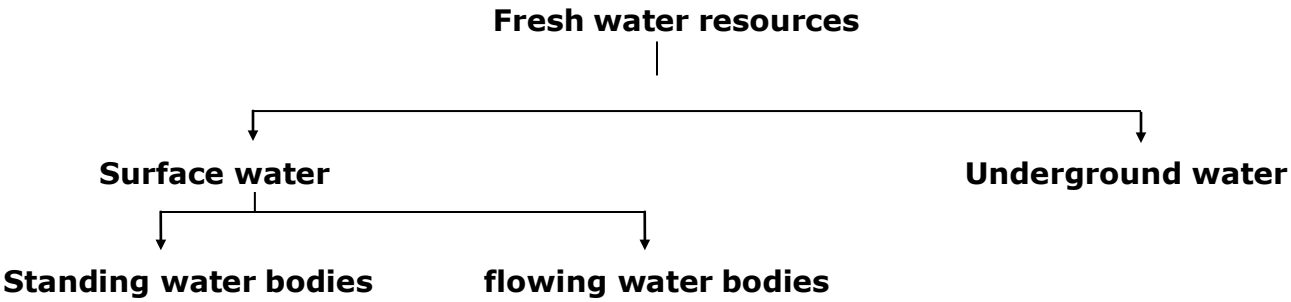
↓

Falls again on earth as rain or snow

↓

Ultimately returns to the ocean.

DISTRIBUTION OF WATER RESOURCES



UNDERGROUND WATER

Aquifer: Layers of highly permeable rock that can store water is called an aquifer. Layer of sand and gravels are good aquifers. Clay and crystalline rocks are not good aquifers.

Effects of over utilization of water

1. Decrease of ground water:

i. Increased usage decreases the ground water.
ii. Insufficient rain fall
iii. Building construction activities sealing the permeability of the soil.

2. Ground subsidence: If ground water withdrawal is greater than it's recharge rate, then the sediments in the aquifers get compacted. As a result shrinkage of land surface takes place.

Problems: a. Structural damages to the buildings
b. Fracture in pipes.
c. Reversing the flow of canals.

3. Lowering of water table: Over utilization of ground water in arid and semi arid regions for agriculture disturbs the state of equilibrium of the hydrological cycle.

Problem: a. Lowering of water table
b. Decrease the number of aquifers
c. Change the speed and direction of water.

4. Intrusion of salt water: In coastal area over exploitation of ground water leads to the intrusion of salt water from sea. Therefore that water cannot be used for drinking and agriculture.

5. Over utilization of water causes earth quakes, landslides and famines.

6. Drying up of wells: Due to over utilization, ground water level decreases much faster than can be regenerated. It leads to drying up of dug well and bore wells.

7. Pollution of water: Near the agricultural land ground water decreases therefore water containing nitrogen enters into the ground and pollute the ground water.

Problem: Water which contains excess nitrate content is not suitable for drinking.

REASONS FOR DECLINE OF GROUND WATER

Population continues to rise at an unprecedented and unsustainable rate; many more areas are expected to experience this imbalance in the near future.

1. **Population explosion:** World population is > 6 billion and will continue to increase significantly during the next few decades - Enormous demands on the world's limited freshwater supply. The total annual freshwater withdrawals today are estimated at 3800 cubic kilometers, twice as much as just 50 years ago (World Commission on Dams, 2000).
2. **Overutilization of Surface and Groundwater:** Occurs at various levels. Use of more water than really needed by human beings. Many agriculturists use more water than necessary to grow crops. Industries in order to maximize short-term economic gains, does not bother its liquid waste and releases it into streams, rivers and the sea.
3. **Deforestation:** Once hill slopes are removed of forest cover, the rainwater rushes down the rivers and is lost. Forest cover permits water to be held in the area permitting it to seep into the ground. This charges the underground stores of water in natural aquifers. This can be used in drought years if the stores have been filled during a good monsoon. This soil and water management and afforestation are long-term measures that reduce the impact of droughts. The destruction of forests influences the regulation of natural water cycle. The removal of dense and uniform cover over the hilly zones leads to occurrence of floods in drainage basins. Nations situated in tropical climates including India experience disastrous floods caused by the indiscriminate deforestation of the slopes above the valleys.
4. **Hydropower generation:** Large amount of water is used for generating power which otherwise used for human needs.
5. **Dams** - for Agriculture and Power Generation

6. **Rain fall:** The erratic and inadequate rainfall results in reduction in storage in subsurface reservoirs. The building construction activities are sealing the permeable zone, reducing the area for percolation of rainwater into subsurface and increase in surface runoff.
7. India's increasing demand for water for intensive irrigated agriculture, for generating electricity, and for consumption in urban and industrial centers, has been met by creating large dams. Dams support 30 to 40% of this area.

FLOOD

It is an over flow of water. It happens when the magnitude of flow of water exceeds the carrying capacity of the channel within its bank.

CAUSES OF FLOOD

1. Heavy rainfall, melting of snow and sudden release of water from dams. (Flash floods)
2. Reduction in the carrying capacity of the channel.
3. Deforestation, mining and over grazing increase the runoff from rains and the level of flood raises.

EFFECT OF FLOOD

1. Water spreads in the surrounding area and submerges them.
2. Cultivated land gets affected.
3. Extinction of civilization.

FLOOD MANAGEMENT

1. Floods can be controlled by dams.
2. Channel management control flood.
3. Flood hazards reduced by forecasting or flood warning.
4. Flood may also be reduced by reduction of run off by increasing infiltration through appropriate afforestation in the catchment area.

DROUGHT

Drought is nothing but scarcity of water, which occurs due to

1. Inadequate rain fall
2. Late arrival of rain fall
3. Excessive withdrawal of ground water.

Lack of water for the needs of agriculture, livestock, industry or human population may be termed as a drought. Drought causes serious damages to plants, animals and human life.

CAUSES OF DROUGHT

1. When annual rain fall is below normal and less than evaporation, drought is created.
2. High population.
3. Intensive cropping pattern

   Ex: Maharashtra - There has been no recovery from drought for the last 30 years due to over exploitation of water by sugarcane crop.

EFFECTS OF DROUGHT

1. Drought causes hunger, malnutrition and scarcity of drinking water an also changes the quality of water.
2. Drought causes widespread crop failure leading to acute shortage of food and adversely affects human and live stock population.
3. Worst situation of drought causes desertification.
4. Raw materials of agro based industries are critically affected during drought time, hence industrial and commercial growth decreases.
5. Drought increases the degradation of natural resources.
6. Drought causes large migration of people and urbanization.

DROUGHT MANAGEMENT

1. Indigenous knowledge is essential.
2. Rain water harvesting system.
3. Construction of reservoirs to improve ground water level.
4. Modern irrigation technology (drip irrigation) very useful to conserve water.
5. Afforestration activities also improve the potential of water in the drought area.
6. Crop mixing and dry forming are the suitable methods which minimize the risk of crop failures in dry area.

DAMS

Dams made significant contributions to human development and the benefits derived from them have been considerable. Large dams are designed to control floods and to help the drought prone areas, with supply of water. But large dams have proved to

cause severe environmental damage. Hence an attempt has been made to construct small dams. Multiple small dams have less impact on the environment.

Benefits: Dams ensure a year round supply of water for domestic use and provide extra water for agriculture, industries and hydropower generation.

Problems: They alter river flows, change nature's flood control mechanisms such as wetlands and flood plains, and destroy the lives of local people and the habitats of wild plant and animal species, particularly is the case with mega dams.

Some of the problems are mentioned below.

- Dam construction and submersion leads to significant loss of farmland and forest and land submergence
- Siltation of reservoirs, water logging and salination in surrounding lands reduces agricultural productivity
- Serious impacts on ecosystems - significant and irreversible loss of species and ecosystems, deforestation and loss of biodiversity, affects aquaculture
- Socio economic problems for example, displacement, rehabilitation and resettlement of tribal people.
- Fragmentation and physical transformation of rivers
- Displacement of people - People living in the catchment area, lose property and livelihood
- Impacts on lives, livelihoods, cultures and spiritual existence of indigenous and tribal people
- Dislodging animal populations
- Disruption of fish movement and navigational activities
- Emission of green house gases due to rotting of vegetation
- Natural disasters – reservoirs induced seismicity, flash floods etc and biological hazards due to large-scale impounding of water – increase exposure to vectorbrone diseases, such as malaria, schistosomiasis, filariasis.

SUSTAINABLE WATER MANAGEMENT

- Building several small reservoirs instead of few mega projects
- Developing small catchment dams and protecting wetlands

- Soil management, micro-catchment development and afforestation permits recharging of underground aquifer, thus reducing the need for large dams
- Treating and recycling municipal waste water for agricultural use.
- Preventing leakages form dams and canals and loss in municipal pipes
- Effective rainwater harvesting in urban environments
- Water conservation measures in agriculture, such as using drip irrigation, control of growing water intensive cash crops ; control of water logging.
- Pricing water at its real value makes people use it more responsibility and efficiently and reduces wastage
- In deforested areas where land has been degraded, appropriate soil management practices, making bunds along the hill-slopes and making nalla plugs can help retain moisture and make it possible to revegetate degraded areas
- Use waste water for activities that does not need fresh water – Recycling
- Adopt mini water harvesting models for domestic usage.
- Protect existing tanks
- Develop systematic water management and adopt strict water auditing
- "Save water Campaigns" for public awareness on water scarcity
- Through rainwater harvesting, community based participatory initiatives and holistic watershed management.
- Responsible water usage can only be achieved by empowering local communities and creating local accountability.
- The government should develop policies that protect water resources, promote sustainable watershed management and invest in technologies that will increase efficiency in irrigation, industrial usage and improve water harvesting techniques.

WATER CONFLICTS

1. Conflict through use: Unequal distribution of water led to interstate and international disputes.

National conflicts:

a. Sharing of cauvery water between Karnataka and TamilNadu.
b. Sharing of Krishna water between Karnataka and Andrapradesh
c. Siruvani – TamilNadu and Kerala

International conflicts:

Indus – India and Pakistan & Colorado river – Mexico and USA

MINERAL RESOURCES

Naturally occurring inorganic crystalline solids with uniform chemical composition are called as minerals.

USES AND EXPLOITATION OF MINERALS

1. Development of industrial plants and machinery. - Fe, Al & Cu
2. Construction work – Fe, Al &Ni
3. Generation of energy - coal, lignite, uranium
4. Designing defense equipments like weapons and ornaments
5. Agricultural purposes – fertilizers and fungicides – Zn & Mn
6. Jewellery –Au, Ag & Pt
7. Making alloys for various purposes
8. Communication purposes – telephone, wires, cables and electronic devices
9. Medicinal purposes, particularly in ayurvedic system

ENVIRONMENTAL DAMAGES CAUSED BY MINING ACTIVITIES

1. Devegetation:

- Topsoil and vegetation get removed
- Deforestation leads to several ecological losses
- Land scape gets badly affected

2. Ground water contamination: Mining pollutes ground water; sulphur is converted into sulphuric acid which enters into the soil.

3. Surface water pollution: Radioactive wastes and other acidic impurities affect the surface water, which kills many aquatic animals.

4. Air pollution: Smelting and roasting are done to purify the metal which emits air pollutants and damage the nearby vegetation. It causes many health problems.

5. Subsidence of land: Mainly underground mining results in cracks in houses, tilting of buildings and bending of rail tracks.

EFFECTS OF OVER EXPLOITATION OF MINERALS

1. Rapid depletion of mineral deposits
2. Wastage
3. Environmental pollution
4. Needs heavy energy requirements.

MANAGEMENT OF MINERAL RESOURCES

1. The efficient use and protection of mineral resources.
2. Modernization of mining industries
3. Search for new deposit
4. Reuse and recycling of the metals.
5. Environmental impacts can be minimized by adopting eco friendly mining technology.

CASE STUDIES-MINING AND QUARRYING IN UDAIPUR

200 open cast mining and quarrying in Udaipur. But 100 mines are illegal. 150 tons of explosives are used per month. It pollutes air, soil and water. It affects irrigation and wild life.

FOOD RESOURCES

Food is an essential requirement for survival of life. Main components are carbohydrates, fats, proteins, minerals and vitamins.

TYPES OF FOOD SUPPLY

1. Crop plants: Grains mostly **c**onstitute about 76% of the world's food.
Ex: Rice, Wheat and Maize

2. Range lands: Produces 17% of world's food from trees and grazing animals.
Ex: Fruits, milk and meat

3. Ocean: Fisheries – 7% of world's food

WORLD FOOD PROBLEM

1. In the earth's surface, 79% is water out of total area. 21% land (forest, desert, mountain and barren land) . Less % cultivated land, at the same time population explosion is high therefore world food problem arises.
2. Environmental degradation like soil erosion, water logging, water pollution, salinity affects agricultural land.
3. Urbanization affects agricultural land. Hence production of rice, wheat, corn and other vegetable is difficult.

TYPES OF NUTRITION

1. Nutritious nutrition: To maintain good health and disease resistance, we need large amount of carbohydrate, proteins, fats and smaller amount of micronutrients such as vitamins and minerals such as Fe, Ca and iodine. Food and agricultural organization (FAO) of United Nations estimated that on an average, the minimum calorie intake on a global state is 2500 calories/day.

2. Under nutrition: People who cannot buy enough food to meet their basic energy needs suffer from under nutrition. They receive less than 90% of this minimum dietary calorie.

Effect of under nutrition: Suffer from mental retardation and infectious diseases.

3. Mal nutrition: Besides minimum calorie intake we also need proteins, minerals, vitamins, iron and iodine. Deficiency leads to malnutrition resulting in several diseases.

Effect of mal nutrition:

.No	**ciency of nutrients**	**Effects**
1	in	th
2		ia
3	e	r
4	in – A	ess

India 3rd largest producer of crops, nearly 300 million Indians are still under nourished.

World food summit 1996: The world food summit, 1996 has set the goal to reduce the number of under nourished and mal nourished people to just half by 2015.

OVER GRAZING

It is a process of eating the forest vegetation without giving a chance to regenerate.

EFFECTS OF OVER GRAZING

1. Land degradation

- Over grazing removing the cover of vegetation
- Exposed soil gets compacted
- Soil moisture reduces.
- Desertification - OG leads to poor, dry and compacted soil.
- Land cannot be used for further cultivation.

2. Soil erosion: When the grasses are removed the soil becomes loose and gets eroded by the action of wind and rain fall.

3. Loss of useful species: OG affects the plant population and their regenerating capacity. OG replace the plant of high nutritive value with plant of low nutritive value.

AGRICULTURE

Agriculture is an art, science and industry of managing the growth of plants animals for human use. It includes cultivation of the soil, growing and harvesting crops, breeding and raising livestock, dairying and forestry.

TYPES OF AGRICULTURE

1. Traditional agriculture
2. Modern (or) industrialised agriculture

1. Traditional agriculture

Small plot, simple tools, surface water, organic fertilizer and a mixture of crops constitute traditional agriculture. They produce enough food to feed their family and to sell it for their income.

2. Modern agriculture

Hybrid seeds of single crop variety, high tech equipments, lot of fertilisers, pesticides and water to produce large amount of single crops.

EFFECTS OF MODERN AGRICULTURE

1. Problems in using fertilizers:

Excess of fertilizers causes micronutrient imbalance. (e.g) Punjab and Haryana deficiency of nutrient zinc in the soil affect the productivity of the soil.

a. **Blue baby syndrome** (nitrate pollution): Nitrate present in the fertilizer causes blue baby syndrome, when the amount exceeds the limit leads to death.

b. **Eutrophication:** Nitrogen and phosphorus in the crop fields washed out by runoff water in the water bodies, which increases the nourishment of the lakes called eutrophication. Hence algal species increases rapidly. Life time of the species is less and they decompose easily and pollute the water which affects the aquatic life.

2. Problems in using pesticides

1. Death of non target organism.
2. Producing new pest – super pest
3. Bio magnification – Most of the pesticides are non bio degradable, keep on concentrating in the food chain and it is harmful to human beings.
4. Risk of cancer:
    a. It directly acts as carcinogen
    b. It indirectly supports immune system.

3. Water logging: Land where water stand for most of the year.

Causes of water logging:

1. Excessive water supply
2. Heavy rain
3. Poor drainage

Remedy:

1. Preventing excessive irrigation
2. Subsurface drainage technology
3. Bio drainage like trees like Eucalyptus

CASE STUDY- PESTICIDES IN INDIA

In Delhi the accumulation of pesticide in the body of mother causes premature

delivery and low birth weight infant.

Pesticides in Pepsi and Coca Cola India has reported that Pepsi and coca cola companies are selling soft drinks with pesticide content 30-40 times higher than EU limits. This damages the nervous system,.

ENERGY RESOURCES

1.2.5.2 ENERGY DISTRIBUTION IN THE WORLD

- Developed countries like USA and Canada constitute only 5% of the world's population but consume 25% of the world's available energy.
- Energy consumed by a person in a developed country for a single day is equal to energy consumed by a single person in a poor country for one year.
- Developed country GNP increases and energy consumption increases. In the poor country GNP and energy consumption are less.

TYPES OF ENERGY RESOURCES:

1. Renewable energy resource (or)Non conventional energy resources
2. Non renewable energy resources (or) Conventional energy resources

RENEWABLE ENERGY SOURCES: Energy which can be regenerated.

Merits of renewable energy resources

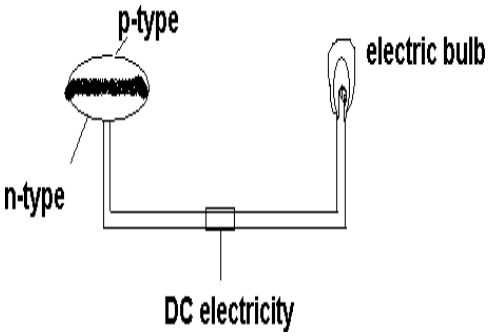
1. Unlimited supply
2. Provides energy security.
3. Fits into sustainable development concept.
4. Reliable and the devices are modular in size.
5. Decentralized energy production.

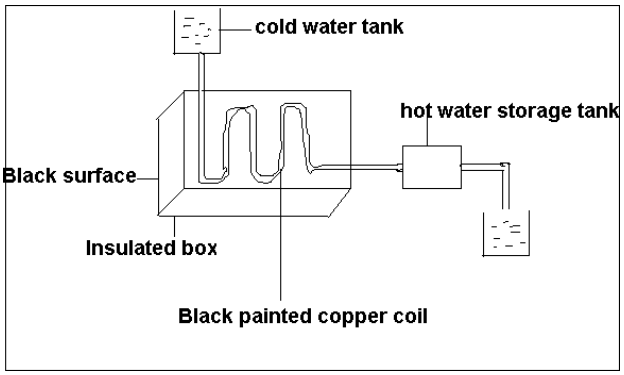
Types of renewable energy resources

1. **Solar energy:** Nuclear fusion reaction of sun produces enormous amount of energy. Several techniques are available for collecting, storing and using solar energy.
    a. **Solar cell (or) Photovoltaic cell (or) PV cell:**
    - Solar cell consists of p- type semi conductor (Si doped with B) and n-type semi conductor (Si doped with P). P-type forms top layer and n-type forms bottom layer.
    - Solar rays fall on the top layer, the electrons from valence band promoted to the conduction band which crosses the p-n junction into n-type semi

conductor. Potential difference between the two layers is created which causes flow of electrons.

Uses: It is used in calculators, electronic watches, street light, water pumps etc.





b. **Solar battery:** Large number of solar cells connected in series is called solar battery. It is used in remote areas where continuous power supply is a problem.

c. **Solar water heater:** It consists of insulated box painted with black paint with glass lid. Inside the box black painted copper coil is present. Cold water is allowed to flow, it is heated up and flows out into a storage tank from which water is supplied through pipes.

2. **Wind energy:** Moving air is called wind. The energy recovered from the force of the wind is called wind energy It's speed is high.

   a. **Wind mills:** When a blowing wind strikes the blade of the wind mill, it rotates continuously. And rotational motion of the blade drives number of machines like water pump, flour mills and electric generators.

   b. **Wind farms:** When a large number of mills are installed and joined together in a definite pattern – it forms wind farm. It produces large amount of electricity.

      Condition: Minimum speed for wind generator is 15 Km/hr

      Advantages:

      1. It does not cause air pollution
      2. Very cheap

3. Ocean energy:

Tidal energy (or) Tidal power: Ocean tides are due to gravitational force of sun and moon which produce enormous amount of energy. High tides – rise of water in the ocean. Low tides – fall of water in the ocean. Tidal energy can be used by constructing a tidal barrage. During high tides sea water enters into the reservoirs and rotates the turbine, produce electricity. During low tides water from reservoir enters into the sea rotate the turbine produce electricity.

Ocean thermal energy:

Temperature difference between surface water and deeper level water in ocean generates electricity. The energy available due to the difference in temperature of water is called ocean thermal energy.

Condition: Temperature difference should be 200C.

Process: Ammonia is converted into vapours on the surface of warm water, it increases the vapour pressure which rotate the turbine and generates electricity. Deeper level cold water is pumped to cool and condense the vapour in to liquid.

3. **Geo thermal energy:** Temperature of the earth increases at a of 20 –750C per/km when we move down the earth. The energy utilised from the high temperature present inside the earth is called geothermal energy.

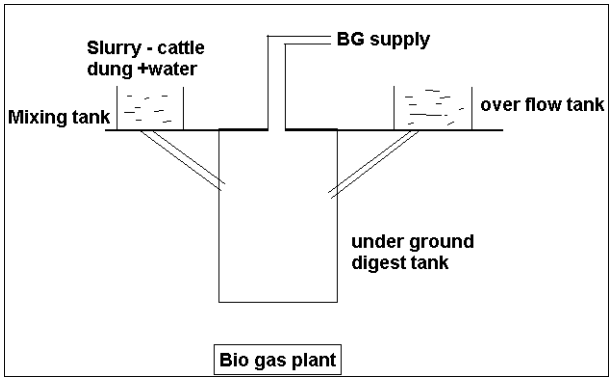
   Natural geysers: Hot water or steam comes out of the ground through cracks naturally is called natural geysers.

