CHAPTER 1 ENVIRONMENT, SCOPE AND IMPORTANCE

1.1 Introduction:

Environmental science is the study of nature and the facts about environment. Basically environment can be defined as "all the social, economical, physical & chemical factors that surrounds man" (or) "all abiotic and biotic components around man-all living and non-living things surrounds man".

1.2 Environment Components can be divided into biotic and abiotic components.

According to ancient man the environment was the Panchaboodhas (i.e) air, water, land, sky and energy. The human were disciples of nature. They were able to protect themselves from harmful one and protect the others. But according to modern man the environment is only air land and water. Exploitation of various earth resources to satisfy the increasing needs of human population has resulted in 1) depletion of various resources of earth 2) pollution. Principles of environmental education:

- Examine the major environmental issues
- Discover the root cause
- Develop problem solving skills
- Promote co-operation in solving problems
- Emphasis active participation in prevention and solution to problems.

1.3 Scope of environmental science:

- Studying the interrelationship between the components of env.
- Carrying out impact analysis and env. Audit
- Preventing pollution from existing and new industries
- Stopping the use of biological and nuclear weapons
- Managing unpredictable disasters etc.

1.4 Public awareness:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. Public awareness of environmental Is at infant stage 30-40% of public of developing country are aware of environmental. Problems but they do not bother about it.

- Ignorance and incomplete knowledge has lead to misconceptions

- Development and improvement in std. of living has lead to serious environmental disasters
- Debate on environmental Issues are treated as anti-developmental

1.5 Reasons for environmental Ignorance:

Science, technology and economics failed to integrate the knowledge on environmental Aspects in curriculum the decision makers do not process environmental Angle of decision making consideration of economic growth, poverty eradication has lead to environmental Degradation only few developmental activities are made considering the environmental Aspects.

1.6 Need For Public Awareness:

The United Nations Conference on Environment and Development held at Reo de Janeiro in 1992 (popularly known as "Earth Summit") and world summit on sustainable development at Johannesburg in 2002, have highlighted the key issues of global environmental concern. They have attracted the attention of people. Any government at its own cannot achieve the goals of clear environment until the public participate in action. Public participation is possible only when the public is aware about the ecological and environmental issues. Eg. Ban- the littering of polythene.

1.7 Methods to propagate environmental Awareness:

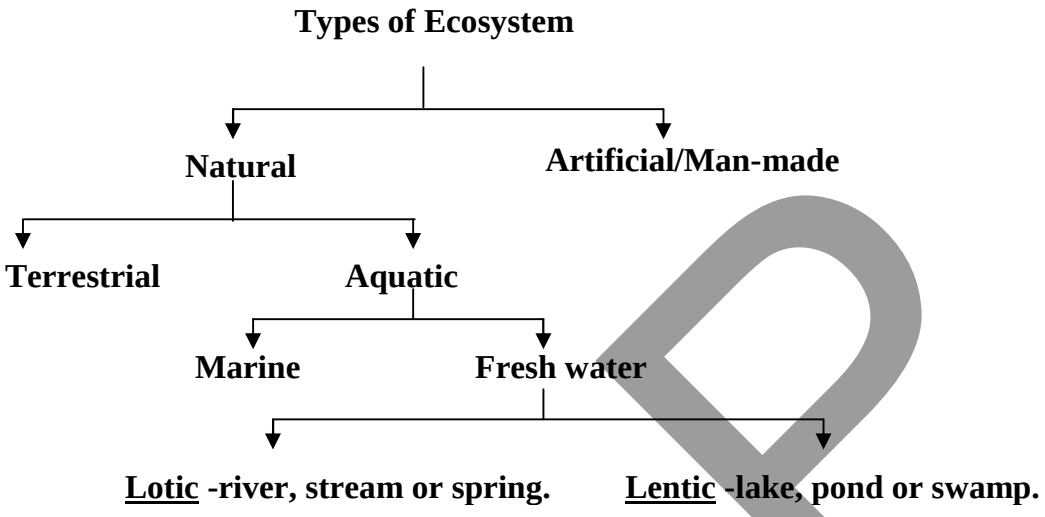
1. Among students through education – introducing environmental studies in the curriculum.
2. Among public through mass media- environmental programmmes through TV, radio etc.
3. Among decision makers, planners, leaders etc.