   Artificial geysers: Artificially a drill hole up to the hot region and by sending a pipe into it. The hot water or steam is used to rotate the turbine and generate electricity.

4. **Bio mass energy:**

   Bio mass: Organic matter produced by plants or animals used as source of energy

   Bio gas: Mixture of methane, carbondioxide and hydrogen sulphide. Methane is the major constituent. It is obtained by anerobic fermentation of animal dung (or) plant wastes in the presence of water.



Bio fuels: Fuels obtained by the fermentation of biomass.

Ex: Ethanol, methanol

Ethanol: Produced from sugar cane. Calorific value is less.

Methanol: Obtained from ethanol Calorific value too less.

Gasohol: Mixture of ethanol and gasoline India trial is going on to use gasohol in cars and buses.

Hydrogen fuel: Hydrogen produced by pyrolysis, photolysis and electrolysis of water. It has high calorific value. Non polluting one because the combustion product is water.

Disadvantages:

1. Hydrogen is highly inflammable and explosive.
2. Safe handling is required.
3. Difficult to store and transport.

NON RENEWABLE ENERGY SOURCES:

Energy which cannot be regenerated is called as non-renewable.

1. **Coal:** It is a solid fossil fuel.

Disadvantages:

1. When coal is burnt large amount of CO_2 is released which causes global warming.
2. S, N produces toxic gases during burning.

2. **Petroleum:** Crude oil is a liquid consists of more than hundreds of hydrocarbons and small amount of impurities. The petroleum can be refined by fractional distillation. In the world level 25% of oil reserves are in Saudi Arabia. At present rate of usage, the world crude oil reserves are expected to get exhausted in just 40 years.

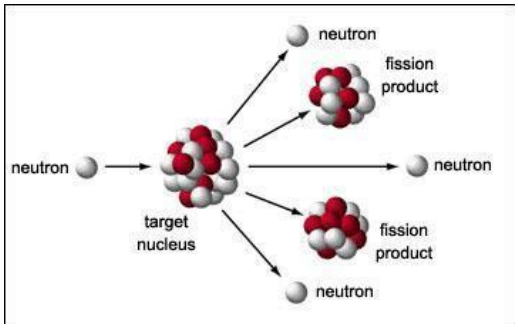
3. **Liquefied petroleum gas (LPG):** Petroleum gases obtained during FD and cracking can be easily converted into liquid under high pressure as LPG. It is colorless and odorless gas, but during cylindering mercaptans are added to detect leakage.
4. **Natural gas:** These are found above oil in oil wells. It is a mixture of methane and other hydrocarbons. Calorific value is high. There are two types. Dry gas and wet gas.
5. **Nuclear energy:** Dr.H.Bhabha is a father of nuclear power development in India. 10 nuclear reactors are present in India. It produces 2% of India's electricity. Nuclear energy can be produced by two types of reactions. Nuclear fission and nuclear fusion.

   Nuclear fission; It is a nuclear change in which heavier nucleus split into lighter nuclei on bombardment of fast moving neutrons. Large amount of energy is released through chain reaction.

   Ex: Uranium with fast moving neutron gives barium and krypton in addition to three neutrons; in the second stage it gives nine neutrons and so on. This process of propagation of the reaction by multiplication is called chain reaction.

   Nuclear fission: It is a nuclear change in which lighter nucleus is combined together at extremely high temperature (1 billion 0C) to form heavier nucleus and a large amount of energy is released.

   Ex: Isotopes of hydrogen combine to form helium molecule.



CASE STUDY

Wind energy in India: India generating 1200 MW electricity using the wind energy. Largest wind farm situated near Kanyakumari in Tamilnadu. It produces 380 MW electricity.

Hydrogen fuel car: General motor company of china discovered a experimental car (fuel H2) can produce no emission only water droplets and vapors come out of the exhaust pipe. This car will be commercially available by 2010.

UNIT-I-ECOSYSTEMS

Concepts 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 the (A) Forest Ecosystem (B) Grassland Ecosystem (C) Desert Ecosystem (D) Aquatic Ecosystems (Ponds, Streams, Lakes, Rivers, Oceans, Estuaries)

INTRODUCTION:

ECOLOGY:

- The term was first coined by Hons Reiter and Haekel in 1869.
- The term ecology (Okekologie) is originated from two Greek words Oikos (eco) – means "house" (or) place of living and "ology" means "the science of (or) the study of. Hence, ecology is the branch of science that deals with the study of the pattern of relations between the organism and their environment.

(OR)

- Ecology is the study of interactions among organisms (or) group of organisms with their environment.

(OR)

- Ecology is the study of ecosystems.

ECO SYSTEM:

- In 1935, the British ecologist A.G.Tansley coined the term "eco system".

- The term **"eco system"** is made up of two Greek words. "Eco" means ecological sphere (or) house (or) place of living (or) surroundings (or) Environment, w here living organism does exist while **"system"** means "group of organisms joined in regular and interdependent manner. Hence,
- A group of organisms interacting among themselves and with environment is known as ecosystem.

(OR)

- A system of interaction of organisms with their surroundings (i.e., environment) is called as "ecosystem".

Examples: Pond, lake, ocean, forest and desert…. Etc are some of the examples of the ecosystems.

2.1.2 FUNDAMENTAL CHARACTERISTICS OF ECOLOGY

STRUCTURE:

- Living /Biotic
- Non-Living /Abiotitic

PROCESS:

- Energy flow
- Cycling of matter

CHANGE:

- Dynamic (Not static)
- Succession etc.

FUNCTION:

- Food chain
- Food web
- Ecological pyramids
- Energy Flow
- Cycling of matter

2.1.3 CHARACTERISTICS OF ECOSYSTEM

- Eco system is the basic functional unit of ecology.
- It contains both biotic and abiotic components.

- The function of ecosystem is related to the cycling of matter (materials) and flow of energy.
- The amount of energy needed to maintain an ecosystem depends on its structure.
- Ecosystem passes from a less complex state to more complex state, which is called as **"ecological succession".**

2.1.4 CLASSIFICATION OF ECOSYSTEM:

- The ecosystem can be generally classified into two types:
    1. Natural Ecosystem
    2. Artificial Eco system

1. NATURAL ECOSYSTEM:

- A natural ecosystem is developed and governed by nature.
- These are capable of operating and maintaining themselves without any major interference by man.
- The following are the two types of natural ecosystem based on their habitat.
    1. Terrestrial Ecosystem.
    2. Aquatic Ecosystem.

1) Terrestrial Ecosystem:

- This ecosystem is related to land.

Examples: Grassland ecosystem.
Forest ecosystem, and
Desert ecosystem etc.

2) Aquatic Ecosystem:

- This ecosystem is related to water, it is further sub divided into two types based on salt content.

i. Fresh Water Ecosystem:

a. Running Water Ecosystems
Examples: Rivers, streams (small narrow rivers)
b. Standing Water Ecosystems
Examples: Pond, lake & well, etc

ii. Marine Ecosystem:

Examples: seas and sea shores <land along the edges of sea>

2. MAN MADE (OR) ARTIFICIAL ECOSYSTEM:

An artificial ecosystem is created and maintained by man for his different needs.

Examples: Reservoirs, Artificial lakes and gardens, etc.

2.1.5 STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM:

- The term structure refers to various components. So, the structure of an ecosystem explains the relationship between the abiotic (non-living) and the biotic (living) components.
  - Each and every ecosystem has two major components are:
    1. Biotic (living) components.
    2. Abiotic (Non-living) components.

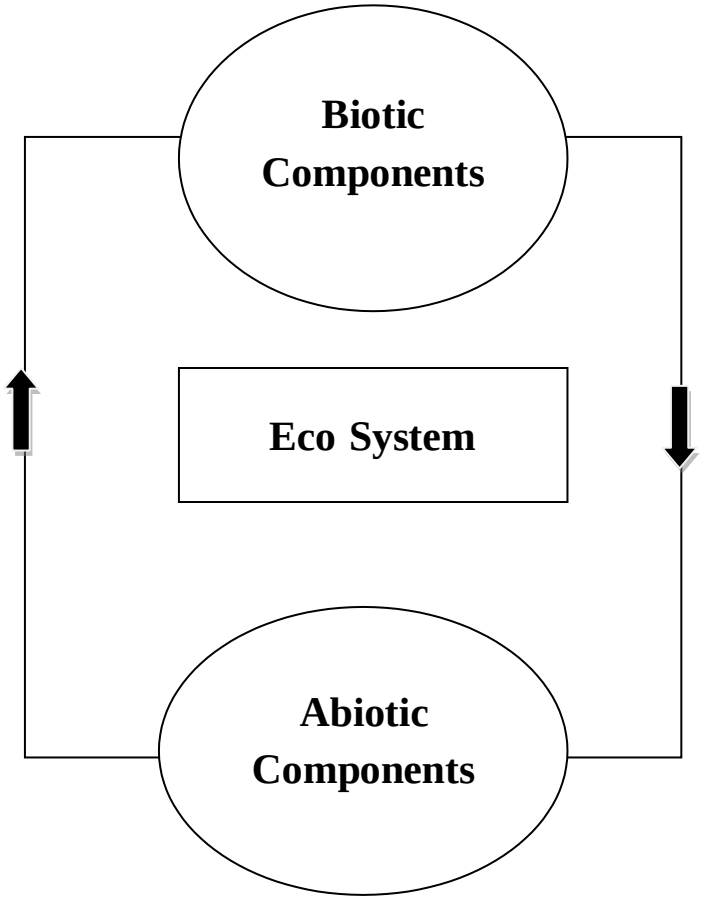


Fig: Components Of Ecosystem

1. Biotic Components: The living component of an ecosystem is called **"Biotic component".**

Examples: Plants (Producers)

Animals (Consumers) and

Micro Organisms (Decomposers)

- The biotic components of an ecosystem are classified into three types based on how they get their food.

A. Producers (Autotrophs) : Plants

B. Consumers (Heterotrophs) : Animals

C. Decomposers (Saprotrophs) : Micro organisms.

A. Producers (or) Autotrophs (Auto=self, troph=feeder)

- Self food producing organisms are known as autotrophs.

  Examples: All green plants and trees.

- Producers synthesize their food themselves through photosynthesis. Hence they are also called **"Photo autotrophs".** (photo = light)

B. Consumers (or) Heterotrophs (Hetero = other, troph = feeder:

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

  Examples: Plant Eating Species: Insects, rabbit, goat, deer, cow, etc.

  Animals Eating Species: Fish, lions, tigers, etc.

- Depending upon the food habits the consumers are divided into four types.

  i. Herbivores (or) Primary Consumers (Plant Eaters)

  ii. Carnivores (or) Secondary Consumers (Meat Eaters)

  iii. Omnivores (or) Tertiary Consumers (With plant & meat eaters)

  iv. Detritivores (dead organism eaters)

i. Herbivores: (**Herbi = the green plant & Vorare = to devour)**

- Animals that eat only plants are called Herbivores.
- They directly depend on the plants for their food. So they are called Plant eaters.

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

ii. Carnivores: (Carne = flesh meat & Vorare = to devour)

- Animals that eat other animals are called carnivores.

- They directly depend on the herbivores for their food.

Examples: Frog, cat, snake & foxes, etc.

iii. Omnivores: (Omni = whole comes from "ohm" & Vorare = to devour)

- Animals that eat both plants and animals are called omnivores.
- They depend on both herbivores and carnivores for their food.

Examples: humans, tigers, lions, rats and fox etc.

iv. Detritivores: (Detritifeeder)

- Animals that eat dead organisms and waste of living are called detritivores.

Examples: beetles, termites, ants, crabs, earthworms, etc.

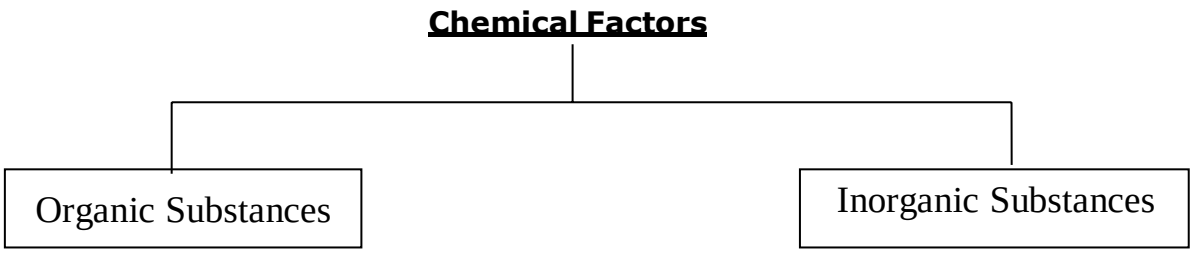
C. Decomposers (or) Saptrotrophs: (Sapros = Rotten, trophos = feeder)

- Decomposers attack the dead bodies of producers and consumers and decompose them into simple compounds. During the decomposition inorganic nutrients are released.
- The organisms which break down the complex compounds into simple products are called decomposers (or) reducers.

Examples: micro-organisms such as bacteria and fungi, etc.

2. Abiotic Components:

- The non-living component of an ecosystem is called "abiotic component"
- These non-living components enter the body of living organism, take part in metabolic activities and then return to the environment. The abiotic component of the ecosystems divided into three portions.
  1. Climate factors : Solar radiation, temperature, wind, water current, rainfall, etc.
  2. Physical factors : light, fire, soil, air, etc.
  3. Chemical factors : Organic and Inorganic substances.



2.1.6 FUNCTION OF AN ECOSYSTEM:

- The function of an ecosystem is related to the cycling of materials (matter) and flow of energy.

2.6.1 Types of functions:

- Functions of an ecosystem are of three types:
    1. **Primary Function:** The producers (plants) can make their food themselves through photosynthesis. This process is called primary function of eco system.
        Examples: All green plants and trees.
    2. **Secondary Function:** The consumers (animals and humans) cannot make their own food. They are always depending upon the producers for their energy. This is called secondary function of eco system.
    3. **Tertiary Function:** Decomposers attack the dead bodies of consumers and producers and decompose them into simpler compounds. During the decomposition inorganic nutrients are released.
        Examples: Micro organisms like bacteria and fungi, etc.

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

A. Food chains
B. Food webs
C. Food pyramids (or) Energy pyramids
D. Energy and material flow.

A. Food Chain:

- Anything which we eat to live is called food.
- Food contains energy.
- Food can be transferred from one organism to the other.
- The process of transfer of food (energy) from one organism to a series of organisms is called as **"food chain".**
- A food chain always starts with a plant life and end with animal life. Thus, a food chain is a picture (or) model that shows the flow of energy from autotrophs (producers) to series of organisms in an environment, as shown in the following figure.

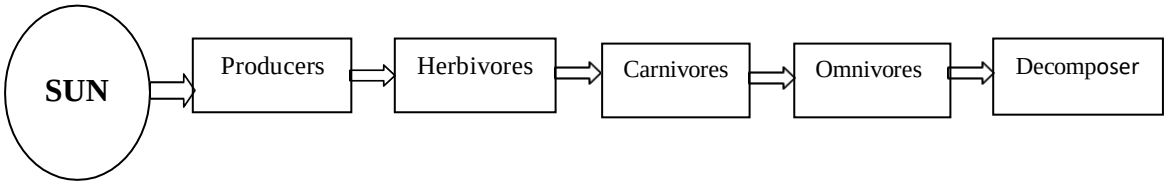


Figure: Schematic representation of food chain.

- Infact, all the food chains starts with the sun. The sun provides energy for plants.
- The producers (plants) can make their food themselves with the help of the sunlight, chlorophyll, water and air. The consumers, including animals and humans, cannot make their own food. They are always depending upon the producers for their energy.
- Decomposers are the micro-organisms that break down the dead animals and plants and release nutrients that become part of the soil, which are re-used by new plants, back to the starting point of the food chain.

Types of food chain:

Three basic types of food **chains** are found in a typical eco system. They are:

1. Grazing food chains.
2. Detritus food chains.
3. Parasitic food chains.

1. Grazing food chains:

- Grazing food chain starts with green plants (producers) and goes to decomposer food chain (or) detritus food chain through herbivores and carnivores.
- It has two types :
  a. Terrestrial food chain and
  b. Aquatic food chain

a. **Terrestrial food chain:** Food chain on land is called terrestrial food chain.

Example: Grassland food chain
Forest land food chain
Desert land food chain

Grass land food chain

Grasses ⟶ Grasshoppers ⟶ Frog ⟶ Snake ⟶ Eagles

Forest food chain

Green plants ⟶ Deer ⟶ Tiger (or) lion

b. **Aquatic food chain :** This food chain is slightly different from terrestrial food chain. It is seen in aquatic (water) eco system. Food chain in water is called "Aquatic food chain".

Example: Marine food chain Example: Ocean

Fresh water food chain Example: Pond, lake, streams, etc.

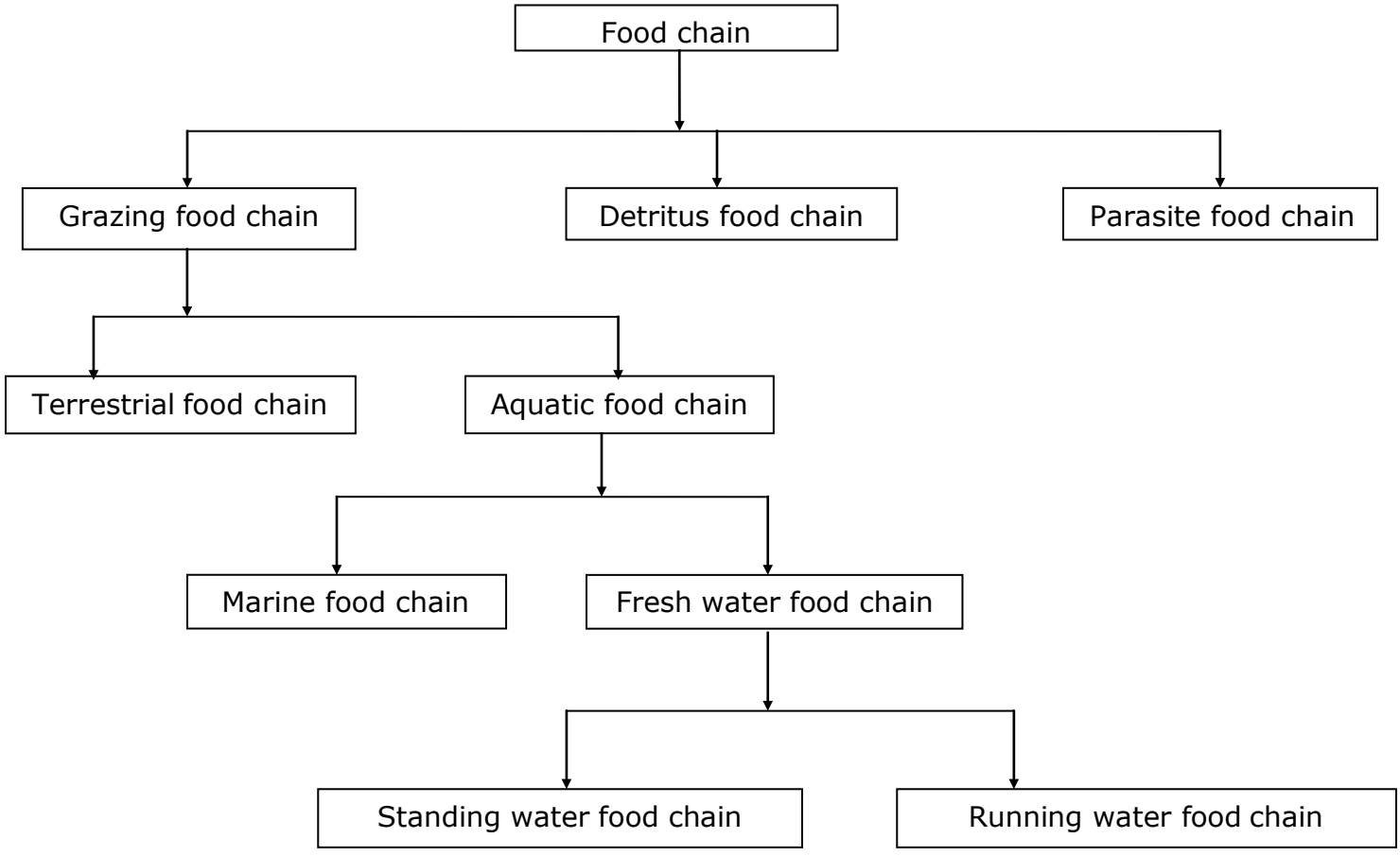
Food chain in a pond

Phytoplankton ⟶ Zoo Plankton ⟶ Small fish ⟶ Large fish ⟶ Man

Marine Food chain:

Sea Weeds ⟶ Small fish ⟶ Large fish ⟶ Sharks and other animals

Figure:



2. Detritus' food chain: Detritus food chain starts with dead organic matter (plants and animals) and goes to decomposer through consumers. Detritus food chains, independent of solar energy, but they depend on influx of dead organic matter.

Example:

Dead Plants ⟶ Soil mitts ⟶ Algae ⟶ Crabs ⟶ Small fish ⟶ Large fish

3. Parasitic food chain: Parasitic food chain operates in many ecosystems. In this food chain either consumer (or) producer is parasitized and the food passes to smaller organisms. A parasitic food chain involves host parasite hyper parasites' links.

Example: Trees ⟶ Fruit eating birds ⟶ Lice & Bugs ⟶ Bacteria ⟶ Fungi

B. Food Web:

- Web means "network" such as spider's web, World Wide Web (WWW) etc.
- So, food web is a network of food chains.
- In a food web many food chains are inter connected, where different types of organisms are connected at different tropic levels, so that there are a number of options of eating and being eaten at each tropic level. Thus, there is a inter connecting of various food chains are called food webs and as shown in following figure.