1.8 Role of NGOs

1. Advise the government in interacting with ground level people
2. Organize public meetings to create environmental awareness Eg. Recent report of "centre for science and environment" on permissible limits of pesticides in cola drinks. Public awareness is needed in the area
3. Study of natural resources-conservation and management
4. Ecology and biodiversity – conservation 3. environmental Pollution and prevention
5. Social issues related to development and environment
6. Human population and environment.

CHAPTER 2 ECOSYSTEMS AND BIODIVERSITY

2.1 Ecosystem -living things in a given area, non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow



2.2.1 Ecology - Study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

2.2 Ecosystem Structure: The living components of an ecosystem

- The roles of organisms in an ecosystem:
- Producer (autotrophy): make food; plants, algae
- Consumer (heterotrophy): eat other organisms
- Decomposer: eat dead organic matter; bacteria and fungi

2.2.1 Classes of Consumers

Herbivore – primary consumer – eats plants

Carnivores – secondary – meat eaters; eat herbivores

Tertiary – feed on carnivores

Omnivores – eat plants/animals.

2.2.2 Role of Organisms

Scavengers – feed on dead organisms (vultures, flies, crows, lobsters)

Detritus feeders – organisms that extract nutrients from fragments of dead organisms into more simple organic waste (termites, earthworms, crabs)

Decomposers – organisms that digest parts of the dead organisms into simplest chemicals (bacteria, fungi)

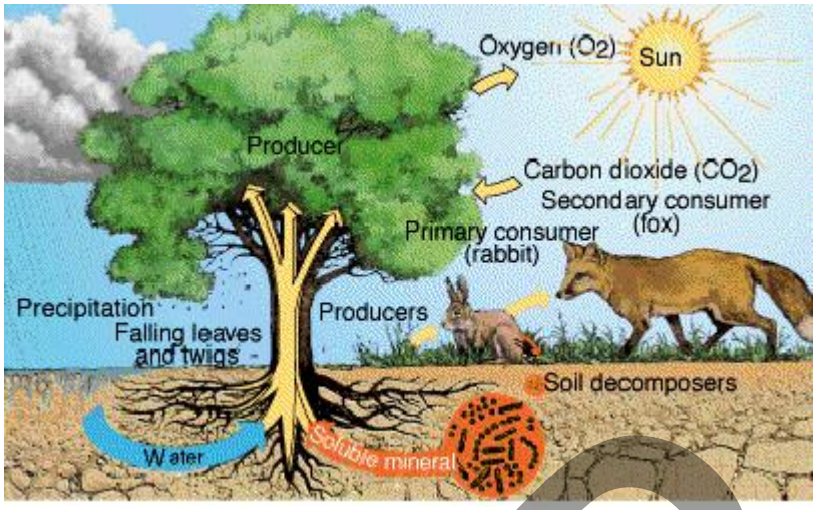


Fig. 2.2.2 Role of organisms

2.3 FOREST ECOSYSTEM (TERRESTRIAL ECOSYSTEM)

2.3.1 Introduction

- A forest is an area with a high density of trees.
- World's total land area is 13,076 million hectares - (Source: FAO; 1989)
- Of which total forests account for about 31% of the world's land area.
- In India, the forest cover is roughly 19% of the total land area.
- The forest ecosystems are of great concern from the environmental point of view.
- It provides numerous environmental services like;
  - Nutrient cycling,
  - Maintaining biodiversity
  - Providing wildlife habitat
  - Affecting rainfall patterns
  - Regulating stream flow
  - Storing water
  - Reducing flooding
  - Preventing soil erosion
  - Reclaiming degraded land & many more….
- Apart from environmental values, forest ecosystems have some traditional values as well.
- Examples are:
  - Fire Wood & Timber.
  - Fruits.
  - Gums.
  - Herbs & drugs.

2.3.2 Structure and Function of Forest Ecosystem

I. Biotic components

- The various biotic components, representatives from the three functional groups, of a forest ecosystem are:

1) Producer Organisms

- In a forest, the producers are mainly trees.
- Trees are of different kinds depending upon the type of forest developed in that climate.
- Apart from trees, climbers, epiphytes, shrubs and ground vegetation.
- Dominant species of trees in major types of forest ecosystems are:
  - Tectona grandis, Acer, Betula, Picea, Pine, Cedrus.

2) Consumers

- In a forest, consumers are of three main types;

a) Primary Consumers

- These are Herbivores which feed directly on producers.

  Eg:

  - Ants, Beetles, Bugs, spiders etc. feeding on tree leaves.
  - Larger animals such as Elephants, Deer, giraffe etc. grazing on shoots and/or fruits of trees.

b) Secondary Consumers

- These are carnivores and feed on primary consumers.

  Eg: Birds, Lizards, Frogs, Snakes and Foxes.

c) Tertiary Consumers

- These are secondary carnivores and feed on secondary consumers
  - These include top carnivores like Lion, Tiger.

3) Decomposers

- These include wide variety of saprotrophic micro- organism like;
  - Bacteria (Bacillus Sp., Clostridium sp., pseudomonas.
  - Fungi (Aspergillus sp., Ganoderma sp., Fusarium.
  - Actinomycetes (Streptomyces).
- They attract the dead or decayed bodies of organisms & thus decomposition takes place.
- Therefore, nutrients are released for reuse.

II. Abiotic components

- These include basic inorganic & organic compounds present in the soil & atmosphere.
- In addition dead organic debris is also found littered in forests.

Producers: Different tree species

Consumers in a Forest Ecosystem

Decomposers in a Forest ecosystem

Fig.2.3 Forest Ecosystem

2.4 GRASSLAND ECOSYSTEM (TERRESTRIAL ECOSYSTEM)

2.4.1 Introduction

- Grasslands (also called Greenswards) are areas where the vegetation is dominated by grasses and other herbaceous (non-woody) plants.
- Grasslands occupy about 24% of the earth's surface.
- Grasslands occur in regions too dry for forests and too moist for deserts
- The annual rainfall ranges between 25- 75 cm, Usually seasonal
- The principal grasslands include:
  - Prairies (Canada, USA),Pampas (South America),Steppes (Europe & Asia) Veldts (Africa)
- The highest abundance & greatest diversity of large mammals are found in these ecosystems.
- The dominant animal species include
  - Wild horses, asses & antelope of Eurasia,
  - Herds of Bison of America; and
  - The antelope & other large herbivores of Africa.

2.4.2 Structure and functions of Grassland Ecosystems

I. Biotic components

1) Producer Organisms

- In grassland, producers are mainly grasses; though, a few herbs & shrubs also contribute to primary production of biomass.
- Some of the most common species of grasses are:
    - Brachiaria sp., Cynodon sp., Desmodium sp., Digitaria sp.

2) Consumers

- In a grassland, consumers are of three main types;

a) Primary Consumers

- The primary consumers are herbivores feeding directly on grasses. These are grazing animals such as
    - Cows, Buffaloes, Sheep, Goats, Deer, Rabbits etc.
    - Besides them, numerous species of insects, termites, etc are also present.

b) Secondary Consumers

- These are carnivores that feed on primary consumers (Herbivores)
- These include;-Frogs, Snakes, Lizards, Birds, Foxes, Jackals etc.

c) Tertiary Consumers

- These include hawks etc. which feed on secondary consumers.

3) Decomposers

- These include wide variety of saprotrophic micro- organism like: Bacteria; Fungi; Actinomycetes
- They attract the dead or decayed bodies of organisms & thus decomposition takes place.
- Therefore, nutrients are released for reuse by producers.

II. Abiotic components

- These include basic inorganic & organic compounds present in the soil & aerial environment.
- The essential elements like C, H, N, O, P, S etc. are supplied by water, nitrogen, nitrates, sulphates, phosphates present in soil & atmosphere.