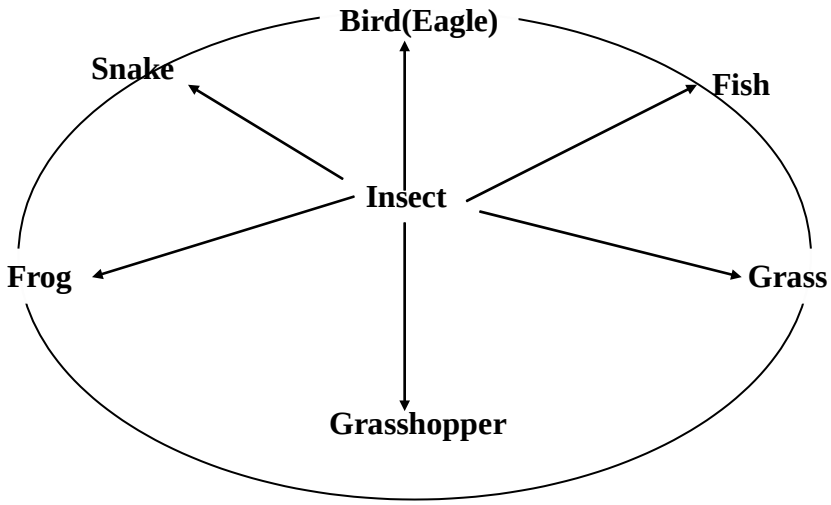
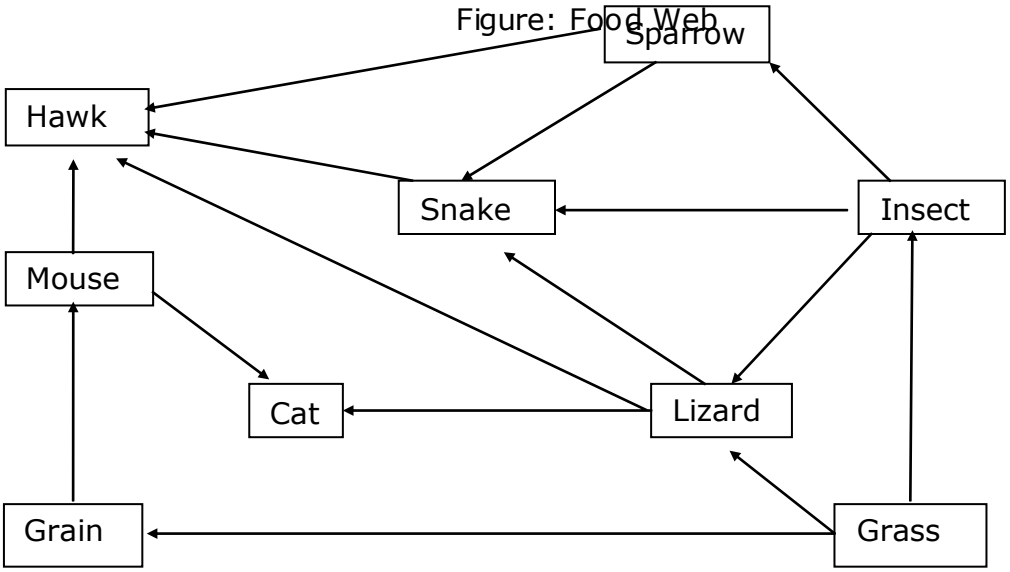


Figure: Food Web



This food web shows many linear food chains <as shown in figure>. These linear food chains are inter connected with other food chains operating in the eco system to form a food web. The grazing food chains are as follows:

- Grains ⟶ Mouse ⟶ Cat
- Grains ⟶ Mouse ⟶ Hawk
- Grains ⟶ Mouse ⟶ Snake ⟶ Hawk
- Grains ⟶ Insect ⟶ Sparrow ⟶ Hawk
- Grass ⟶ Insect ⟶ Lizard ⟶ Snake ⟶ Hawk
- Grass ⟶ Insect ⟶ Sparrow ⟶ Snake ⟶ Hawk

The above food web is a simple one. Much more complex food webs do exist in nature.

C. Ecological Pyramids:

- The concept of ecological pyramids was first developed by British ecologist Charles Elton in 1927.
- Ecological pyramids are the diagrammatic representation of tropic structures in which the tropic levels (i.e., tiers) are depicted in successive stages.
- An ecological pyramid is shown in the following figure.

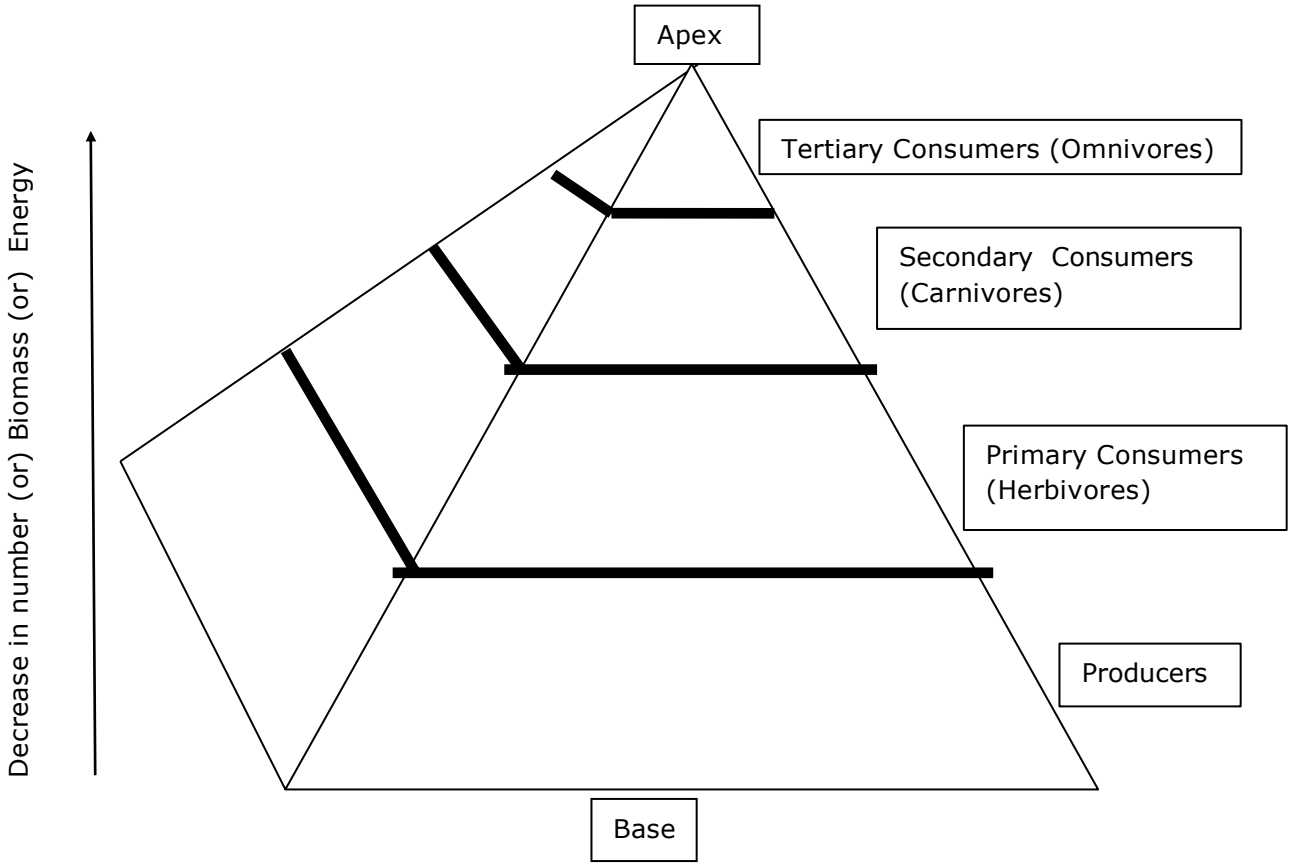


Figure: Formation of an Ecological Pyramid

- In ecological pyramids, tropic levels are shown in the following manner:
    i. The producers represent first tropic level in the ecological pyramid.
    ii. The herbivores (or) primary consumers represent second tropic level in the ecological pyramid.
    iii. The carnivores (or) secondary consumers represent third tropic level in the ecological pyramid.
    iv. The omnivores (or) tertiary consumers represent fourth tropic level in the ecological pyramid.

- On the basis of the number of organisms, the biomass of organisms and energy flow in organist population. Three types of ecological pyramids are:
    1. Pyramid of numbers.
    2. Pyramid of biomass
    3. Pyramid of energy.

1. **Pyramid of numbers:**
   - It shows the number of individual organisms present in each tropic level.
   - It is expressed in numbers per unit area.
   - Depending upon the type of ecosystem, we have three types of pyramid of numbers.
     a. Upright pyramid of numbers.
     b. Partly upright pyramid of numbers.
     c. Inverted pyramid of numbers.

1. **Upright Pyramid of numbers:**
   - The number of individual organisms gradually decreases from lower tropic level to higher tropic level is called ***"upright pyramid of numbers".***
     Example: A grassland ecosystem and a pond ecosystem show an upright pyramid of numbers.
   - The producers in the grass lands are grasses, which are small in size and large in numbers. So, producers occupy lower tropic level (1^{st} tropic level).
   - The primary consumers (herbivores) are rats, which occupy the II tropic level. Since the numbers of rats are lower when compared to the grasses, the size of which is lower.
   - The secondary consumers (carnivores) are snakes, which occupy the III tropic level. Since the numbers of snakes are lower when compared to the rats, the size of which is lower.
   - The tertiary consumers (omnivores) are eagles, which occupy the IV tropic level. The number and size of the last tropic level is lowest <as shown in figure>.
   - Similarly, in the case of pond ecosystem, producers, herbivores and carnivores are decreases from lower tropic level to the higher tropic level. Thus, these pyramids are upright.
   - Therefore, the numbers of individual organisms permit area, decreases from lower tropic level to higher tropic level as shown in figure.

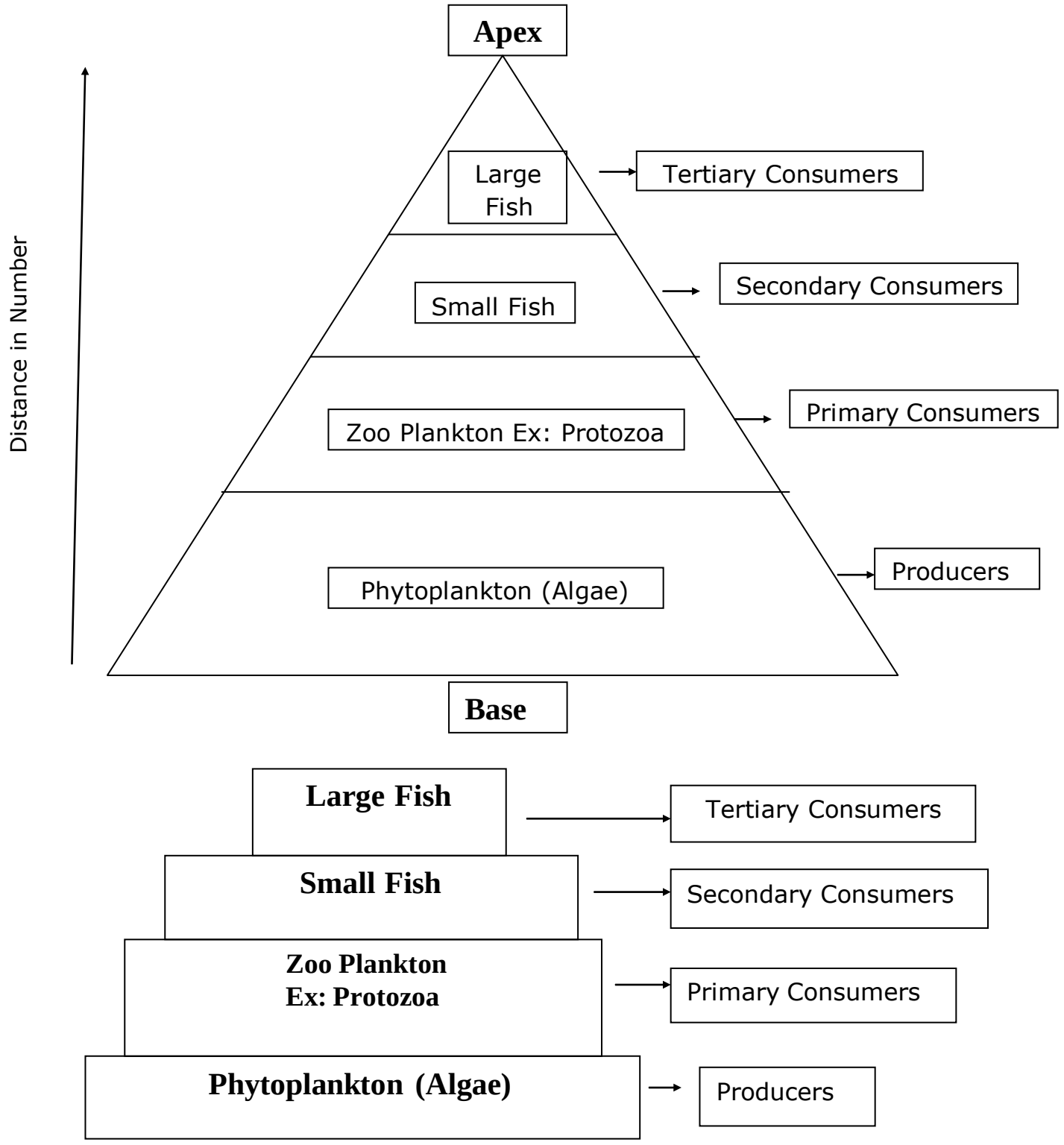
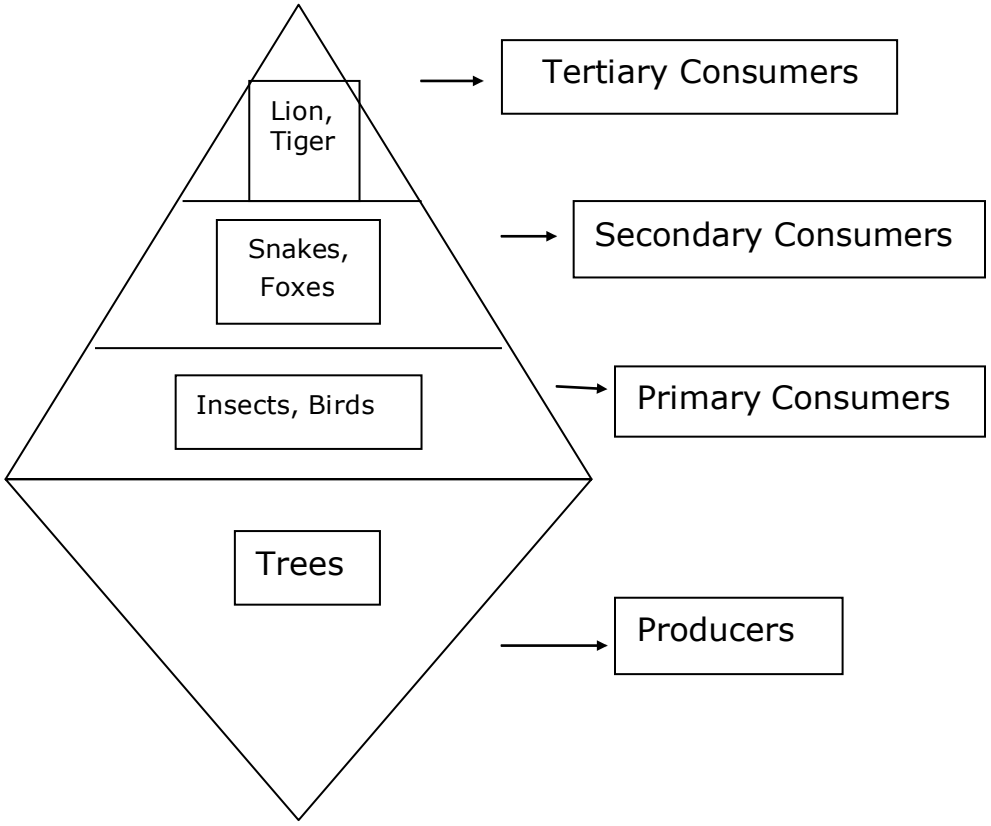


Figure: Pyramid of numbers in an aquatic (pond) ecosystem

2. Partially Upright Pyramid Of Numbers:

- A forest eco system is an example of partially upright pyramid.
- In a forest eco system, big trees are the producers, which are less number. So, these producers occupy the lower tropic level which is narrow base.
- The primary consumers (herbivores) are birds, insects, which occupy the II tropic level. Since the number of birds, insects and other species are higher when compared to the trees, the size of which is broader.
- The secondary consumers (Carnivores) are fox, snakes, lizards, which occupy the third tropic level. Since the number of fox, snakes are lower when compared to the birds, insects the size of which is lower.
- The tertiary consumers (omnivores) are lion, tiger, which occupy the IV tropic level. Since the number of lion, tiger are lower when compared to the fox and snakes the size of which is very (or) narrow lower. So the pyramid is narrow on both sides and broader in the middle and hence it is called partially upright of number as shown in figure.



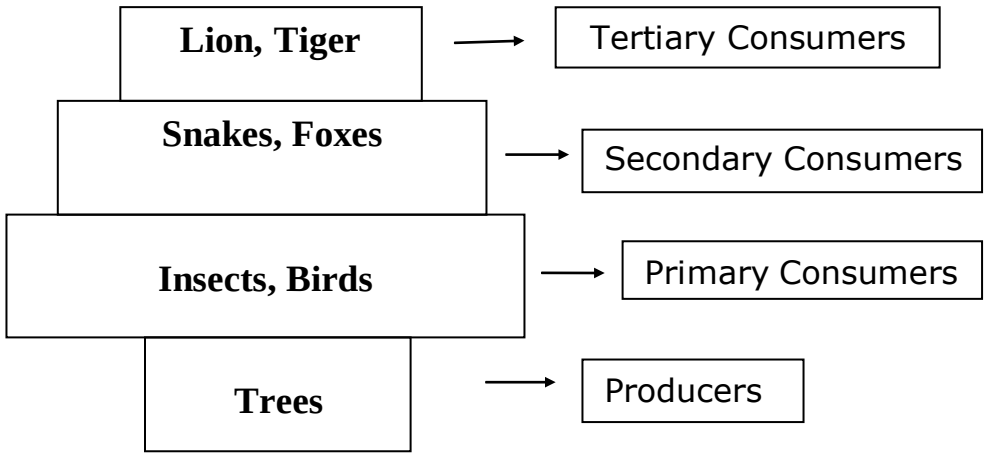
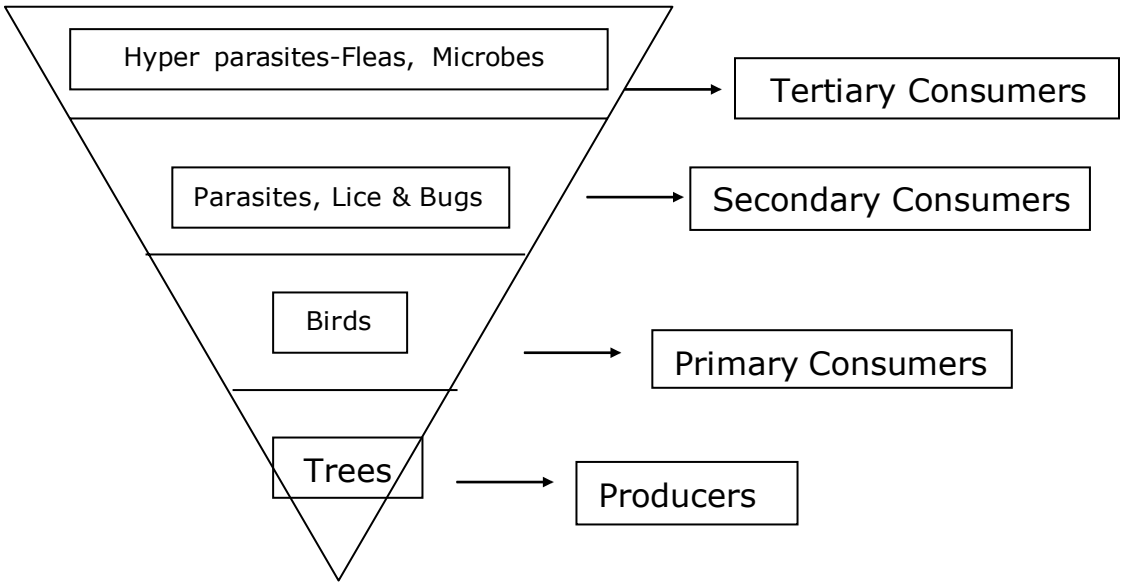


Figure: Pyramid of numbers in the forest ecosystem

3. Inverted Pyramid Of Numbers:

The number of individual organisms gradually increases from lower tropic level to higher tropic level, is known as "**inverted pyramid of numbers".**

Example: Parasitic food chain shows as inverted pyramid of number as shown in the following figure.