Producers: Different grass species

Consumers of Grassland ecosystem

Decomposers in a Grassland ecosystem

Fig.2.4 Grassland Ecosystem

2.5 DESERT ECOSYSTEM

2.5.1 Introduction

- A desert is a landscape or region that receives almost no precipitation.
- Deserts are defined as areas with an average annual precipitation of less than 250 millimeters per year.
- It occupies about 17% of the earth's surface.
- Deserts are characterized by hot days & cold nights.
- The deserts of the world are mainly located in the

  South- western United States, Mexico, North

  America, Asia (Thar, Gobi, Tibet) & west Asia.
- Deserts are characterized by scanty flora & fauna.
- Soils of deserts often have abundant nutrients but little or no organic matter.

2.5.2 Sturucture and Functions of Desert Ecosystms

I. Biotic components

1) Producer Organisms

- In a desert, producers are mainly shrubs/bushes; some grasses & a few trees.
- Dominant plant species include: Succulents (water - retaining plants adapted to arid climate or soil conditions) & hardy grasses.

- ❖ Besides some lower plants such as lichens & xerophytic mosses are also present.

2) Consumer Organisms

These include animals such as insects, reptiles which are capable of living in xeric conditions

- ❖ Besides some nocturnal rodents, birds & some mammalians like camel etc are also found.

3) Decomposers

Due to poor vegetation with very low amount of dead organic matter, decomposers are poor in desert ecosystem.

- ❖ The common decomposers are some bacteria & fungi, most of which are thermophillic.

II. Abiotic components

Due to high temperature & very low rainfall, the organic substances are poorly present in the soil.

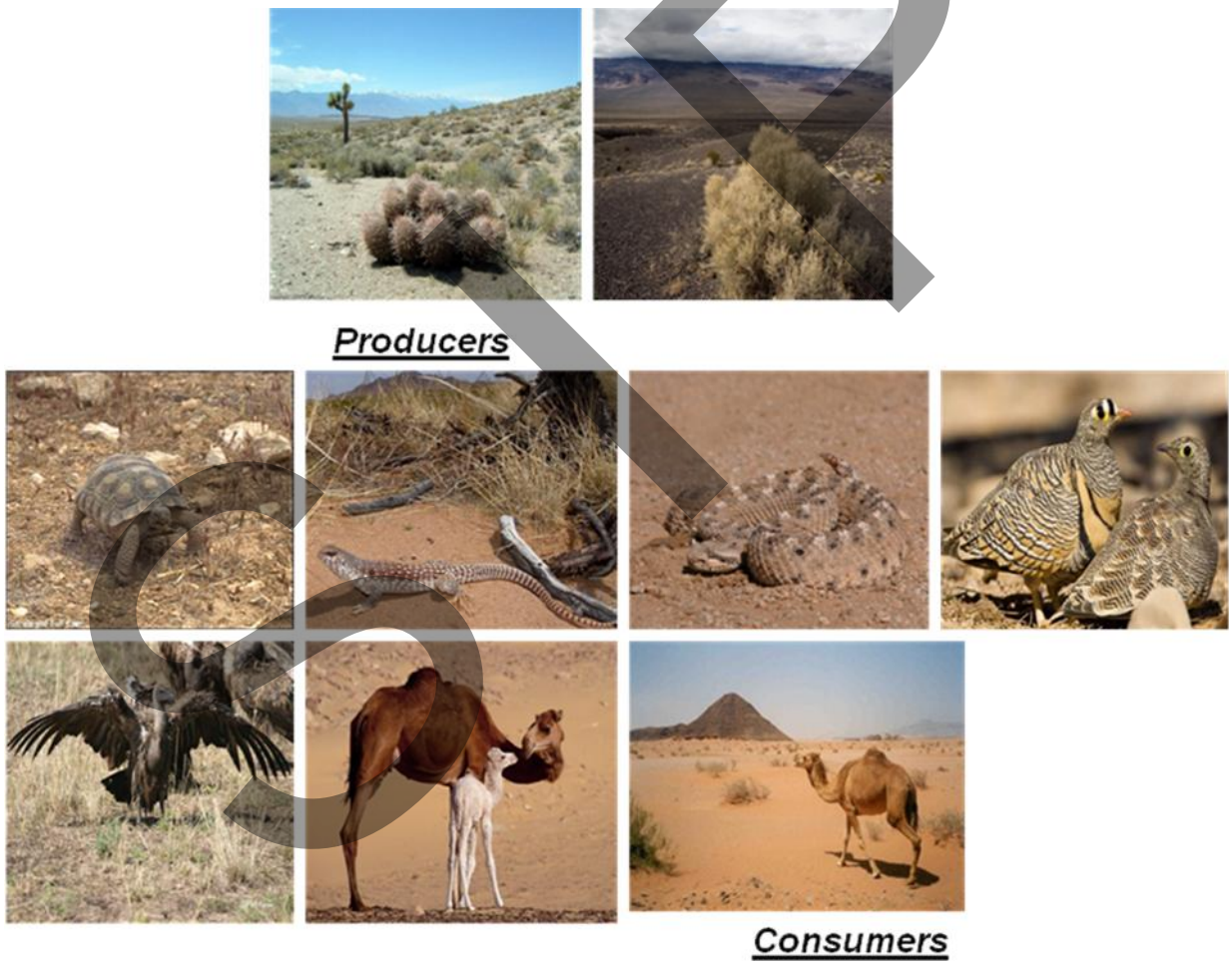


Fig. 2.5 Forest Ecosystem

2.6 AQUATIC ECOSYSTEMS

2.6.1 Introduction

- ❖ Aquatic ecosystems deal with biotic community present in water bodies.
- ❖ In terrestrial ecosystem, carbon dioxide & oxygen are present in gaseous form whereas in aquatic ecosystem, these are available in dissolved state.

- Depending upon the quality and nature of water, the aquatic ecosystem are categorized into:
    - Freshwater Ecosystem and
    - Marine Ecosystem.

2.6.2 Freshwater Ecosystems

- Freshwater ecosystems cover 0.8% of the Earth's surface and contain 0.009% of its total water.
- Freshwater ecosystems contain 41% of the world's known fish species.
- Aquatic ecosystems perform many important environmental functions. For example:
    - They recycle nutrients, purify water, attenuate floods, recharge ground water and provide habitats for wildlife.
    - Aquatic ecosystems are also used for human recreation, and are very important to the tourism industry, especially in coastal region.
- There are three basic types of freshwater ecosystems:
    - Lentic: slow-moving water, including Pools, Ponds, and Lakes.
    - Lotic: rapidly-moving water, for example Streams and Rivers.
    - Wetlands: areas where the soil is saturated with water or inundated for at least part of the time

2.6.3 Lakes & pond Ecosystem

- A pond is a place where living organisms not only live but interact with biotic & abiotic components.
- Ponds are often exposed to tremendous anthropogenic pressure which significantly affects the system.
- Lakes are usually big standing freshwater bodies.
- They have a shallow water zone called Littoral zone; an open water zone where effective penetration of solar light takes place, called limnetic zone and a deep water zone where light penetration is negligible, called Profoundal zone.

I. Biotic components

1) Producer Organisms

- It includes submerged, free floating and amphibious macrophytes (like; Hydrilla, Utricularia, Wolfia, Azolla, Typha etc.) and minute floating and suspended lower phytoplanktons (like; Ulothrix, Spirogyra, Oedogonium etc.)

2) Consumer Organisms

a) Primary consumers:These are zooplanktons (ciliates, flagellates, other protozoan, small crustaceans) and benthos.

b) Secondary consumers: These are carnivores like insects and fishes feeding on herbivores

c) Tertiary consumers: These are the large fishes feeding on small fishes.

3) Decomposers Micro – organisms like bacteria, fungi and actinomyctes.