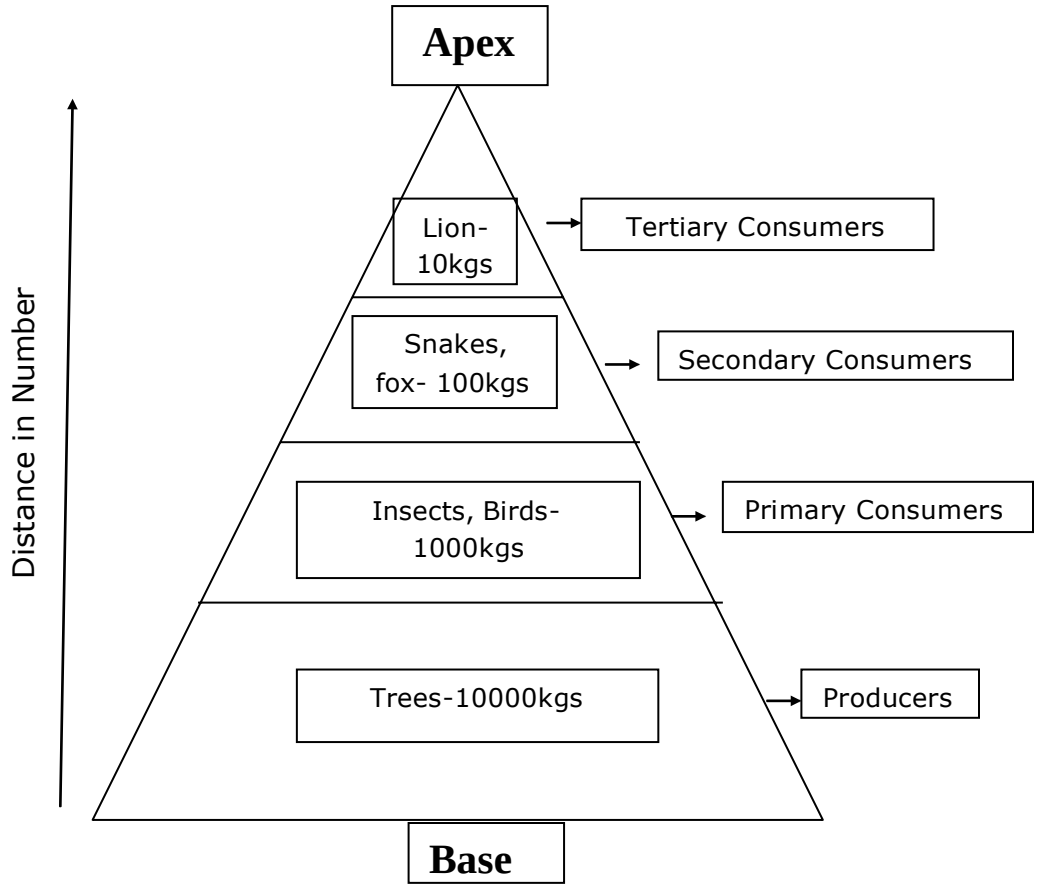
2. Pyramid of Biomass:

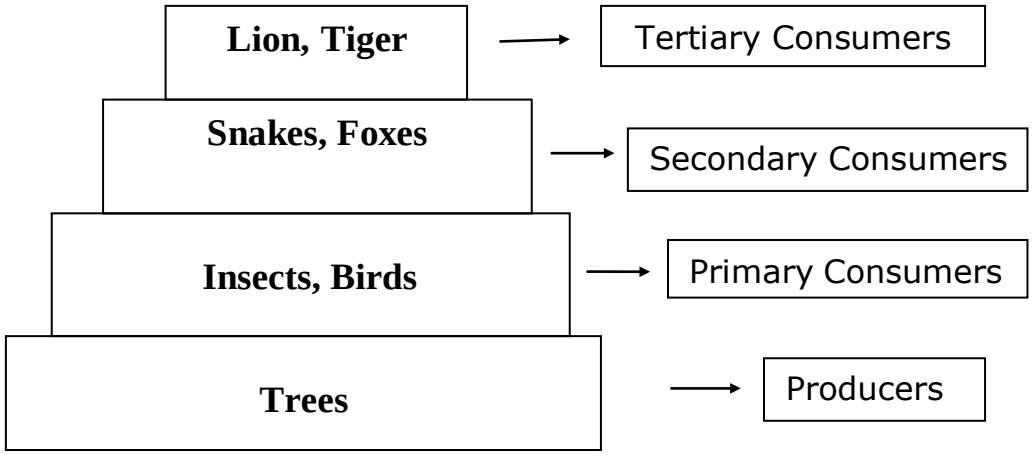
- It represents the total amount of biomass (mass (or) weight of biological material (or) organism) present in each tropic level.
- It is expressed in gram per unit area.

- Depending upon the type of ecosystem, we have two types of pyramid of biomass.
    i. Upright pyramid of biomass.
    ii. Inverted pyramid of biomass.

i. Upright Pyramid Of Biomass:

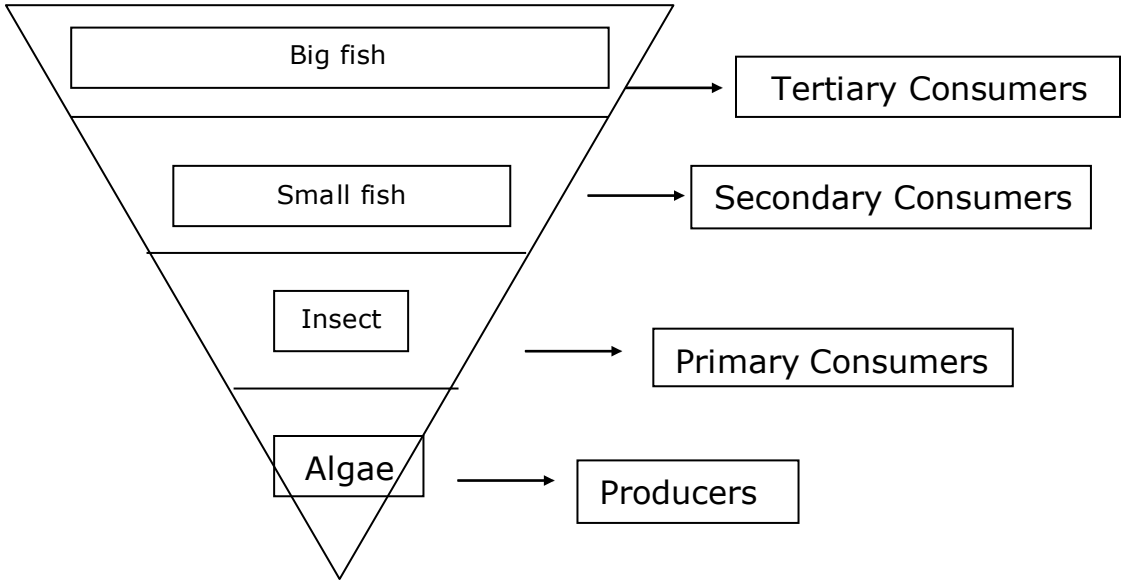
- The pyramid of biomass gradually decreases from the produce level (or) first tropic level to consumer level (higher tropic level) is called "upright pyramid of biomass"
- A forest ecosystem showed an upright pyramid of biomass.
- In this ecosystem, the biomass decreases from the producer level to consumer levels (as shown in figure)





ii. Inverted pyramid of biomass:

- The pyramid of biomass gradually increases from producer level to consumer level are called as Inverted pyramid of biomass.
- Example: The pond ecosystem shows an inverted pyramid of biomass.
- In this, ecosystem, the biomass increases from producer level to consumer levels as shown in the following figure.



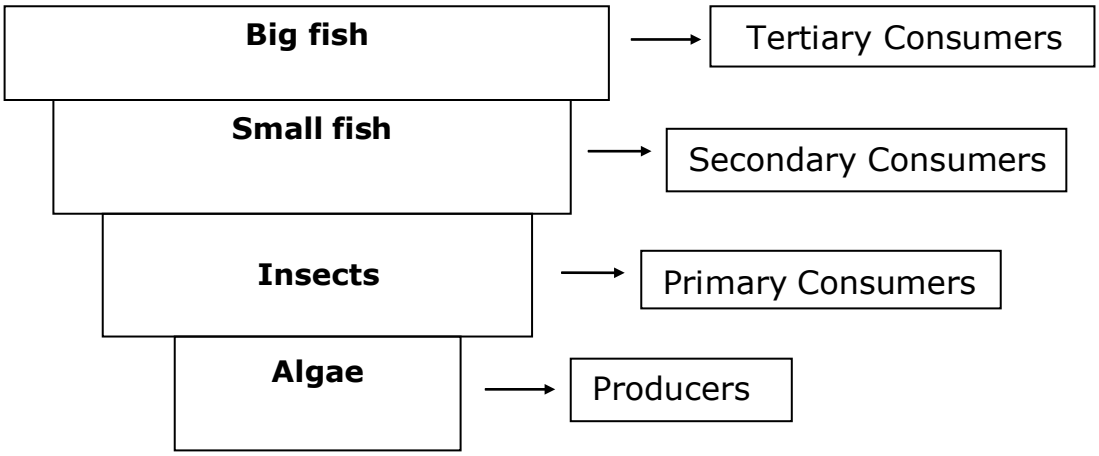
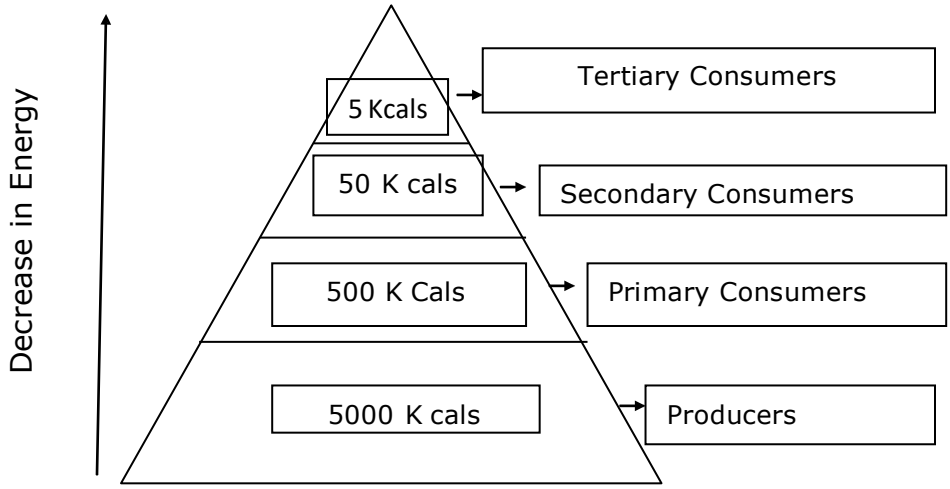
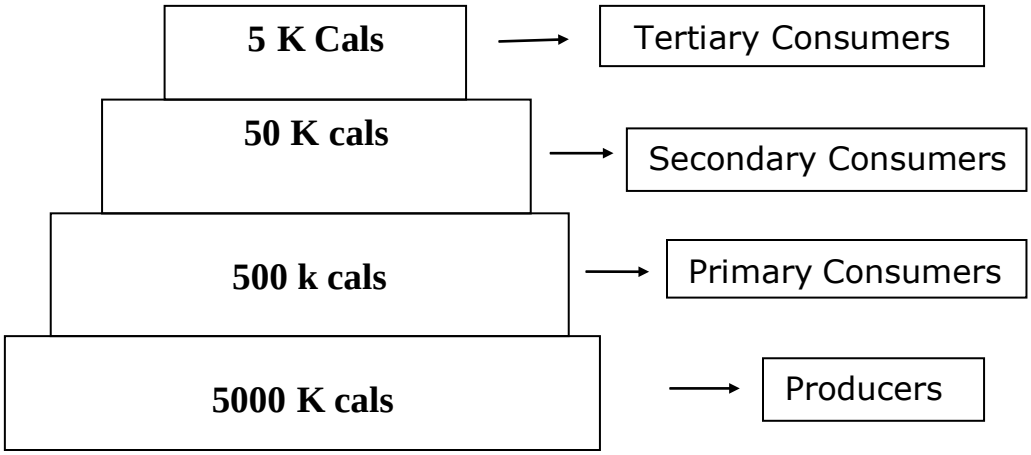


Figure: Pyramid of biomass in pond (eco system)

3. Pyramid of Energy:

- It represents the amount of flow of energy in each tropic level.
- It is expressed in calories per unit area per year.
- In an eco system, the energy flows from producer level to the consumer level. At each successive tropic level, there is a huge loss of energy (about 90%) in the form of heat, respiration, etc. Thus, at each next higher level only 10% of the energy passes on. Hence, there is a sharp decrease in energy at each and every producer to omnivores (or) top carnivores. Therefore, the pyramid of energy is always upright as shown in figure.





2.1.7 MAJOR TYPES OF ECOSYSTEMS

2.1.7.1 FOREST ECOSYSTEM

Definition: It is a natural ecosystem consisting of dense growth of trees and wild animals

Types:

1. Tropical – deciduous, evergreen, wet green
2. Littoral and swamps
3. Sub tropical

Characteristics:

Abiotic: soil, sun light, temperature etc

Biotic : forest trees, shrubs and animals

Structure:

Producer	:	Trees and shrubs
Consumer	:	Primary – elephants, deer etc.
		Secondary – snakes, birds, lizards etc
		Tertiary – lions, tigers etc
Decomposers	:	fungi, bacteria

2.1.7.2 AQUATIC ECOSYSTEM

Definition:

Deals with water bodies and biotic communities present in them-Classified as fresh water and marine ecosystems. Fresh water systems are classified as lentic and lotic ecosystems.

Types:

A. Pond ecosystem: Small fresh water ecosystem – seasonal in nature – organisms: algae, aquatic plants, insects, fishes etc. Ponds are very often exposed to anthropogenic pressure like cloth washing, bathing, cattle bathing, swimming etc.

B. Lake ecosystem: Big fresh water ecosystem – Zonation or stratification, especially during summer is a common one.

Top layer – shallow, warm, prone to anthropogenic activities – Littoral zone

Second layer – enough sunlight, high primary productivity – Limnetic zone

Third layer – very poor or no sunlight – Profundal zone

Eg. Dal lake in Srinagar, Naini lake in Nainital

Organisms:

1. Planktons – phytoplankton eg. Algae – zooplankton eg. Rotifers
2. Nektons – that swims in water eg. Fishes
3. Neustons – that float on the surface of water Benthos – that attached to sediments eg. Snails

Types of lakes : Many types

1. Oligotrophic lakes – with less nutrient content
2. Eutrophic lakes – with very high nutrient content due to fertilizer contamination
3. Desert salt lakes – that contains high saline water due to over evaporation
4. Volcanic lakes – formed by water emitted from magma due to volcanic eruptions
5. Dystrophic lakes – that contains highly acidic water (low pH)
6. Endemic lakes – lakes that contain many endemic species, etc.

C. Streams: fresh water ecosystem where water current plays a major role. Oxygen and nutrient content are uniform. Stream organisms have to face extreme difference in climatic conditions but they do not suffer from oxygen deficiency as pond and lake organisms. This is because large surface area of running water provides more oxygen supply. The animals have very narrow

range of tolerance towards oxygen deficiency. Thus stream are worst victims of industrial pollution.

D. River ecosystem: large streams flowing from mountain highlands are rivers.

- Three phases:
    1. Mountain highlands – rushing down water fall of water – large quantity of dissolved oxygen – plants attached to rocks and fishes that require more oxygen are found.
    2. Second phase – gentle slopes of hills – warmer – supports the growth of plants and fishes that require less oxygen are seen.
    3. Third phase: river shapes the land – lots of silts, nutrients are brought – deposited in plains and delta – very rich in biodiversity.

E. Oceans: Gigantic reservoirs of water covering >70% of earth surface – 2,50,000 species – huge variety of sea products, drugs etc. – provide Fe, Mg, oils, natural gas, sand etc. – major sinks of carbon di oxide – regulate biochemical cycles.

- Two zones:
    1. coastal zone – warm, nutrient rich, shallow – high sunlight – high primary productivity.
    2. Open sea – away from continental shelf – vertically divided in to 3 zones.
        - Euphotic zone – abundant sunlight
        - Bathyal zone – dim sunlight
        - Abyssal zone – dark zone – world's largest ecological unit.

F. Estuary: coastal area where river meet ocean – strongly affected by tidal actions – very rich in nutrients – very rich in biodiversity also – organisms are highly tolerant – many species are endemic – high food productivity – however to be protected from pollution.

Characteristics:

Structural Components:

Abiotic: pH, nutrients, D.O, temp, climatic conditions, etc.

Biotic: Phytoplankton, fishes, snails insects, birds, etc.

2.1.7.3 GRASSLAND ECOSYSTEM:

Dominated by grass – few shrubs and trees are also found – rainfall average but erratic – overgrazing leads to desertification.

Three types – depending on the climate

a. **Tropical grass lands –** found near the boarders of tropical rain forests. Eg. Savannas in Africa. Animals – Zebra, giraffes etc. – fires are common in dry seasons – termite mounds produce methane – leads to fire – high in photosynthesis – deliberate burning leads to release of high CO_2 – global warming.
b. **Temperate grasslands –** flat and gentle slopes of hills. Very cold winter and very hot summer - dry summer fires do not allow shrubs and trees to grow – soil is quite fertile – cleaned for agriculture.
c. **Polar grasslands –** found in arctic polar region – organism – arctic wolf, fox, etc. – A thick layer of ice remains frozen under the soil surface throughout the year – known as permafrost – summer insects and birds appear.

Components:

Structural Components:

Abiotic: soil pH, nutrients, soil moisture, temp, climatic conditions, etc.

Biotic: grass, caterpillar, butterfly, worms, insects, birds, etc.

UNIT-III-BIODIVERSITY

Introduction to Biodiversity – Definition: Genetic, Species and Ecosystem Diversity – Biogeographical Classification of India – Value of Biodiversity: Consumptive Use, Productive Use, Social, Ethical, Aesthetic and OptionValues – 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 of Biodiversity. Field Study of Common Plants, Insects and Birds.

INTRODUCTION

- Biodiversity is the abbreviated word for —biological diversity (bio -life or living organisms, diversity-variety). Thus biodiversity is the total variety of life on our planet, the total number of races, varieties and species. The sum of total of various types of microbes, plants and animals (producers, consumers and decomposers) in a system.
- Biomes can be considered life zones, environment with similar climatic, topographic and soil conditions and roughly comparable biological communities (Eg. Grassland, forest). The biomes shelter an astounding variety of living organisms (from driest desert to dripping rain forest, from highest mountain to deepest ocean trenches, life occurs in a marvelous spectrum of size, shape, colour and inter relationship). The variety of living organisms, the biodiversity, makes the world beautiful.
- There are 1.4 million species known presently. But based on new discoveries, by research expeditions, mainly in tropics, taxonomists estimate there are between 3-50 million different species may be alive today. Insects make up more than one half of all known species and may comprise more than 90% of all species on earth.

LEVELS OF BIODIVERSITY

- The concept of biodiversity may be analyzed in 3 different levels. They are
  1. Ecosystem diversity
  2. Species diversity
  3. Genetic diversity

1. Community or Ecosystem diversity

- A set of biotic components (plants, animals and microorganisms) and abiotic components (soil, air, water, etc) interacting with each other is

known as an ecosystem.

- Ecosystem or ecological diversity means the richness and complexity of a biological community, including tropic levels, ecological processes (which capture energy), food webs and material recycling.

- The diversity at an ecological level or habitat level is known as ecosystem diversity.

  Ex: River ecosystem- Rivers include fish, aquatic insects, mussels and a variety of plants that have adapted.
- Ecosystem diversity is the aggregate of different environmental types in a region.
- It explains the interaction between living organisms and physical environment in an ecosystem.

2. Species diversity –

- A discrete groups of organisms of the same kind is known as species.
- Species diversity is the diversity between different species.
- The sum of varieties of all living organisms at the species level is known as species diversity.
- Species diversity describes the number of kinds of organisms within individual communities or ecosystems.
- The biotic component is composed of a large number of species of plants, animals and microorganisms which interact with each other and with the abiotic component of the environment.

  Ex: The total number of species living on earth is approximately more than 2 million. However, only around 1.5 million are found and assigned scientific names.

  Plant species: Apple, Mango, Wheat, Grapes, Rice etc
  Animal species: Lion, Tiger, Elephant,Deer etc

3. Genetic diversity –

- A species with different genetic characteristics is known as a sub-species or "genera".
- Genetic diversity is a measure of the variety of versions of same gene within individual species.
- Within individual species, there are varieties, that are slightly different from one other. These differences are due to differences in the combination of genes.

- Genes are the basic units of hereditary information transmitted from one generation to the other.

  Ex: (i) Rice varieties - All rice varieties belong to the species "*oryzasativa*". However there are thousands of rice varieties that show variation at the genetic level in the form of different size, shape, colour and nutrient content.

  (ii) Teak wood varieties: The various teak wood varieties available are - Indian teak, Burma teak, Malaysian teak etc.

FUNCTIONS OF BIODIVERSITY: Two main functions of biodiversity are

1. It is the source on which the entire human species depends on for food, fibre, shelter, fuel and medicine.
2. It depends on biosphere which in turn leads to stability in climate, water, soil, air and overall health of biosphere.

VALUE OF BIODIVERSITY

Definition and estimation of the value of biodiversity is not easy. The value of biodiversity is classified into:

1. Direct Value and
2. Indirect Value

1. Direct value of biodiversity: It is of two types

a. Consumptive use value and

b. Productive use value

a. Consumptive use value:

- The consumptive use value is the value placed on nature's products that are consumed directly, without passing through a market. Some of them are firewood, food, and game meat.
- When direct consumption requires recreation, as in sport fishing and game viewing, the consumptive value is the whole recreational experience. Consumptive value seldom appears in national income accounts, but could be easily included in measures such as GDP. It is valued from the cost if resource was sold at market value, rather than being consumed.
- High consumptive use values on resources may lead to the following problems:

- Over-exploitation of wildlife in developing countries
- Loss of traditional controls on hunting and
- Loss of wildlife populations at productive levels.

- Consumptive use value benefits the communities closest to the resource if harvested sustainably and managed efficiently.

b. Productive use value:

- Productive use value refers to products that are commercially harvested (sold in a market).
- Its value is estimated at the production end rather than retail end by adding an inflated cost to the finished product.
- Productive use value is often the only value of biological resource reflected in national income accounts and may have a major impact on the national economy.
- Timber, fish, honey, construction materials, mushrooms, fruits, medicinal plants and game meat sold in a market have productive use value.