II. Abiotic component

- These are the inorganic as well as organic substances present in the bottom soil or dissolved in water. In addition, to the minerals, some dead organic matter is also present.

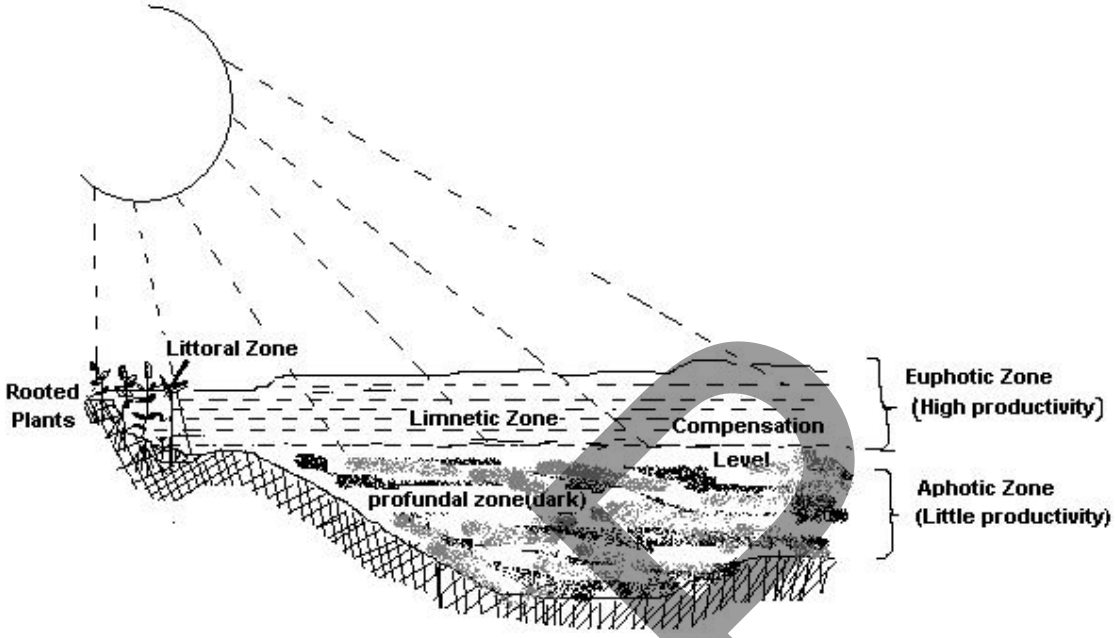


Fig.2.6.4 Zonation in a lake ecosystem

2.6.4 Marine or Ocean Ecosystem

- Marine ecosystems are among the Earth's aquatic ecosystems. They include: Oceans, Estuaries and Lagoons, Mangroves and Coral reefs, the Deep sea and the Sea floor.
- These are the gigantic reservoirs of water covering approximately 71% of the Earth's surface (an area of some 361 million square kilometers).
- These ecosystems are different from freshwater ecosystem mainly because of its salty water.
- The salt concentration in an open sea is usually 3.5% (35 parts per thousand (ppt)). Dominant ions are sodium & chloride.
- Average temperature of Marine ecosystem is 2-3 degree centigrade, devoid of light.

I. Biotic components

1) Producers It includes phytoplanktons (diatoms, dinoflagillates), large seaweeds (mainly algae like chlorophyceae, phaeophyceae & rhodophyceae; angiosperms like Ruppia, Zostera, posidonia), and mangrove vegetation (like Rhizophora, Carapa etc.)

2) Consumers

a) Primary consumers: These are herbivores and feed directly on producers (Crustaceans, Mollusks, fish etc.)

b) Secondary consumers: These are carnivorous fishes (Herring, Sahd and Mackerel)

c) Tertiary consumers: These are top carnivorous fishes (Cod, Haddock, etc.)

3) Decomposers These are micro – organisms like bacteria, fungi

II. Abiotic components

- High Na, Ca, Mg and K salt concentration, variable dissolved oxygen content, light & temperature make a unique physiochemical conditions in marine water.

Fig.2.6.5 Ocean Ecosystem

2.7 ENERGY FLOW IN ECOSYSTEM

- All organisms must obtain a supply of energy and nutrients from their environment in order to survive.
- The transformations of energy in an ecosystem begin first with the input of energy from the sun.
- Because, it is the first step in the production of energy for living things, it is called “Primary production”.
- Photosynthesis -- Chemical reaction where green plants use water & carbon dioxide to store the sun’s energy in glucose.
- ENERGY is stored in glucose.
- Glucose is stored as starch in plants
- The majority of autotrophs are photoautotrophs that harness the energy of the sun and pass some of this energy onto consumers through feeding pathways.
- The energy contained within producers and consumers is ultimately passed to the decomposers that are responsible for the constant recycling of nutrients.
- Thus, there is a one-way flow of energy through the biotic community and a cycling of nutrients between the biotic and abiotic components of the ecosystem
- Energy flow cannot occur in reverse direction.
- Starts from autotrophs (the producer level, i.e., first trophic level) to Heterotrophs including plant eaters or Herbivores (second trophic level) and so on.
- The amount of energy decreases with successive trophic levels.
- Only About 1% of energy from the sun is used by green plants & rest remains unutilized.
- Similarly, there is loss of energy in each trophic level.
- The transfer of food energy between the organisms in an ecosystem can be tracked by constructing food chains, food webs, pyramids of numbers, biomass and energy and energy flow diagrams.

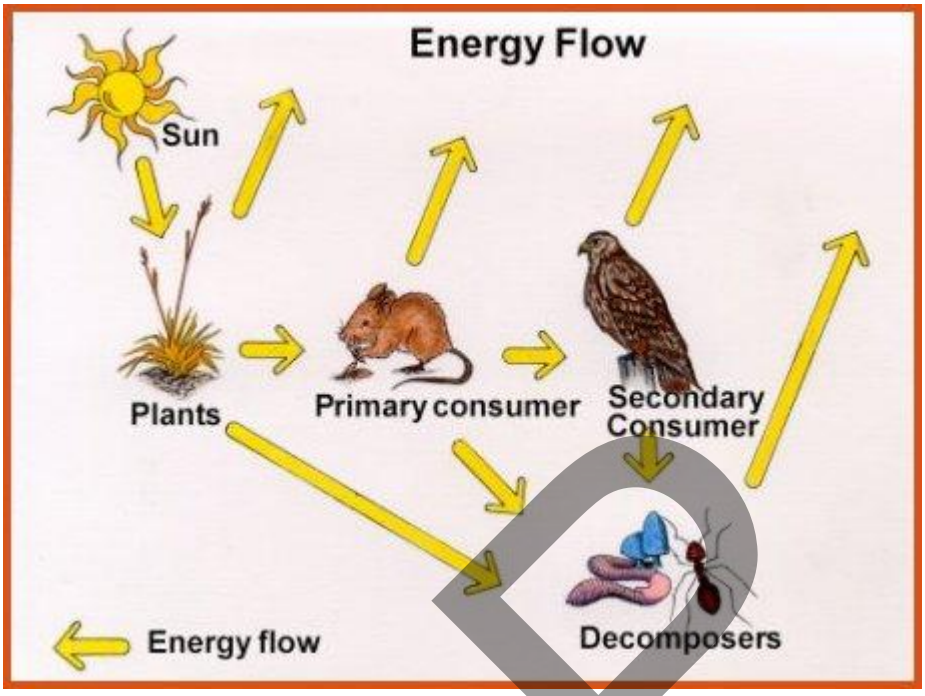


Fig.2.7 Energy Flow

2.8 FOOD CHAIN

- A food chain may be defined as, “the transfer of energy and nutrients through a series of organisms with repeated process of eating and being eaten”.
- In an ecosystem, all the organisms are linked together with one another by food relationship.
- Each organism living or dead is potential food for some other organism.