2. Indirect value of biodiversity

- Indirect values provide economic benefits without being harvested and do not appear in GDP. However, they are crucial to other natural products which influence the GDP.
- These values involve functions performed by biodiversity which are not of any use. Ex: Ecological Processes etc.
- Direct values are often derived from indirect values because plants and animals are supported by the services provided by their environments.
- Many classes of plant and animal species are consumed by tribal and non-tribal communities.

  Ex:

  1. Ecological functions
  2. Flood and storm protection
  3. Waste assimilation
  4. Microclimatic functions
  5. Nutrient cycles

6. Photosynthesis
7. Carbon stores
8. Soil protection, etc.

Indirect value of biodiversity is of the following types:

1. Non-consumptive use value
2. Optional value
3. Existence or ethical value and
4. Information value

1. Non-consumptive use value:

- This indirect value deals with nature's functions and services.
- It includes photosynthesis of plants which provides support system for other species by maintaining water cycle, regulating climate, production and protection of the soil, absorption and breakdown of pollutants, recreational, aesthetic, socio-cultural, scientific, educational, spiritual and historic values of natural environments.
- Recreational value is important with regard to tourism and helps the national GDP.

2. Optional value:

- This refers to the potential of biodiversity that is currently known and needs to be explored.
- This refers to the idea that there may be several existing species that may prove to be important in future and their usefulness needs to be studied with reference to a specific problem currently plaguing the society.

  Ex:

  1. The growing biotechnology field is searching for a the cure for diseases like cancer and AIDS.
  2. Medicinal plants and herbs play a very important role in the economic growth of our country.

3. Existence value:

- This is the value gained from continuous knowledge of existence. Also, this is the value that people are willing to pay to keep a species /

community /ecosystem from going extinct. Examples of this are high amounts being spent for animals like pandas, whales, lions etc.

- Our rich heritage teaches us to worship plants, animals, rivers and mountains. Examples being the Ganga river, trees like Banyan and Peepal and plants like the Vambu, Tulsi and Vengai are worshipped.

4. **Information value:** This relates to the educational, scientific and aesthetic and tourism values of biodiversity in an ecosystem

5. **Aesthetic Values:** Beautiful plants and animals inspire us to protect biodiversity. The most important aesthetic value of biodiversity is eco-tourism.

Ex:

1. People from distant places spend time and money to visit areas where they can enjoy aesthetic value of biodiversity. This is called eco-tourism.
2. The pleasant music of wild birds, beautifully coloured butterflies, colour of peacocks and colour of flowers are very important for their aesthetic value.

THREATS TO BIODIVERSITY

- Any disturbance in a natural ecosystem tends to reduce its biodiversity.
- Waste generated due to increase in human population and industrialization spoils the environment and leads to decreased diversity in biological species.
- Any change in the system leads to a major imbalance and threatens the normal ecological cycle.
- Causes for loss of biodiversity are:
    1. Habitat loss
    2. Poaching of wildlife and
    3. Man-wildlife conflicts

1. Habitat loss: The loss of populations of interbreeding organisms is caused by habitat loss. Factors influencing habitat loss are:

a. **Deforestation:** Loss of habitat is mainly caused by deforestation activities. Forests and grasslands are cleared for conversion into agriculture lands or settlement areas or developmental projects. Forests and grasslands are natural home to thousands of species which disintegrate due to loss of their natural habitat.

b. **Destruction of wetlands:** Wetlands, estuaries and mangroves are destroyed due to farming, filling and pollution that cause loss of biodiversity
c. **Habitat fragmentation:** When the habitat is divided into small and scattered patches the phenomenon is called habitat fragmentation. This leads to the disappearance of most wildlife
d. **Raw material:** To produce hybrid seeds, wild plants are used as raw materials leading to extinction of many wild plant species.
e. **Production of drugs:** Pharmaceutical companies collect wild plants for the production of drugs leading to extinction of several medicinal plant species.
f. **Illegal trade:** Illegal trade of wildlife reduces biodiversity leading to habitat loss
g. **Developmental activities:** Construction of dams in forest areas coupled with the discharge of industrial effluents kills birds and other aquatic life.

2. Poaching of wildlife: Poaching refers to killing animals or commercial hunting. It contributes to loss of biodiversity. Poaching can be of two types listed below:

1. **Subsistence poaching:** This refers to killing animals for survival.
2. **Commercial poaching:** This refers to hunting animals in order to sell their products.

Factors influencing poaching:

1. **Human population**: Increased human population in India has led to pressure on forest resources, leading to degradation of wildlife habitats
2. **Commercial activities**: Although a ban has been imposed internationally on the trade of products of endangered species, there is a continued smuggling of wildlife products. Since trading of such products is highly profitable, poachers continue to hunt endangered animals and smuggle their fur, skin and tusks to other countries. Wildlife products include *furs, horns, tusks, live specimens and herbal products*. *Richest source* of biodiversity lies in developing nations in *Asia, Africa and Latin America*. *Advanced countries* like *Europe, North America, Japan, Taiwan, Hong Kong* are the *major importers* of wildlife products.

3. **Man-Wildlife Conflicts:** Man-wildlife conflicts arise, when wildlife starts causing immense damage and danger to man. Under such conditions it is very difficult for the

forest department officials to convince the affected villagers to gain the villagers support for wildlife conservation.

Ex:

1. In Sambalpur, Orissa, several people were killed by elephants. In retaliation, the villagers killed and injured several elephants.
2. In Mysore, elephants were killed by farmers in retaliation to the damage done by elephants to their cotton and sugarcane fields.
3. Villagers sometimes hide explosives in their fields to ward-off animals which explode when the elephants enter the fields
4. Several people were killed when leopards attacked them in Sanjay Gandhi National Park, Mumbai

Factors influencing man-animal conflicts

1. Shrinking forest cover compels wildlife to move outside the forest
2. Human encroachment into forest area induces a man-wildlife conflict
3. Injured animals have a tendency to attack man
4. Wild animals venture out of the forest area in search of food
5. Villagers set-up electric wiring around their fields. This injures animals (Elephants) who suffer pain and get violent.
6. Cash compensation paid by the government is not enough.
7. Garbage near human settlements or food crops attracts wild animals.

BIO-GEOGRAPHICAL 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.
- Bio-geographers have classified India into ten bio-geographic 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 Tibetean 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:

   a. The desert of western Rajasthan
   b. The desert ofGujarat
   c. 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 overs approximately 15.6% of the country's landmass.
5. **Western Ghats:** The western ghats are a mountain range that runs along the western cost 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 experience 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 pains 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 Lakshwadeep islands are included in this but the area of these islands is negligible.

INDIA AS MEGA-DIVERSITY NATION

- India's rich biological diversity - its immense range of ecosystems, species and genetic forms is by virtue of its tropical location, climate and physical features.
- India's biogeographical composition is unique as it combines living forms from three major biogeographical realms, namely - Eurasian, Agro-Tropical and Indo-Malayan.
- India's fabulous biodiversity is estimated to be over 45,000 plant species representing about seven percent of the world's flora; and its bewildering variety of animal life represents 6.5 per cent of world's fauna. 15,000 species of flowering plants, 53,430 species of insects; 5050 species of molluscs, 6,500 species of other invertebrates; 2,546 species of fishes; 1228 species of birds, 446 species of reptiles, 372 species of mammals and 204 species of amphibians have been identified.
- In India about 1, 15,000 species of plants and animals have been identified and described.
- India stands tenth in 25 most plant-rich countries of the world. Plant richness means greater uniqueness of species present.
- India has been described as one of 12 mega-diversity countries possessing a rich means of all living organisms when biodiversity is viewed as a whole. The greater the multidiversity of species, greater is the contribution to biodiversity. There are 25 clearly defined areas in the world called 'hot spots' which support about 50,000

endemic plant species, comprising 20 per cent of the world's total flora. India's defined location of 'hot spots' is the Western Ghats and the Northeastern regions.

- Forests, which embrace a sizeable portion of biodiversity, now comprise about 64 m. hectares or about 19 per cent of the land area of the country, according to satellite imaging. Roughly 33 cent of this forest cover represents primary forest. Indian flora comprises about 15,000 flowering plants and bulk of our rich flora is to be found in the Northeast, Western Ghats, the Northwest and Eastern Himalayas, and the Andaman and Nicobar Islands. Likewise, Assam and the Western Ghats are home to several species of mammal fauna, birds, and reptilian and amphibian fauna.
- As one of the oldest and largest agriculture societies, India has also a striking variety of at least 166 species of crop plants and 320 species of wild relatives of cultivated crops. There is a vital, but often-neglected factor when we focus on biodiversity. It may be a matter of she surprise for many to understand that the tribals who officially constitute 7.5 per cent of India's population have preserved 90 per cent of the country's biocultural diversity. To a large extent, the survival of our biodiversity depends on how best the tribals are looked after.
- To preserve our rich biodiversity, nine biosphere reserves are set up in specific biogeographic'' zones: the biggest one is in the Deccan Peninsula in the Nilgiris covering Tamil Nadu, Andhra Pradesh and Karnataka. Others are the Nanda Devi in Uttar khand in the Western Himalayas, the Nokrek in Meghalaya, Manas and Dibru Saikhowa in Assam, the Sunderban's in the Gangetic plain in West Bengal, Similar in Orissa, the Great Nicobar and the Gulf of Mannar in Tamil Nadu.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

ENDANGERED SPECIES OF INDIA: A plant, animal or microorganism that is in immediate risk of biological extinction is called endangered species or threatened species. In India, 450 plant species have been identified as endangered species. 100 mammals and 150 birds are estimated to be endangered. India's biodiversity is threatened primarily due to:

1. Habitat destruction
2. Degradation and

3. Over exploitation of resources

- The RED-data book contains a list of endangered species of plants and animals. It contains a list of species of that are endangered but might become extinct in the near future if not protected.
- Some of the rarest animals found in India are:
  1. Asiatic cheetah
  2. Asiatic Lion
  3. Asiatic Wild Ass
  4. Bengal Fox
  5. Gaur
  6. Indian Elephant
  7. Indian Rhinocerous
  8. Marbled Cat
  9. Markhor

Extinct species is no longer found in the world.

Endangered or threatened species is one whose number has been reduced to a critical number**.** Unless it is protected and conserved, it is in immediate danger of extinction. **Vulner**able **species** is one whose population is facing continuous decline due to habitat destruction or over exploitation. However, it is still abundant.

Rare species is localized within a restricted area or is thinly scattered over an extensive area. Such species are not endangered or vulnerable. A few endangered pecies in the world are listed below:

1. West Virginia Spring Salamander (U.S.A)
2. Giant Panda (China)
3. Golden Lion Tamarin (Brazil)
4. Siberian Tiger (Siberia)
5. Mountain Gorilla (Africa)
6. Pine Barrens Tree Frog (Male)
7. Arabian Oryx (Middle East)
8. African Elephant (Africa)

Other important endangered species are:

1. Tortoise, Green sea Turtle , Gharial, Python (Reptiles)

2. Peacock, Siberian White Crane, Pelican, Indian Bustard (Birds)
3. Hoolock gibbin, Lion-tailed Macaque, Capped mokey, Golden monkey (Primates)
4. Rauvol fia serpentina (medicinal plant), Sandal wood tree, etc

Factors affecting endangered species

1. Human beings dispose wastes indiscriminately in nature thereby polluting the air, land and water. These pollutants enter the food chain and accumulate in living creatures resulting in death.
2. Over-exploitation of natural resources and poaching of wild animals also leads to their extinction.
3. Climate change brought about by accumulation of green houses gases in the atmosphere. Climate change threatens organisms and ecosystems and they cannot adjust to the changing environmental conditions leading to their death and extinction.

- An international treaty to help protect endangered wildlife is, "Convention on International Trade in Endangered Species 1975" (CITES). This treaty is now signed by 160 countries.
    1. CITES lists 900 species that cannot be commercially traded as live specimens or wildlife products as they are in danger of extinction.
    2. CITES restricts trade of 2900 other species as they are endangered.

Drawbacks of cites

1. This treaty is limited as enforcement is difficult and convicted violators get away by paying only a small fine.
2. Member countries can exempt themselves from protecting any listed species.

ENDEMIC SPECIES OF INDIA

Species that are found only in a particular region are known as endemic species. Almost 60% the endemic species in India are found in Himalayas and the Western Ghats.

Endemic species are mainly concentrated in:

4. North-East India
5. North-West Himalayas
6. Western Ghats and
7. Andaman & Nicobar Islands.

Examples of endemic Flora species are

1. Sapria Himalayana
2. Ovaria Lurida
3. Nepenthis khasiana etc

Endemic fauna of significance in the western ghats are:

1. Lion tailed macaque
2. Nilgiri langur
3. Brown palm civet and
4. Nilgiri tahr

Factors affecting endemic species:

1. Habitat loss and fragmentation due to draining and filling of inland wetlands.
2. Pollution also plays an important role.
   Ex: Frog eggs, tadpoles and adults are extremely sensitive to pollutants especially pesticides.
3. Over-hunting and
4. Populations can be adversely affected by introduction of non active predators and competitors. Disease producing organisms also play an important adversary in reducing populations of endemic species.

THREATS TO BIODIVERSITY

Due to

1. **Habitat loss** Deforestation activities (cutting trees for timber, removal of medicinal plants)
2. Production of hybrid seeds requires wild plants as raw material, farmers prefer hybrid reeds, many plant species become extinct.
3. Increase in the production of pharmaceutical companies made several number of medicinal plants and species on the verge of extinction.
4. Removal of forest-cover for road laying and also due to soil erosion.
5. Illegal trade of wild life.
6. Population explosion, construction of dam, discharge of industrial effluents use of pesticides.

Poaching of wild life

- Due to poaching, illegal trade and smuggling activities most of our valuable fauna are under threat organised crime has moved into illegal wild life smuggling because of huge profit Eg. Tiger, Deer for hides, Rhinoceros – for horns, Elephant – for ivory tusk, Sea Horse, Star turtle – sold to foreign market.
- (Extinction, the elimination of species, is a normal process of the natural world. Species die put and are replaced by others as part of evolutionary change.
- Human caused reduction: The climate change caused by our release of green house gases in the atm. could have catastrophic effects. Human disturbance of natural habitat is the largest single cause pf loss of biological diversity. Woodlands and grasslands are converted now use about 10% of the world's land surface for crop production and about twice the amount for pasture and grasslands.)
- Hunting: Over harvesting is responsible for depletion or extinction of many species.
- Eg. The American passenger pigeon was the world's most abundant bird. In spite of this vast population, market hunting and habitat destruction caused the entire population to crash with in 20 years.

Fragmentation

Habitat fragmentation reduces the biodiversity because many animals like bears and large cats require large territories to subsist. Some forest birds reproduce only in deep forest or habitat far from human settlement. A large island for example, can support more individuals of given species and therefore less likely to suffer extinction due to genetic problems and natural catastrophes.

Commercial products:

Smuggling of fuels, hides, horns and folk medicines also affect the biodiversity in an abrupt manner.

CONSERVATION OF BIODIVERSITY

The following measures should be taken to conserve biodiversity

1. Illegal hunting and trade of animals and animal products should be stopped immediately
2. People-at-large should boycott purchasing coats, purse or bags made of animal skin
3. Bio-diversity laws should be strengthened.

4. Adequate crop and cattle compensation schemes must be started
5. Solar powered fencing must be provided with electric current proof trenches to prevent animals from entering fields.
6. Cropping pattern should be changed near the forest borders
7. Adequate food and water should be made available for wild animals within forest zones.
8. Development and construction work in and around forest region must be stopped.

- Biodiversity is one of the important tools for sustainable development. The commercial, medical, genetic, aesthetic, and ecological importance of biodiversity emphasizes the need for its conservation.

Factors affecting biodiversity:

1. Biodiversity is disturbed by human activity
2. Poaching of animals, over-exploitation of natural sources and degradation of habitats affect biodiversity.
3. Marine ecosystems are disturbed due to oil spills and discharge of effluents
4. Climatic factors like global warming, ozone depletion and acid rain also affect biodiversity

Need for biodiversity

1. It provides recreation and tourism
2. Drugs, herbs, food and other important raw materials are derived from plants and animals
3. It preserves the genetic diversity of plants and animals
4. It ensures sustainable utilization of life supporting systems on earth.
5. It needs to conservation of essential ecological diversity and life supporting systems
6. Loss of biodiversity leads to ecological and environmental deterioration

Types of conservation

There are two types of biodiversity conservation:

1. In-situ conservation and
2. Ex-situ conservation

1. IN-SITU CONSERVATION

In-situ conservation involves protection of flora and fauna within its natural habitat. The natural habitats or ecosystems under in-situ conservation are called "protected areas".

a. Biosphere reserves
b. National parks
c. Wildlife sanctuaries
d. Gene sanctuaries

a. Biosphere reserves: They cover large areas (>5000 sq.km.) They are normally used to protect species for a long time. The roles of biosphere reserves are listed below:

i. Long-term survival of evolving ecosystem
ii. Protect endangered species
iii. Protect maximum number of species and communities
iv. Serve as site of recreation and tourism
v. May also be used for educational and research purposes
vi. Biosphere reserves function as an open system and changes in land use are not allowed. No tourism and explosive activities are allowed in biosphere reserves.

b. A national park: It is an area dedicated for the conservation of wildlife along with its environment. It covers an area ranging from 100 to 500 sq.km. One or more national parks may exist within a biosphere reserve. A national park is used for enjoyment through tourism, without affecting the environment. It is used to protect, propagate and develop wildlife. Grazing domestic animals inside national parks is prohibited All private rights and forestry activities are prohibited inside a national park

c. Wildlife sanctuary is an area that is reserved for the conservation of animals only.

i. It protects animals only
ii. It allows operations such as harvesting of timber, collection of forest products, private ownership rights and forestry operations, provided it does not affect animals adversely

d. Gene sanctuary is an area where plants are conserved.

Other projects for the conservation of animals are *Project Tiger, Gir Lion Project, Crocodile breeding project, project elephant etc*

Advantages of in-situ conservation

i. It is cheap and convenient
ii. Species get adjusted to natural disasters like drought, floods, forest fires etc.

Disadvantages of in-situ conservation

i. A large surface area of earth is required to preserve biodiversity
ii. Maintenance is not proper due to shortage of staff and pollution

2. EX-SITU CONSERVATION

Ex-situ conservation involves protection of flora and fauna outside their natural habitats. This type of conservation is mainly done for conservation of crop varieties and wild relatives of crops.

1. Ex-situ conservation involves maintenance and breeding of endangered plant and animal species under controlled conditions
2. It identifies those species that are at a high risk of extinction
3. It prefers species that are important for man in the near future among the endangered species.

Important centers of ex-situ conservation:

1. Botanical gardens
2. Seed banks
3. Microbial culture collections
4. Tissue and cell cultures
5. Museums and
6. Zoological gardens

Methods of ex-situ conservation

National Bureau of Plant Genetic Resources (NPBGR) It is located in New Delhi and uses the Cryopreservation Technique to preserve agricultural and horticultural crops. Cryopreservation technique involves using liquid nitrogen at -196 C. Varieties of rice, turnip, radish, tomato, onion, carrot, chilli, tobacco have been successfully preserved for years using this technique.

National Bureau of Animal Genetic Resources (NPAGR) It is located in Karnal, Haryana and preserves the semen of domesticated bovine animals.

National Facility for Plant Tissue Culture Repository (NFPTCR) In this facility, conservation of varieties of crop plants or trees is done using tissue culture. This facility has been created within the NPBGR.

Advantages of Ex-situ conservation

1. Survival of endangered species is increasing due to special care and attention
2. In captive breeding the animals are assured of food, water, shelter and security thereby have a longer life span
3. It is carried-out in cases of endangered species that do not have any chance of survival in the wild

Disadvantages of Ex-situ conservation

1. It is an expensive method
2. Freedom of wildlife is lost
3. Animals cannot survive in the natural environment

UNIT IV ENVIRONMENTAL POLLUTION

Definition – Causes, Effects and Control Measures of:- (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) 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.

INTRODUCTION

- **Pollution** may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or manmade.
- The agents that pollute are called pollutants.

POLLUTANTS

Pollutants are by-products of man's action. The important pollutants are summarized below:

- **Deposited matter—**Soot, smoke, tar or dust and domestic wastes.
- **Gases—**CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals—**Lead, zinc, iron and chromium.
- **Industrial pollutants—**Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants—**Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants—**Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants—**Radioactive substances and radioactive fall-outs of the nuclear test.

Classification of Pollutants

Nature of disposal: On the basis of natural disposal, pollutants are of twotypes:

1. **Non-degradable pollutants:** These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminum cans, mercuric salts and even DDT. These continue to accumulate in the environment.
2. **Biodegradable pollutants:** These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal.

Nature of form: On the basis of the form in which they persist after their releaseinto the environment, pollutants can be categorized under two types:

(i) Primary pollutants: These include those substances, which are emitted directly from some identifiable sources. This include-

a. **Sulphur compounds:** SO2, SO3, H2S produced by the oxidation of fuel.
b. **Carbon compounds:** Oxides of carbon (CO+CO2) and hydrocarbons.
c. **Nitrogen compounds:** NO2 and NH3.
d. **Halogen compounds:** Hydrogen fluoride (HF) and hydrochloric acid (HCl).
e. **Particles of different size and substances:** These are found suspended in air. The fine particles below the diameter of 100u are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.

(ii) Secondary pollutants: The secondary pollutants are produced by the combination of primary emitted pollutants in the atmosphere.

Ex: In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxy-acetyle nitrate (PAN) and ozone (O3), both of them are toxic components of smog and cause smarting eyes and lung damage.

TYPES OF POLLUTION

3.3.1 AIR POLLUTION

3.3.1.1 Introduction: Air pollution is one such form that refers to the contamination of the air, irrespective of indoors or outside. A physical, biological or chemical alteration to the air in the atmosphere can be termed as pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for plants, animals and humans to survive as the air becomes dirty.

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

3.3.1.2 Causes of Air pollution:

1. **Burning of Fossil Fuels:** Sulfur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one of the major causes of air pollution. Pollutants emitting from vehicles cause immense amount of pollution. Carbon Monoxide produced by improper or incomplete combustion emitted from vehicles is another major pollutant along with Nitrogen Oxides that is produced from both natural and manmade processes.
2. **Agricultural activities:** Ammonia is a very common by product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities emit harmful chemicals into the air and cause water pollution.
3. **Exhaust from factories and industries:** Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.
4. **Mining operations:** Mining is a process wherein minerals below the earth are extracted using large equipments. During the process dust and chemicals are released in the air causing massive air pollution.
5. **Indoor air pollution:** Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution.

6. **Suspended Particulate matter:** Suspended particulate matter popular by its acronym SPM, is another cause of pollution.

3.3.1.3 Types of Air Pollutants

- **Primarily air pollutants** can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulfur-dioxide emitted from factories
- **Secondary pollutants** are the ones that are caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

3.3.1.4 Common air pollutants

1. **Carbon Dioxide:** CO_2 content of air has increased by 20% during the last century. CO_2 causes nausea and headache. Its increase in the air may cause green house effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding of coastal regions.
2. **Carbon Monoxide:** It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled. It combines with hemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.
3. **Oxides of Nitrogen:** These include NO and NO_2, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.
4. **Oxides of Sulphur:** SO_2 and SO_3 are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO_2 causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO_2 and SO_3 react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

5. **Photochemical Oxidants:** Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with un-burnt hydrocarbons to form peroxyacyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.
6. **Hydrocarbons:** These are un-burnt discharges from incomplete combustion of fuel in automobiles. These forms PAN with nitrogen oxides, which is highly toxic.
7. **Particulate Matter:** Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.
8. **Aerosols:** Aerosols are chemicals released in the air in vapor form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aero planes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.
9. **Radioactive Substances:** These are released by nuclear explosions and explosives. These are extremely harmful for health.
10. **Fluorides:** Rocks, soils and. minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

3.3.1.5 Control measures

The atmosphere has several built-in self cleaning processes such as dispersion, gravitational settling, flocculation, absorption, rain-washout, etc to cleanse the atmosphere. However, control of contaminants at their source level is a desirable and effective method through preventive or control technologies.

1. **Source control:** Some measures that can be adopted in this direction are
    1. Using unleaded petrol

2. Using fuels with low sulphur and ash content
3. Encouraging people to use public transport, walk or use a cycle as opposed to private vehicles
4. Ensure that houses, schools, restaurants and playgrounds are not located on busy streets
5. Plant trees along busy streets as they remove particulates, carbon dioxide and absorb noise
6. Industries and waste disposal sites should be situated outsdide the city preferably on the downwind of the city.
7. Catalytic converters should be used to help control emissions of carbon monoxide and hydrocarbons

2. Control measures in industrial centers:

1. Emission rates should be restricted to permissible levels by each and every industry
2. Incorporation of air pollution control equipment in design of plant layout must be made mandatory
3. Continuous monitoring of the atmosphere for pollutants should be carried out to know the emission levels.

3.3.1.6 Equipment used to control air pollution

Air pollution can be reduced by adopting the following approaches.

1. Ensuring sufficient supply of oxygen to the combustion chamber and adequate temperature so that the combustion is complete thereby eliminating much of the smoke consisting of partly burnt ashes and dust.
2. To use mechanical devices such as scrubbers, cyclones, bag houses and electro-static precipitators in manufacturing processes. The equipment used to remove particulates from the exhaust gases of electric power and industrial plants are shown below. All methods retain hazardous materials that must be disposed safely. Wet scrubber can additionally reduce sulphur dioxide emissions.
3. The air pollutants collected must be carefully disposed. The factory fumes are dealt with chemical treatment.

3.3.2 WATER POLLUTION

3.3.2.1 Introduction: Water pollution may be defined as "the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life."

3.3.2.2 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.

3.3.2.3 Types, effects and sources of water pollution

Water pollution is any chemical, biological or physical change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses.

S.No	Pollutants	Human sources	Health Effects
1	Infectious agents Ex: Bacteria, Viruses, Protozoa, and parasitic worms.	Human and animal wastes	Variety of diseases
2	Oxygen demanding wastes (Dissolved oxygen) Ex: Organic wastes such as animal manure and plant debris	Sewage, Animal feedlots, paper mills and food processing facilities	Degrade water quality by depleting water of dissolved oxygen. This causes fish and other forms of oxygen-consuming aquatic life to die.
3	Inorganic chemicals Ex: Water soluble inorganic	Surface runoff, industrial effluents	• Make freshwater unusable for drinking and irrigation

	chemicals: Acids, Compounds of toxic metals such as lead (Pb), arsenic (As) and selenium (Se) and Salts such as NaCl in oceans and fluoride (F^-) found in some soils.	and household cleansers	• Cause skin cancer and neck damage, Damage to nervous system, liver and kidneys • Harm fish and other aquatic life • Lower crop yields • Accelerate corrosion of metals exposed to such water
4	Organic chemicals Ex: Oil, Gasoline, Plastics, Pesticides, Cleaning solvents and Detergents.	Industrial effluents, household cleansers and surface runoff from farms.	• Can threaten human health by causing nervous system damage and some cancers. • Harm fish and wildlife.
5	Plant nutrients Ex: Water soluble compounds containing nitrate, Phosphate and Ammonium ions.	Sewage, manure and runoff of agricultural and urban fertilizers	• Can cause excessive growth of algae and other aquatic plants, which die, decay, deplete dissolved oxygen in water thereby killing fish • Drinking water with excessive levels of nitrates lower the oxygen carrying capacity of the blood and can kill urban children and infants.
6	Sediment Ex: Soil, silt, etc.	Land erosion	• Causes cloudy water thereby reducing photosynthetic activity • Disruption of aquatic food chain

			• Carries pesticides, bacteria and other harmful substances • Settles and destroys feeding and spawning grounds of fish • Clogs and fills lakes, artificial reservoirs, stream channels and harbors
7	Radioactive materials: Ex: Radioactive isotopes of: Iodine, Radon, Uranium, Cesium and Thorium.	Nuclear power plants, mining and processing of uranium and other ores, nuclear weapon production and natural sources.	Genetic mutations, birth defects and certain cancers.
8	Heat (Thermal pollution) Ex: Excessive heat	Water cooling of electric power plants and some types of industrial plants.	• Low dissolved oxygen levels thereby making aquatic organisms more vulnerable to disease, parasites and toxic chemicals. • When a power plant starts or shuts down for repair, fish and other organisms adapted to a particular temperature range, can be killed by an abrupt temperature change known as thermal shock.

3.3.2.4 Control measures of water pollution

1. Administration of water pollution control should be in the hands of state or central government
2. Scientific techniques should be adopted for environmental control of catchment areas of rivers, ponds or streams
3. Industrial plants should be based on recycling operations as it helps prevent disposal of wastes into natural waters but also extraction of products from waste.
4. Plants, trees and forests control pollution as they act as natural air conditioners.
5. Trees are capable of reducing sulphur dioxide and nitric oxide pollutants and hence more trees should be planted.
6. No type of waste (treated, partially treated or untreated) should be discharged into any natural water body. Industries should develop closed loop water supply schemes and domestic sewage must be used for irrigation.
7. Qualified and experienced people must be consulted from time to time for effective control of water pollution.
8. Public awareness must be initiated regarding adverse effects of water pollution using the media.
9. Laws, standards and practices should be established to prevent water pollution and these laws should be modified from time to time based on current requirements and technological advancements.
10. Basic and applied research in public health engineering should be encouraged.

3.3.3 THERMAL POLLUTION

3.3.3.1 Introduction

Thermal pollution is defined as the addition of excess of undesirable heat to water thereby making it harmful to man, animal or aquatic life. Thermal pollution may also cause no significant departures from or activities of aquatic communities.

3.3.3.2 Sources of Thermal Pollution

The following sources contribute to thermal pollution.

1. **Nuclear power plants:** Nuclear power plants including drainage from hospitals, research institutions, nuclear experiments and explosions,

discharge a lot of heat that is not utilized along with traces of toxic radio nuclides into nearby water streams. Emissions from nuclear reactors and processing installations are also responsible for increasing the temperatures of water bodies. The operations of power reactors and nuclear fuel processing units constitute the major contributor of heat in the aquatic environment. Heated effluents from power plants are discharged at 10 C higher than the receiving waters that affect the aquatic flora and fauna.

2. **Coal-fired power plants:** Coal fired power plants constitute a major source of thermal pollution. The condenser coils in such plants are cooled with water from nearby lakes or rivers. The resulting heated water is discharged into streams thereby raising the water temperature by 15C. Heated effluent decreases the dissolved content of water resulting in death of fish and other aquatic organisms. The sudden fluctuation of temperature also leads to *"thermal shock"* killing aquatic life that has become acclimatized to living in a steady temperature.
3. **Industrial effluents:** Industries like textile, paper, pulp and sugar manufacturing release huge amounts of cooling water along with effluents into nearby natural water bodies. The waters polluted by sudden and heavy organic loads result in severe drop in levels of dissolved oxygen leading to death of several aquatic organisms.
4. **Domestic Sewage:** Domestic sewage is discharged into rivers, lakes, canals or streams with minimal treatment or without any treatment. These wastes have a higher organic temperature and organic load. This leads to decrease in dissolved oxygen content in the receiving waters resulting in the set-up of anaerobic conditions causing release of foul and offensive gases in water. Eventually, this leads to development of anoxic conditions resulting in rapid death of aquatic organisms.
5. **Hydro-electric power:** Generation of hydroelectric power sometimes leads to negative thermal loading in water systems. Apart from electric power industries, various factories with cooling requirement contribute to thermal loading.

3.3.3.3 Thermal pollution in streams by human activities

- Industries and power plants use water to cool machinery and discharge the warm water into a stream
- Stream temperature rises when trees and tall vegetation providing shade are cut.
- Soil erosion caused due to construction also leads to thermal pollution
- Removal of stream side vegetation
- Poor farming Practices also lead to thermal pollution

3.3.3.4 Effects of Thermal pollution

1. **Reduction in dissolved oxygen**: Concentration of Dissolved Oxygen (DO) decreases with increase in temperature.
2. **Increase in toxicity**: The rising temperature increases the toxicity of the poison present in water. A 10C increase in temperature of water doubles the toxicity effect of potassium cyanide, while 80C rise in temperature triples the toxic effects of o-xylene causing massive mortality to fish.
3. **Interference in biological activity**: Temperature is considered to be of vital significance to physiology, metabolism and biochemical processes that control respiratory rates, digestion, excretion, and overall development of aquatic organisms. Temperature changes cause total disruption to the entire ecosystem.
4. **Interference in reproduction:** In fishes, several activities like nest building, spawning, hatching, migration and reproduction depend on optimum temperature.
5. **Direct mortality**: Thermal pollution is directly responsible for mortality of aquatic organisms. Increase in temperature of water leads to exhaustion of microorganisms thereby shortening the life span of fish. Above a certain temperature, fish die due to failure of respiratory system and nervous system failure.
6. **Food storage for fish**: Abrupt changes in temperature alter the seasonal variation in the type and abundance of lower organisms leading to shortage of right food for fish at the right time.

3.3.3.5 Control measures for 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 maximize dissipation of heat to the atmosphere and minimize 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

3.3.4 SOIL POLLUTION

3.3.4.1 Introduction

Soil pollution is defined as, "contamination of soil by human and natural activities which may cause harmful effect on living organisms".

3.3.4.2 Types, effects and sources of soil pollution

S.No	Pollutants	Sources	Health Effects
1	Industrial wastes	Industrial pollutants are mainly discharged from various origins such as pulp and paper mills, chemical fertilizers, oil refineries, sugar factories, tanneries, textiles, steel, distilleries, fertilizers, pesticides, coal and mineral mining industries, drugs, glass, cement, petroleum and engineering industries etc.	These pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil or water, disturb the biochemical process and finally lead to serious effects on living organisms.
2	Urban wastes	Plastics, glasses, metallic cans, fibers, paper, rubbers, street sweepings, fuel residues, leaves, containers, abandoned vehicles and other discarded manufactured products.	Alter the constitution of soil Cause Water logging Cause biomagnifications of toxic materials through food chain
3	Agricultural practices	fertilizers, pesticides, weedicides, farm wastes, manure debris, soil erosion	Water logging, Salinisation, micronutrient imbalance, loss of fertile soil
4	Radioactive pollutants	Atomic reactor, nuclear radioactive devices, Explosion of hydrogen weapons and cosmic radiations	Mutations, changes functions of living beings, Biomagnifications, cancers, Infant mortality

5	Biological agents	The human and animal wastes, garbage, waste water	Variety of diseases Cause nutrient imbalance
6	Pesticides	chlorinated hydrocarbon insecticide Organic phosphorous pesticides	Reduces the activity of sex hormones of male and female. Causes diseases to human beings.
7	Fertilizers	Different fertilizers discharge N, Na, K, S, Nitrates etc	The nitrate causes cancer, blue baby syndrome in infants.
8	Polymer, Plastics & other water	Waste from different sources	Biomagnifications, water logging, create cancers in animals and human beings.

3.3.4.3 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
2. Contour cultivation and strip cropping may be practiced instead of shifting cultivation
3. Terracing and building diversion channels may be undertaken.
4. Reducing deforestation and substituting chemical manures by animal wastes also helps arrest soil erosion in the long term.
5. **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.
6. **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.

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

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

8. **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.

9. **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.

10. **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.

3.3.5 NOISE POLLUTION

3.3.5.1 Introduction

Noise is defined as, "the unwanted, unpleasant or disagreeable sound that causes discomfort to all living beings". Sound intensity is measured in decibels (dB) , that is the tenth part of the longest unit Bel. One dB is the faintest sound that a human ear can hear.

3.3.5.2 Types of noise: Environmental noise has been doubling every ten years. Noise is classified as:

1. Industrial Noise
2. Transport Noise
3. Domestic Noise

Industrial Noise:

It is sound with a high intensity sound caused by industry machines. Sources of such noise pollution are caused by machines from machines in various factories, industries and mills. Noise from mechanical saws and pneumatic drills is unbearable and a nuisance to the public. The Indian Institute of Oto-Rino Laryngology, Chennai reported that increasing industrial pollution damages the hearing ability by at least 20%. Workers in steel industry, who work close to heavy industrial blower, are exposed to 112dB for eight hours suffer from occupational pollution.

Transport Noise:

Transport noise mainly consists of traffic noise from road, rail and aircraft. The number of automobiles on roads like motors, scooters, cars, motor cycles, buses, trucks and diesel engine vehicles has increased enormously in the recent past further aggravating the problem of transport noise. Noise levels in most residential areas in metropolitan cities are hovering around the border line due to increased vehicular noise pollution. This high level of noise pollution leads to deafening in the elderly.

Domestic noise:

This type of noise includes disturbance from household gadgets and community. Common sources of noise are musical instruments, TV, VCR, Radios, Transistors, Telephones, and loudspeakers etc. Statistically ever since the industrial revolution, noise in the environment has been doubled every ten years.

3.3.5.3 Effects of Noise pollution

- Noise pollution affects both human and animal health. It leads to:
    - contraction of blood vessels
    - making skin pale
    - Excessive adrenalin in the blood stream which is responsible for high blood pressure.
    - Blaring sounds are known to cause mental distress
    - Heart attacks, neurological problems, birth defects and abortion
- Muscle contraction leading to nervous breakdown, tension, etc

- The adverse reactions are coupled with a change in hormone content of blood, which in-turn increases heart beat, constriction of blood vessels, digestive spams and dilation of the pupil of the eye.
- Adverse affects health, work efficiency and behavior. Noise pollution may cause damage to the heart, brain, kidneys, liver and may produce emotional disturbance.
- The most immediate and acute effect of noise is impairment of hearing that diminishes some part of the auditory system. Prolonged exposure to noise of certain frequency pattern leads to chronic damage to the inner ear.
- Impulsive noise may cause psychological and pathological disorders
- Ultrasonic sound can affect the digestive, respiratory, cardiovascular system and semicircular canals of the internal ear.
- The brain is adversely affected by loud and sudden noise by jets and airplanes. People are subjected to psychiatric illness.
- Recent reports suggest that blood is thickened by excessive noise.
- The optical system of human beings is also affected by noise pollution. Severe noise pollution causes:
    - Popularly dilation
    - Impairment of night vision and
    - Decrease in rate of color perception

3.3.5.4 Control measures:

1. **SOURCE CONTROL:** This includes source modification such as acoustic treatment to machine surface, design changes, limiting operational timings, etc
2. **TRANSMISSION PATH INTERVENTION:** This includes containing the source inside a sound insulating enclosure, constructing a noise barrier or provision of sound absorbing materials along the path.
3. **RECEPTOR CONTROL:** This includes protection of the receiver by altering the work schedule or provision of personal protection devices such as ear plugs for operating noisy machinery. The measure may include dissipation and deflection methods.
4. **OILING:** Proper oiling will reduce noise from the machine.

3.3.5.5 Preventive measures

1. Prescribing noise limits for vehicular traffic
2. Ban on honking (usage of horns) in certain areas
3. Creation of silence zones near schools and hospitals
4. Redesigning buildings to make them noise proof
5. Reduction of traffic density in residential areas
6. Giving preference to mass public transport system.

3.3.6 MARINE POLLUTION

3.3.6.1 Introduction

The discharge of waste substances in to the sea resulting in harm to the living resources, hazards to the human health hindrances to the fishery and impairment of quality use of sea water.

3.3.6.2 Sources

1. **Dumping the wastes:** Dumping of untreated wastes and sewages in the oceans by coastal towns, cities and industries. Rivers on the way to sea carry huge amount of sewage garbage agricultural discharge pesticide heavy metals. Huge quantity of plastic dumped in to the sea.
2. **Oil:** This is discharged in to the sea as crude oil and as separate fraction. Oil and it's fractions are used in houses automobiles and industries. This causes devastation of marine environment
3. **Radioactive materials** enter the ocean from nuclear weapon testing.
4. **Toxics:** Toxic waste is the most harmful form of marine pollution. Once toxic wastes affects an organism it quickly passes along the food chain and as sea food which cause various problems.
5. **Marine Debris:** Garbage like plastic bags, ropes helium balloons

3.3.6.3 Effects of marine pollution

1. Heavy metals and organic pollutants damages birds by thinning of egg shells and tissue damage of egg.

2. Oil pollution causes damage to marine animals and plants including algae bird, fish etc.
3. Oil spilling in the sea causes abnormal low body temperature in birds resulting in hypothermia. During Exxon Valdez accident 150 rare species of bald eagles are affected by ingested oil.
4. Oil films are able to retard the rate of oxygen uptake by water.
5. Hydrocarbon and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer.
6. Many marine birds ingest plastic that causes gastrointestinal disorders.
7. Oil spills inhibit photosynthesis and the growth of planktons. All aquatic animals depend either directly of indirectly on planktons the basis of tropic chain.

3.3.6.4 Control of marine pollution

- Nature and world conservation union suggest the principles

1. The industrial unit on the coastal lines should be equipped with pollution control instrument.
2. Urban growth near the coast should be regulated.

- Methods of removal of oil

1. Physical methods.
    - skimming the oil off the surface with suction device
    - Floating oil can be absorbed using absorbing materials like ploy urethane foam. Chopped straw and saw dust also used to absorbed oil from the sea water.
2. Chemical methods like dispersion , emulsification and using chemical additives are used to coagulated the oil

3.3.6.5 Protective method

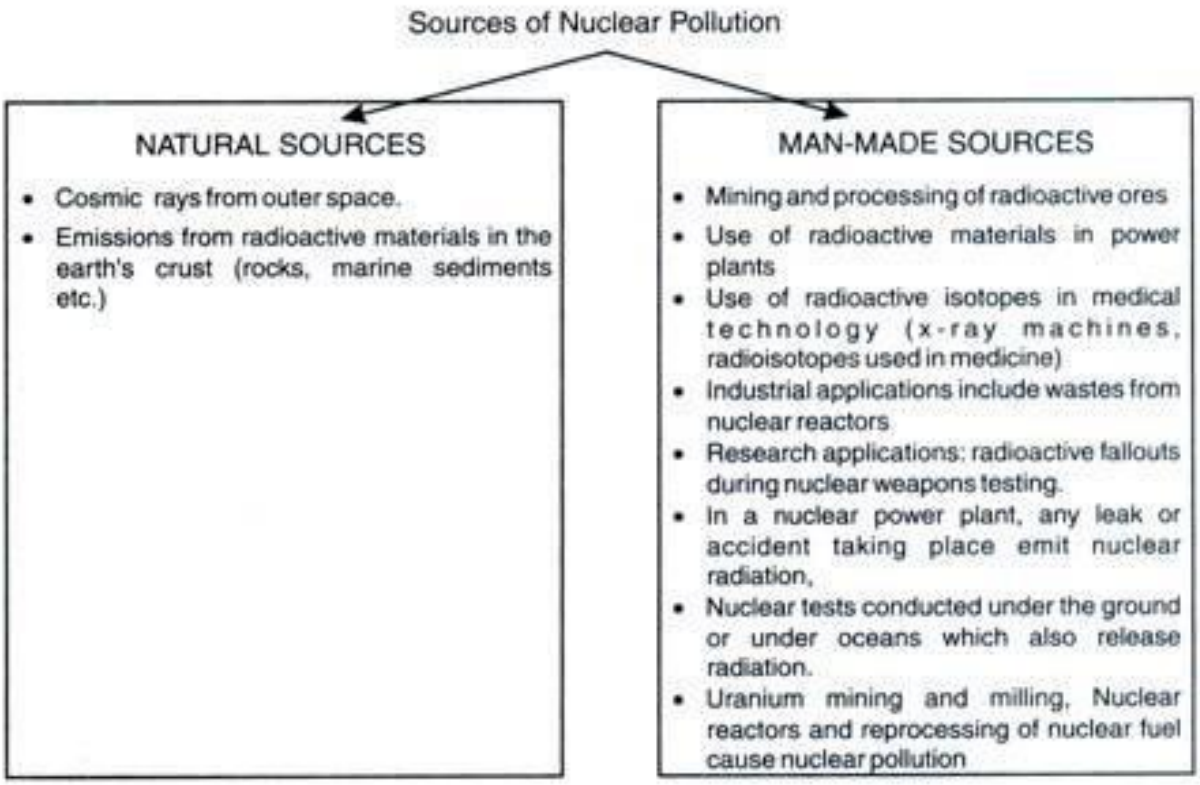
1. Municipal and industrial waste should be treated before disposing in to sea
2. Coastal waste are periodically analyzed for detecting pollution level
3. Soil erosion in the coastal land should be arrested be suitable techniques
4. Recreation beaches should be maintained to meet hygienic and aesthetic standard.

3.3.7 Nuclear Pollution

Nuclear pollution is the physical pollution of air, water and soil by radioactive materials.

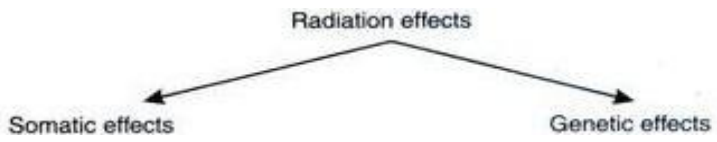
3.3.7.1 Sources of Nuclear Pollution

The sources of radioactivity include both natural and manmade.



3.3.7.2 Effects of Nuclear Pollution

Studies have shown that the health effects due to radiation are dependent on the level of dose, kind of radiation, duration of exposure and types of cells irradiated. Radiation effects can be somatic or genetic.



1. **Somatic effects:** Somatic affects the function of cells and organs. It causes damages to cell membranes, mitochondria and cell nuclei resulting in abnormal cell functions, cell division, growth and death.
2. **Genetic effects:** Genetic effects the future generations. Radiations can cause mutations, which are changes in genetic makeup of cells. These effects are mainly due to the damages to DNA molecules. People suffer from blood cancer and bone cancer if exposed to doses around 100 to 1000 roentgens.

3.3.7.3 Management of Radioactive Waste

- The radioactive waste which comes out from industry, nuclear reactors should be stored and allowed to decay either naturally in closed drums or in very large underground air tight cemented tanks (Delay and Decay).
- The intermediate radioactive waste should be disposed off into the environment after diluting it with some inert materials (Dilute and Disperse)
- Now-a-days small quantities of high activity wastes are converted into solids such as concrete and then it is buried underground or sea. (Concentrate and contain)

3.3.7.4 Control Measures

- Laboratory generated nuclear wastes should be disposed off safely and scientifically.
- Nuclear power plants should be located in areas after careful study of the geology of the area, tectonic activity and meeting other established conditions.
- Appropriate protection against occupational exposure.
- Leakage of radioactive elements from nuclear reactors, careless use of radioactive elements as fuel and careless handling of radioactive isotopes must be prevented.

- Safety measure against accidental release of radioactive elements must be ensured in nuclear plants.
- Unless absolutely necessary, one should not frequently go for diagnosis by x-rays.
- Regular monitoring of the presence of radioactive substance in high risk area should be ensured.
- Among the many options for waste disposal, the scientists prefer to bury the waste in hundreds of meters deep in the earth's crust is considered to be the best safety long term option.

3.3.8 SOLID WASTE MANAGEMENT

3.3.8.1 Introduction

Rapid population growth and urbanization in developing countries has led to people generating enormous quantities of solid waste and consequent environmental degradation. The waste is normally disposed in open dumps creating nuisance and environmental degradation. Solid wastes cause a major risk to public health and the environment. Management of solid wastes is important in order to minimize the adverse effects posed by their indiscriminate disposal.

3.3.8.2 Types of solid wastes

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

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

- **Sources of urban 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.

3.3.8.3 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.

3.3.8.4 SOURCES OF INDUSTRIAL WASTES

- The main source of industrial wastes is 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.

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

3.3.8.6 STEPS INVOLVED IN SOLID WASTE MANAGEMENT

Two important steps involved in solid waste management are- Reduce, Reuse and Recycle of Raw Materials

1. **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 cycle tubes and this reduces waste generation during manufacture of rubber bands.

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

   Ex: Old aluminum 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.

3.3.8.7 Discarding wastes

The following methods are adopted for discarding wastes:

1. Landfill
2. Incineration and
3. Composting

1. LANDFILL: Solid wastes are placed in a sanitary landfill in which alternate layers of 80 cm thick refuse is covered with selected earth-fill of 20 cm thickness. After 2-3 years solid waste volume shrinks by 25-30% and land is used for parks, roads and small buildings. This is the most common and cheapest method of waste disposal and is mostly employed in Indian cities.

Advantages:

1. It is simple and economical
2. Segregation of wastes is not required
3. Land filled areas can be reclaimed and used for other purposes
4. Converts low-lying, marshy waste-land into useful areas.
5. Natural resources are returned to soil and recycled.

Disadvantages:

1. Large area is required
2. Land availability is away from the town, transportation costs are high
3. Leads to bad odor, if landfill is not properly managed.
4. Land filled areas will be sources of mosquitoes and flies requiring application of insecticides and pesticides at regular intervals.
5. Causes fire hazard due to formation of methane in wet weather.

2. INCINERATION:

- It is a hygienic way of disposing solid waste. It is suitable if waste contains more hazardous material and organic content. It is a thermal process and very effective for detoxification of all combustible pathogens. It is expensive when compared to composting or land-filling.
- In this method municipal solid wastes are burnt in a furnace called incinerator. Combustible substances such as rubbish, garbage, dead organisms and non-combustible matter such as glass, porcelain and metals are separated before feeding to incinerators.

- The non-combustible materials can be left out for recycling and reuse. The leftover ashes and clinkers may account for about 10 to 20% which need further disposal by sanitary landfill or some other means.
- The heat produced in the incinerator during burning of refuse is used in the form of steam power for generation of electricity through turbines.
- Municipal solid waste is generally wet and has a high calorific value. Therefore, it has to be dried first before burning. Waste is dried in a preheated from where it is taken to a large incinerating furnace called "destructor" which can incinerate about 100 to 150 tons per hour.
- Temperature normally maintained in a combustion chamber is about 700 C which may be increased to 1000 C when electricity is to be generated.

ADVANTAGES:

1. Residue is only 20-25% of the original and can be used as clinker after treatment
2. Requires very little space
3. Cost of transportation is not high if the incinerator is located within city limits
4. Safest from hygienic point of view
5. An incinerator plant of 3000 tons per day capacity can generate 3MW of power.

DISADVANTAGES:

1. Its capital and operating cost is high.
2. Operation needs skilled personnel.
3. Formation of smoke, dust and ashes needs further disposal and that may cause air pollution.

3. COMPOSTING: It is another popular method practiced in many cities in our country. In this method, bulk organic waste is converted into fertilizer by biological action. Separated compostable waste is dumped in underground trenches in layers of 1.5m and finally covered with earth of 20cm and left for decomposition. Sometimes, Actionmycetes are introduced for active decomposition. Within 2 to 3 days, biological action starts. Organic matter is destroyed by actinomycetes and lot of heat is liberated increasing the temperature of compost by 75C and the refuse is finally converted into powdery brown

colored odorless mass called humus that has a fertilizing value and can be used in agriculture. Humus contains lot of Nitrogen essential for plant growth apart from phosphates and other minerals.

ADVANTAGES:

1. Manure added to soil increases water retention and ion-exchange capacity of soil.
2. This method can be used to treat several industrial solid wastes.
3. Manure can be sold thereby reducing cost of disposing wastes
4. Recycling can be done

DISADVANTAGES:

1. Non-consumables have to be disposed separately
2. The technology has not caught-up with the farmers and hence does not have an assured market.

3.3.9 DISASTER MANAGEMENT

3.3.9.1 FLOODS

Increased rainfall or rapid snow melting causes more flow of water in the streams. This excess water flow in a stream covering the adjacent land is called a flood. Floodplain is defined in terms of a flood frequency. Flood frequency is referred as 10 -year flood, 100-year flood, etc. A 10-year flood at any point in a stream is that discharge of water which may be expected to occur on average once in 10 years. Floodplains are genera lly fertile, flat and easily formed.

3.3.9.1 CAUSES OF FLOOD

- Construction of buildings in a flood plain
- Removing vegetation
- Paving roads and parking areas
- Deforestation
- Heavy rainfall
- Urbanization

- Earthquakes

3.3.9.2 Effects of flood

- Erosion of top soil and vegetation
- Damage and loss to land, house and property
- Spread of endemic waterborne diseases
- Interruption of basic facilities of community such as highways, railways, telephone, electricity and day-to-day essentials
- Silting of reservoirs and dams
- FLOOD CONTROL
- Construction of flood control dam
- Deepening, widening and straightening of streams
- Lining of streams
- Banning of construction of buildings in floodplains
- Converting flood-plains into wildlife habitat, parks, and recreation areas.

3.3.9.2 LANDSLIDES

- Landslides occur when mass of earth material move downward. It is also called mass wasting or mass movement.
- sudden landslide occurs when unconsolidated sediments of a hillside are saturated by rainfall or water logging.
- Many landslides take place in coincidence with earthquakes. The most common form of landslides is earthquake induced landslides or more specifically rock falls and slides of rock fragments that form on steep slopes.
- The size of area affected by earthquake induced landslides depends o n the magnitude of the earthquake, its focal depth, the topography and geologic conditions near the causative fault, the amplitude, frequency, composition and duration of ground shaking.

3.3.9.2.1 Control measures for landslides

- Avoid construction activity in landslide occurring areas.
- Reducing slope of hilly side
- Stabilizing the slope portion
- Increasing plantation of deep rooted vegetation on the slope.

3.3.9.3 EARTHQUAKES

- An earthquake occurs when rocks break and slip along a fault in the earth. Earthquakes occur due to deformation of crust and upper mantle of the earth.
- Due to heating and cooling of the rock below these plates, movement of adjacently overlying plates and great stresses, deformation occurs.
- Tremendous energy cans build-up between neighboring plates.
- If accumulated stress exceeds the strength of the rocks, the rocks break suddenly releasing the stored energy as an earthquake.
- The earthquake releases energy in the form of waves that radiate from the epicenter in all directions.
- The 'p' wave or primary wave alternately compresses and expands material in the same direction it is travelling.
- This wave can move through solid rocks and fluids.
- These are the fastest waves. The is wave or secondary wave is slower and shake the ground up, down, back and forth perpendicular to the direction in which it is travelling. Surface waves follow both the 'P' and 'S' waves.
- The magnitude of an earthquake is measured in Richter scale. The Richter scale is logarithmic.

3.3.9.3.1 Effects of earthquake

- Ground shaking
- Liquefaction of ground
- Ground displacement
- Landslides
- Flood
- Fire

- Tsunami

3.3.9.3.2 Control of earthquake

- There is virtually no technique to control the occurrence of earthquake. However, certain preventive measures can be taken to minimize the damage.
- Minimizing development activity (especially construction, mining, construction of dams and reservoirs) in areas known to be active seismic zones.
- Continuously monitoring seismic activity using 'seismographs' and alerting people regarding any recorded disturbance in advance.

UNIT V ENVIRONMENTAL POLICY, LEGISLATION & EIA

Environment Production 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.

Approaches for sustainable development:

1. Devloping appropriate technology-technology which is locally adoptable, ecofriendly, resource efficient and culturally suitable should be adopted. It uses local labour, less resources and produces minimum waste.
2. Reduce ,Reuse and Recycle (3Rapproach) –Optimum use of natural resources using it again and again instead of throwing it on wasteland or water and recycling the material in to further products. It reduces waste generation and pollution.
3. Providing environmental education and awareness-Thinking and attitude of people towards earth and environment should be changed by providing environmental awareness and education.
4. Consumption of renewable resources- It is very important to consume the natural resources in such a way that the consumption should not exceed the regeneration capacity.
5. Non-renewable resources should be conserved by recycling and reusing.
6. By population control we can make sustainable development.

Urban problems related to energy:

Urbanization –Movement of human population from rural; areas to urban areas for want of better education, communication, health, employment etc.

Causes:

Cities are the main centers of economic growth, trade transportation, medical facilities and employment.

Urban sprawl:

The phenomenon of spreading of the cities in to sub-urban or rural areas is called urban sprawl. Urban growth is so fast and is difficult to accommodate all commercial industrial

residential and educational facilities within the limited area.

Energy demanding activities:

Urban people consume lot of energy and materials in comparison with rural people. This is beause urban people have high standard of life and their life style demand more energy.

Examples for energy demands:

1. Residential and commercial lightings.
2. Industries using large proportion of energy.
3. Usage of fans fridge, A.C, washing machines.

Environmental Ethics

It refers to issues, principles and guidelines related to human interactions with their Environment. **(OR)**

Ethics is a branch of philosophy. It deals with morals and values. An ethic is a principle or value that we use to decide whether an action is good or bad.

Ethics differs from country to country.

Functions of Environment:

1. It moderates climate conditions of the soil.

2 A healthy economy depends on healthy environment. 3It is the life supporting medium for all organisms.

3. It provides food , air , water and other important natural resources to the human

beings Environmental problems : Deforestation activities , population growth and urbanization water Pollution due to effluents and smoke from industries, Scarcity.

Solution to environmental problems:

Reduce the waste matter and energy resources.

Recycle and reuse as many of our waste product And resources as possible. Avoid over exploitation of natural resources.

Minimse soil degradation and Protect the biodiversity of the earth. Reduce population and increase the economic growth our country.

Ethical guidelines on environmental protection:

1. The earth is the habitat of all living species and not of human beings alone.
2. Natural resources and energies are depleting fast. We must protect them.
3. Involve yourself in the care of the earth and experience nature.
4. Respect nature, you are a part of it.
5. Think of the global cause and act for local protection
6. Keep yourself informed about ecological changes and developments.
7. Observe austerity, reserve scarce resources for the future and the future generations.
8. We must be cooperative, honest, affectionate and polite to society and nature.

CLIMATE:

It is the average weather of an area. It is the general weather condition, seasonal variations of the region. The average of such conditions for a long period is called climate.

Causes of climate changes:

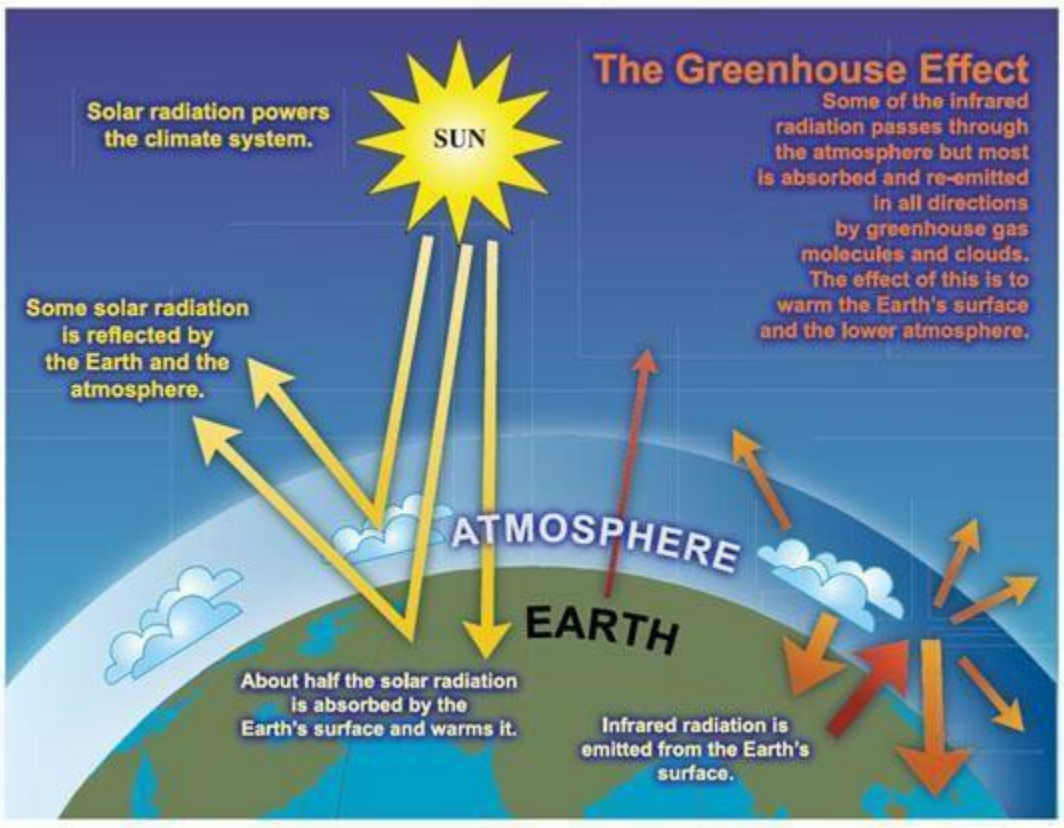
1. Presence of green house gases in the atmosphere Increases the global temperature.
2. Depletion of ozone layer increases the global temperature.

Effects of climate change:

1. Small climate changes disturb agriculture which leads To migration of animals and human.
2. Climate change may upset hydrological cycle which results in floods and droughts in different parts of the world.
3. Global pattern of winds and oceans currents also gets disturbed by climate change.

Green house effect: Green house gases are CO_2 , Methane .Nitrous oxide NO_2, CFC

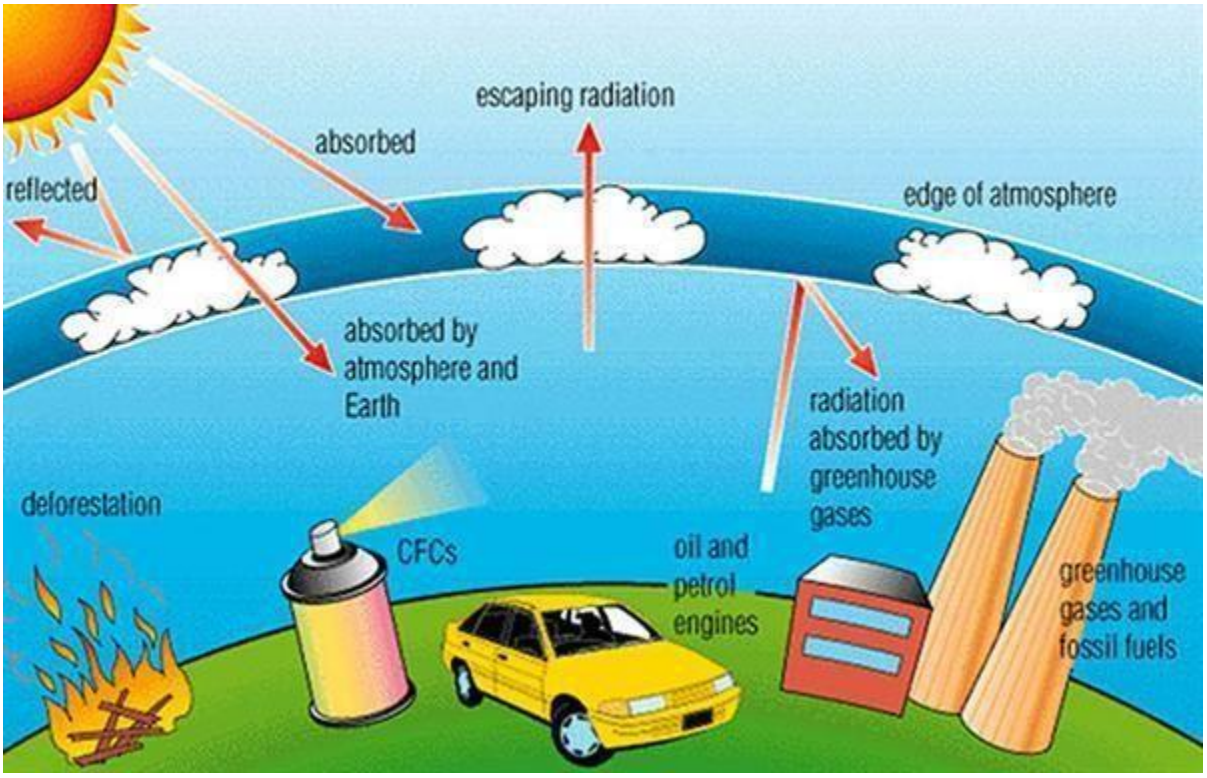
Among these CO_2 is the most important green house gas.O_3 and SO_2 act as serious pollutants causing global warming.Progrssive warming up of a gas surface due to blanketing effect of man made CO2 atmosphere.



GLOBAL WARMING:

Green house gases in the atmosphere are transparent to light but absorb IR radiation. These gases allow sunlight to penetrate the atmosphere and are absorbed by the earth surface. This sunlight is radiated back as IR which is absorbed by gases. As a result the earth surface and lower atmosphere becomes warm. This is called global warming.

105



EFFECTS OF GLOBAL WARMING:

1. Sea level increases as result of melting and thermal expansion of ocean.

2. High CO2 level in the atmosphere have a long term negative effect on crop production and forest growth.

3. Global rainfall pattern will change .Drought and floods will become more common. Raising temperature will increase domestic water demand.

4. Many plants and animal species will have a problem of adapting. Many will be at the risk of extinction, more towering verities will thrive.

5. As the earth becomes warmer the floods and drought becomes more frequent. There would be increase in water-borne diseases.

MEASURES TO CHECK GLOBAL WARMING:

1. CO_2 emission can be cut by reducing the use of fossil fuel.
2. Plant more trees.
3. Shifting from coal to natural gas.
4. Stabilize population growth.
5. Remove efficiently CO_2 from smoke stocks.
6. Removal atmospheric CO_2 by utilizing photo synthetic algae.

ACID RAIN:

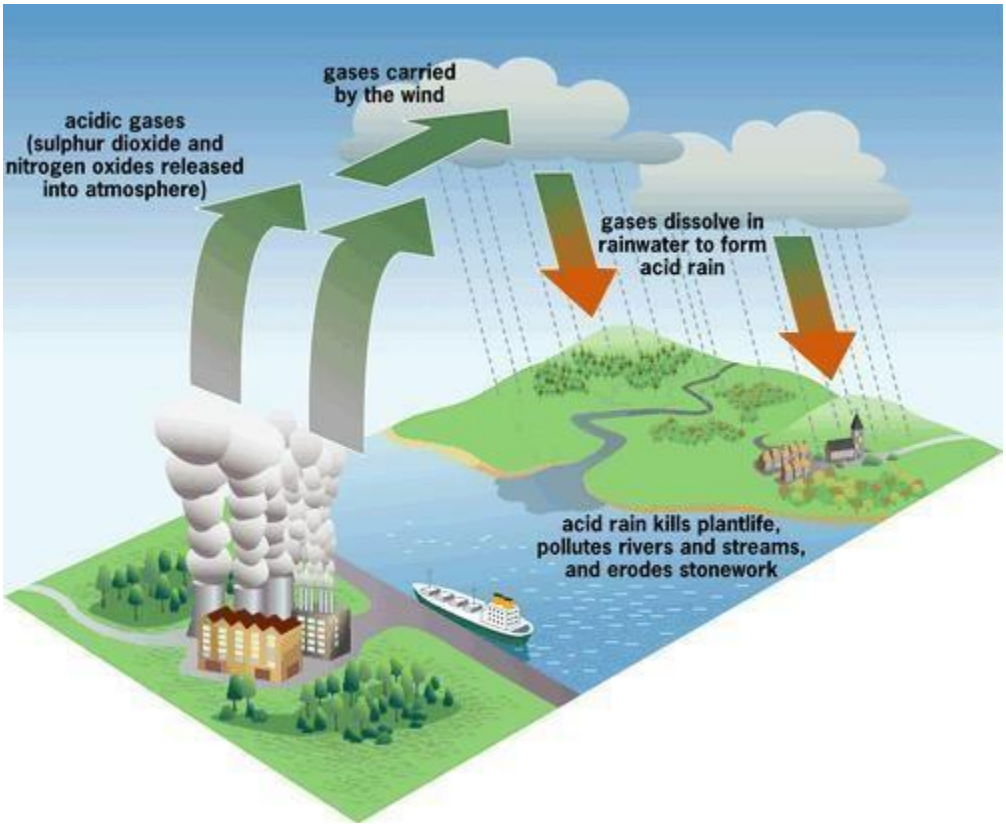
Normal rain water is always slightly acidic (pH 5-5.6) because of Co_2 present in the atmosphere gets dissolved in it. Because presence of SO_2 and NO_2 gases as pollutants in the atmosphere. The pH of the rain is further lowered. This type of precipitation of water is called acid rain.

Formation:

Acid rain means the presence of excessive acids in the rain water. The thermal power plants industries and vehicles release NO_2 and SO_2 in to the atmosphere due to the burning of coal and oil. These gases reacts with water vapor in the atmosphere and from acids like HNO_3,$H2SO_4$.These acids descends on to the earth as acid rain through rain water.

$SO_x + H_2O \square H_2SO_4$

$NO_y + H_2O \square HNO_3$



EFFECTS:

Effect on human being:

Human nervous system respiratory system and digestive system are affected by acid rain.It cause premature death from heart and lung disorder like asthma, bronchitis.

On building:

At present Taj mMahal in Agra is suffering due to SO2 and H2SO4 fumes from Madura refinery.Acid rain corrodes houses, monuments ,statues ,bridges and fences.

Acid rain causes corrosion of metals.

Terestrial and lake Ecosystem.

Reduce the rate of photosynthesis and growth in terrestrial vegetation.

Acid rain retards the growth of crops like beans potatoe ,carrot ,spinach. Acid rain rduces fish population ,black flies,mosquitoes ,deer flies occurs largely which causes number of complications in ponds rivers and lakes.

Activity of bacteria and other microscopic animals is reduced in acidic water. The dead materials are not rapidly decomposed.Hence the nutrients like N,P are locked up in dead matter.

Control of acid rain:

Emmision of No2 and SO2 from industries from power plants should be reduced by using pollution control equipments.

Liming of lakes nad soils should be done to correct the adverse effect of acid rain. In thermal points low sulphur content coal should be used.

OZONE LAYER DEPLETION

Ozone gas is present in the atmosphere. It is highly concentrated at the stratosphere Between10to 50 Km above the sea level and is called as ozone layer.

Importance: O_3 protects us from damaging UV radiation of the sun. It filters UV- B radiation. Now days certain parts of O_3 layer is becoming thinner and O_3 holes are formed. Because of this more UV–B radiation reaches the earth's surface. UV –B radiation affects DNA molecules, causes damages to the outer cell of plants and animals.

It causes skin cancer and eye disease in human beings.

Formation of O_3 : It is formed in the atmosphere by photochemical reaction

$O_2 + hv$ ----------) $O^* + O^*$

The atomic oxygen reacts with molecular O_2 to
form O_3 $O^* + O_2 + M$ ----------) $O_3 + M$

Where M = third body like nitrogen.

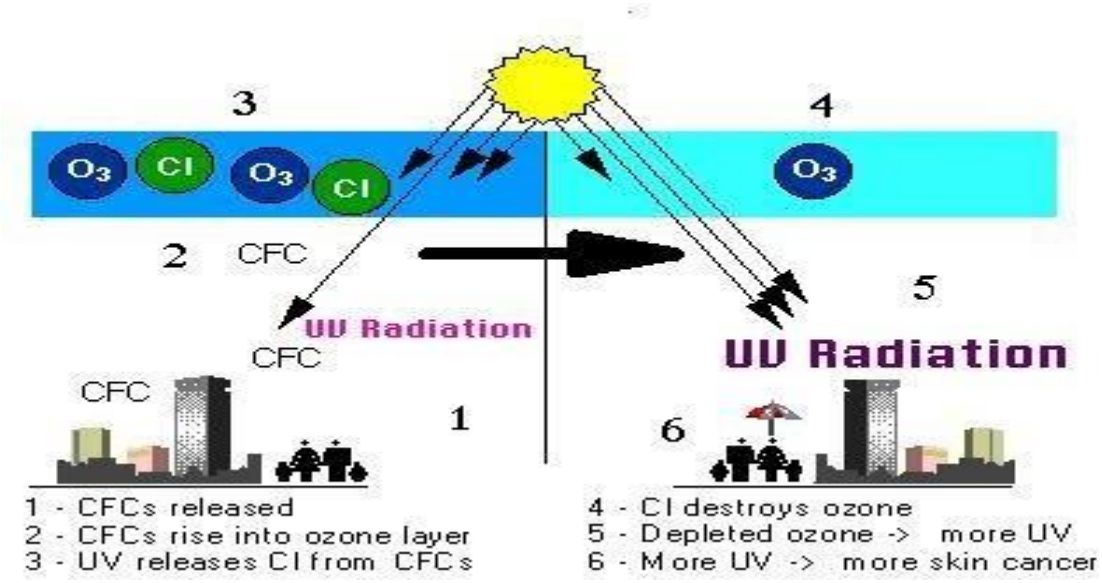
Causes of O_3 layer depletion : Refrigerators , air conditioners , aerosol sprays and cleaning solvents release CFC s into the atmosphere. CFCs releases chlorine which breakes O_3 to O_2

$Cl + O_3$ ----------) $ClO + O_2$ (g) ClO
$+ O^*$ ----------) $Cl + O_2$

Each chlorine atom is capable of breaking several O_3 molecules . It is a chain reaction. 1% loss of O_3 results in 2% increase in UV rays reaching the earth surface .

Ozone depletion chemicals CFC , HCFC , BFC. Some times atmospheric sulfur dioxide Is converted in to H_2SO_4 which increases the rate of O_3 layer depletion.

109



Effects ozone layer depletion:

Effects on human beings

1. UV rays causes skin cancer.
2. Increases the rate of non melanin skin cancer in fair colored people.
3. Prolonged expose to UV rays leads to actinia Katatities (slow blindness) and cataracts.

Effects on aquatic system :

1. UV rays affects phytoplankton , fish , larval crabs.
2. phytoplankton consumes large amounts of CO_2 .
3. Decrease in phytoplankton results in more amount of CO_2 in atmosphere. This contributes to global warming.3. Ozone Depleting chemicals can causes global warming.

Control measures : Manufacturing and using of O_3 depleting chemicals should be stopped. Use of methyl bromide .which is a crop fumigant should be controlled. Replacing CFC s by other maerials which are less damage

NUCLEAR ACCIDENTS AND HOLOCAUST

Energy released—during a nuclear reaction is called nuclear energy. Nuclear fission and Nuclear fusion are used to prepare nuclear energy. During nuclear accidents large amount of energy and radioactive products are released into the atmosphere.

Types of nuclear accidents :-

Nuclear Test- Nuclear explosions –release radioactive particles and radioactive rays into the atmosphere.

Nuclear power plant accidents: Nuclear power plants located in seismic vulnerable area may cause nuclear accidents which releases radiation.

Improper disposal of radioactive wastes: Drums with radioactive wastes, stored underground rust and leak radioactive wastes into water, land and air.

Accidents during transport . Trucks carrying radioactive wastes (or) fuels in accidents. The major accident at a nuclear power plant is a core melts down.

Effects of nuclear radiation

1. Radiation affects DNA in cells.
2. Exposure to low dose of radiation (100to 250 rds) people suffer from fatigue, vomiting ,and loss of hair.
3. Exposer to high radation (400- 500 rds) affect bone marrow ,blood cells , natural resistance fail of blood clot.
4. Exposure to very high dose of radiation (10000rds) kills organisms by damaging the tissues of heart and brain.

Nuclear Holocaust : -Destruction of Biodiversity by nuclear equipments and nuclearbombs is called nuclear holocaust.

Effects of nuclear holocaust.

Nuclear winter, Nuclear bombardment will cause combustion of wood , plastics , forests etc.

Large quantity of soot will be carried out into the atmosphere.

Black soot absorbs all UV radiation and will not allow the radiation to reach the earth. There fore cooling will result. This reduces evaporation of water .In stratosphere there wont be significant moisture to rain out the black soot. Due to nuclear explosion a process opposite to global warming will occur. This is called Nuclear winter.

Nuclear holocaust in Japan

In 1945 two nuclear bombs were dropped in Hiroshima and Nagasaki in Japan. About 100000 people were

Killed and the cities were badly destroyed. This explosion emitted forceful neutrons and gamma radiation.

Radioactive Strontium liberated in the explosion replaced calcium in the bones .Large scale bone deformities occurred in the people of these cities.

ENVVIRONMENTAL LEGISLATION AND LAWS

Water (prevention and control of pollution) Act.1974.

This act provides for maintaining and restoring the sources of water. It also provide for preventing and controlling water pollution.

Features of water act.

1. This act aims to protect the water from all kind of pollution and to preserve the quality of water in all aquifers.
2. The act further provides for the establishment of central board and state boards For prevention of water pollution.
3. The states are empowered to restrain any person from discharging a pollutant (or) sewage or) effluent into any water body with out the consent

of the board.

4. The act is not clear about the definition of pollutant, discharge of pollutant Toxic pollutant.

State pollution control board

The consent of this board is needed

1. To establish any industry or any treatment and disposal system or any extension or addition which likely discharge Or trade effluent into a stream or well or river or on land.
2. To use any new or altered outlet for the discharge of sewage.
3. To begin to make any new discharge of sewage.

Act also empowers the state board to order closure or stoppage of supply of Electricity, water or any other service to the polluting unit.

AIR PREVENTION ACT 1981

This act was enacted in the conference held at Stock Holm. It envisages the establishments Of central and State control boards to monitor air quality and pollution control.

Important features:

1. The central board may lay down the standards for quality of air.
2. The central board co-ordinates and settle the disputes between state boards.
3. The central board provides technical assistance and guidance to state boards.
4. The state boards are empowered to lay down the standards for emission of air pollutants from industries or other resources.
5. The state boards are to examine the manufacturing processes and control equipment for for the prescribed standards.
6. The direction of central board is mandatory on state boards.
7. With out the consent of the central board operation of an industrial unit is prohibited in heavily polluted area.
8. Violation of law is punishable with imprisonment for three months or fine of Rs 10000 or both.

This act applies to all pollution industries. This act empowers the state board to order closure of any industrial unit or stoppage of water supply or stoppage of electricity.

FOREST (COSERVATON) ACT 1980

This act is enacted in 1980. It aims to arrest deforestation. This act covers all types of Forests including reserved forests, protected forests and any forest land.

IMPORTANT Features of the act :

1. The reserved forests shall not be diverted or dereserved wit out the permission Of central govt.
2. The forest land may not be used nonforest purposes.
3. This act stops illegal activities with in forest area.

Features of amendment act of 1988

.1. Forest departments are departments are forbidden to assign any forest land by way of lease or to any private person or NG body for re- afforestation.
2. For re-afforstation clearance of any forest land is forbidden.
3. The division of forest land for non –forest uses is punishable.

WILD LIFE ACT 1972.

This act was amended in 1983, 1986, and 1991.This act is aimed to protect and preserve all animals and plants that are not Domesticated. India has 350 species of mammals, 1200 species of birds and about 20000 Known species of insects. Some of them are listed as endangered species in wild life protection act. Wild life is declining due to human action. Wild life products like skins, firs, feathers, Ivory etc. have decimated the population of many species. Wild life population monitored regularly and management strategies formulated to protect them.

Important Features

1The act covers the rights and non- rights of forest dwellers.
2It allows restricted grazing in sanctuaries but prohibits in national parks.

3. I t also prohibits the collection of non timber forest.
4. The rights of forest dwellers recognized by forest policy of 1988 are taken away by Amended wild life act of 1991.

ENVIRONMENT (PROTECTION) ACT 1986

This act empowers the central govt. to fix the standards for quality of air, water, soil, and noise. The central govt. formulates procedures and safe guards for handling of hazard substances.

Important features: 1. this act empowers the govt. to lay down procedures and safe guards for the prevention of accidents which cause pollution and remedial measures if accidents occur.

2 The govt.has the authority to close or prohibit or regulate any industry or its operation if

The violation of provisions of the act occurs.

3. Violation of the act is punishable with imprisonment for 5 years or fine of one lakh or both.

4. If violation continues an additional fine of Rs5000 per day may be imposed for entire period of Violation of rules.

5. The act empowers the officer of the central govt.to inspect the sight or the plant or machinery for preventing pollution and to collect samples of air , water, soil and other materials from any

Factory or its premises for testing.

PUBLIC AWARENESS

In order to conserve our environment each and every one must be aware about our environment problems and objectives of various environmental policies at natural and local level.

Objectives of public awareness:

1. To create awareness among rural and city people about ecological Imbalance, local environment and technological development.

2 To organize meetings, tree plantation programs, group discussion on development, exhibitions.

3. To focus on current environment problems and situations.

4. To train our planners, decision makers, politicians and administrators.

5. To eliminate poverty by providing employment that over comes the basic environmental issues.

METHODS TO CREATE ENVIRONMNTAL AWARENESS

1. Environmental education must be imparted to the students in schools and colleges.

2. Media like TV Radio and cable net work can educate the people on environmental issues through Cartoons, documentaries, street plays.

3. Cinema about environmental education should be prepared and screened in theatres compulsorily .This films may be released with tax free to attract the public.

4. All the news papers and magazines must publish the environment related problems.

5. Special audio visual and slide shows should be arranged in public places.

6. Voluntary organizations like NCC, NSS, and ROTRACT Club should be effectively utilized for creating environmental awareness.

7. Arranging competitions like story and essay writing painting competition on environmental issues for student as well as public.Attreactive prizes should be awarded for the best effort.

8. Public leaders cine actors and popular social reformers can make an appeal to the public about the urgency of environmental protection.

Environmental Audit in Environmental Impact Assessment (EIA)

Definition:

An Environmental Audit is a systematic, documented, periodic, and objective process of evaluating how well environmental organization, management, and equipment are performing with the aim of helping to safeguard the environment. In the context of EIA, it is used to ensure that the project complies with environmental regulations and mitigation measures

proposed during the EIA process.

Purpose of Environmental Audit:

- To ensure compliance with environmental laws, standards, and permits.
- To verify whether the environmental management plan (EMP) is implemented properly.
- To identify gaps between actual and expected environmental performance.
- To recommend corrective actions for improving environmental performance.
- To promote sustainable development by minimizing environmental risks.

Types of Environmental Audits:

1. Compliance Audit: Checks if the project complies with environmental laws, regulations, and permit conditions.
2. Functional Audit: Focuses on specific functions like waste management, air pollution control, or water treatment.
3. Management Audit: Evaluates the effectiveness of the environmental management system (EMS) within an organization.
4. Due Diligence Audit: Conducted before project acquisitions or mergers to identify **environmental liabilities**.

Components of an Environmental Audit:

1. Planning: Define scope, objectives, and criteria of the audit.
2. Data Collection: Site visits, monitoring reports, interviews with staff, sampling and testing.
3. Evaluation: Analyze data to determine compliance and performance.
4. Reporting: Prepare a report with findings, gaps, and recommendations.
5. Corrective Actions: Suggest and implement steps to improve or correct environmental performance.

Importance of Environmental Audit in EIA:

- Acts as a feedback mechanism to improve future EIAs.
- Helps in decision-making for environmental licensing and renewals.
- Ensures transparency and builds public trust.
- Encourages continuous improvement in environmental management.
- Reduces the risk of environmental accidents and legal actions.

Example Scenario:

Let's say a thermal power plant was approved based on an EIA that proposed certain mitigation measures like:
- Installing electrostatic precipitators
- Treating wastewater before discharge
- Proper disposal of fly ash

An Environmental Audit would later check:
- Are these systems installed are functioning as intended?
- Are emissions and effluent levels within permissible limits?
- Is the ash being disposed of or reused as per plan?

Difference Between Environmental Audit and Environmental Monitoring

Environmental Audit and Environmental Monitoring are both important tools in Environmental Impact Assessment, but they differ in purpose and approach:

1. Environmental Audit:

- Focus: Evaluates compliance and performance.
- Nature: Periodic and retrospective.
- Objective: Identify gaps and suggest improvements.
- Scope: Broader – includes systems, practices, and compliance.
- Example: Checking if mitigation measures are working as promised.

2. Environmental Monitoring:

- Focus: Measures environmental parameters (e.g., air, water, noise).
- Nature: Continuous or regular.
- Objective: Track changes in environmental quality.
- Scope: Narrower – focused on data collection and reporting.
- Example: Measuring air pollution levels around a construction site.

Environmental liability : refers to the potential costs a company or individual faces when purchasing or leasing an asset, or when they cause environmental damage. These liabilities can arise from various sources, including past or ongoing pollution, oil/chemical spills, or releases that negatively impact the environment or human health. Environmental liability is often rooted in the "polluter pays principle" where the responsible party is held accountable for remediation and other associated costs.

Baseline Monitoring of Socio-Economic Environment

Baseline Monitoring of the Socio-Economic Environment is a critical part of Environmental Impact Assessment (EIA). It involves collecting and analyzing data on the current status of human communities, their economic activities, health, education, culture, and other social factors in a project-affected area before the implementation of a proposed project.

Purpose of Baseline Monitoring:

- Understand the existing socio-economic conditions of the region.

- Identify vulnerable groups and communities that may be affected.

- Provide a benchmark against which future changes due to the project can be measured.

- Support decision-making and planning to minimize negative impacts and enhance positive outcomes.

Key Components of Socio-Economic Baseline Monitoring:

Demographic Profile:

- Population size and density

- Age and gender distribution

- Household size

- Migration patterns

Livelihood and Employment:

- Major occupations (agriculture, fishing, industry, etc.)

- Employment rate

- Income levels

- Dependency ratios (e.g., dependents vs. working members)

Health and Sanitation:

- Availability and accessibility of healthcare facilities

- Prevalent diseases

- Water and sanitation conditions

- Nutritional status

Education:

- Literacy rates

- Number and types of educational institutions

- Enrolment and dropout rates

Housing and Infrastructure:

- Types and quality of housing

- Access to electricity, roads, drinking water, and communication

- Waste management facilities

Land Use and Ownership:

- Patterns of land use (agriculture, forest, residential)

- Land tenure systems

- Ownership and access rights

Cultural and Social Institutions:

- Local customs, traditions, festivals

- Religious and community groups

- Social hierarchy and power dynamics

Poverty and Vulnerable Groups:

- Below Poverty Line (BPL) population
- Scheduled Castes, Scheduled Tribes, minorities
- Women-headed households
- Disabled and elderly persons

Public Services and Governance:

- Functioning of local governance institutions (Panchayats, Municipalities)
- Law and order situation
- Access to government schemes

Methods of Data Collection:

Primary Data Collection:

- Household surveys
- Focus group discussions
- Interviews with key informants (village leaders, NGO workers)

Secondary Data Sources:

- Census data
- Government reports (health, education, labor)
- Reports from NGOs and international organizations
- Previous EIA or socio-economic studies

Importance in EIA:

- Helps in impact prediction: e.g., whether people will lose their land, jobs, or access to resources.
- Aids in developing mitigation measures: like relocation plans, compensation, skill training.
- Assists in preparing Social Management Plans (SMPs) and Resettlement & Rehabilitation (R&R) plans.

Challenges in Socio-Economic Baseline Monitoring:

- Diversity and complexity of social systems
- Resistance or lack of cooperation from communities

- Inadequate or outdated secondary data

- Gender bias or exclusion of marginalized voices

Conclusion:

Baseline monitoring of the socio-economic environment is not just a data-gathering exercise, but a foundational step that ensures environmental planning is inclusive, just, and sustainable. It recognizes that people are central to the environment and that development should improve, not diminish, their quality of life.