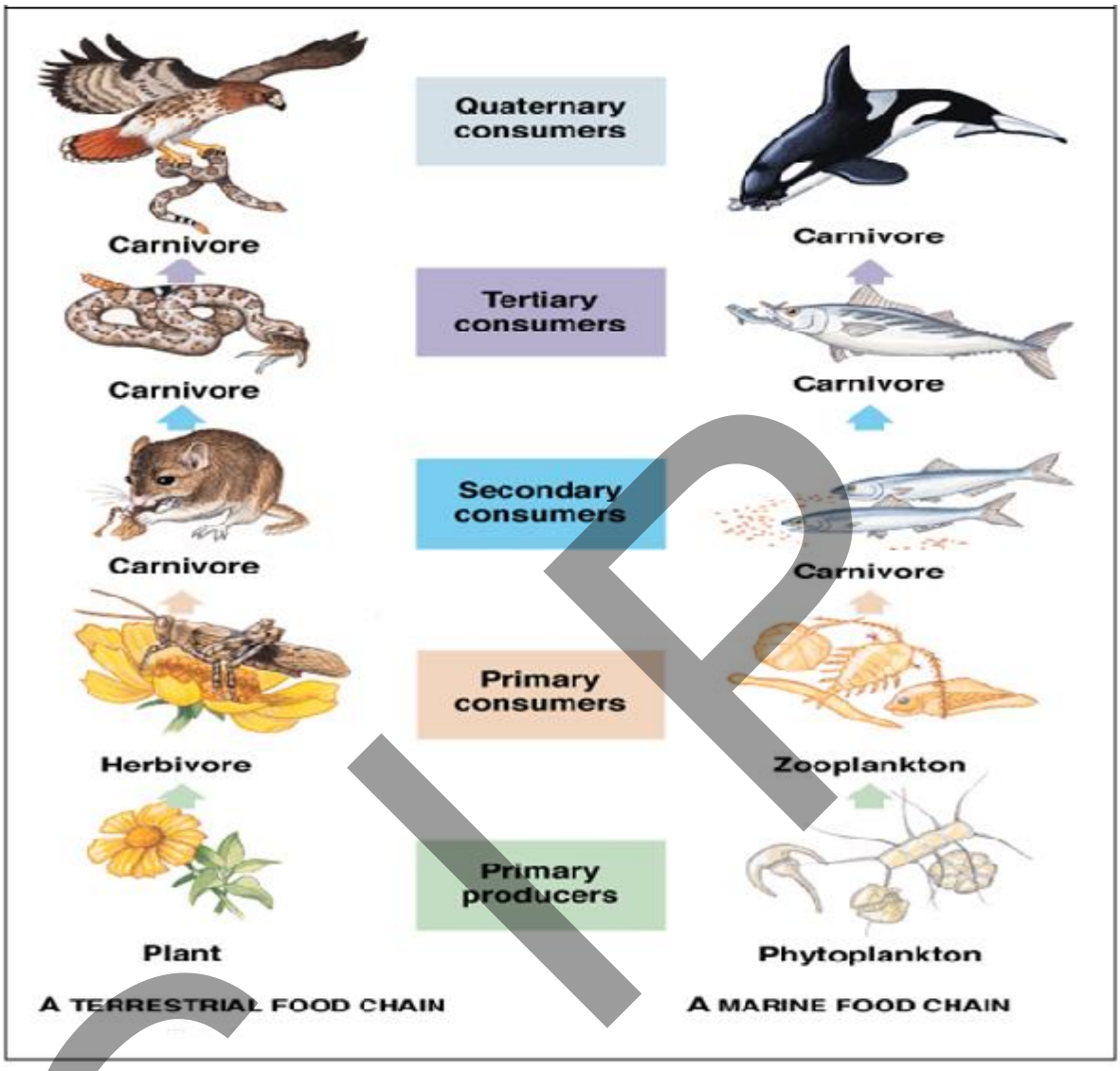


Fig.2.8 Food Chain

2.9 FOOD WEB

- Under natural conditions, the linear arrangement of food chains hardly occurs & these remains connected interconnected with each other through different types of organisms.
- Interlocking pattern of several interlinked food chains is termed as FOOD WEB.

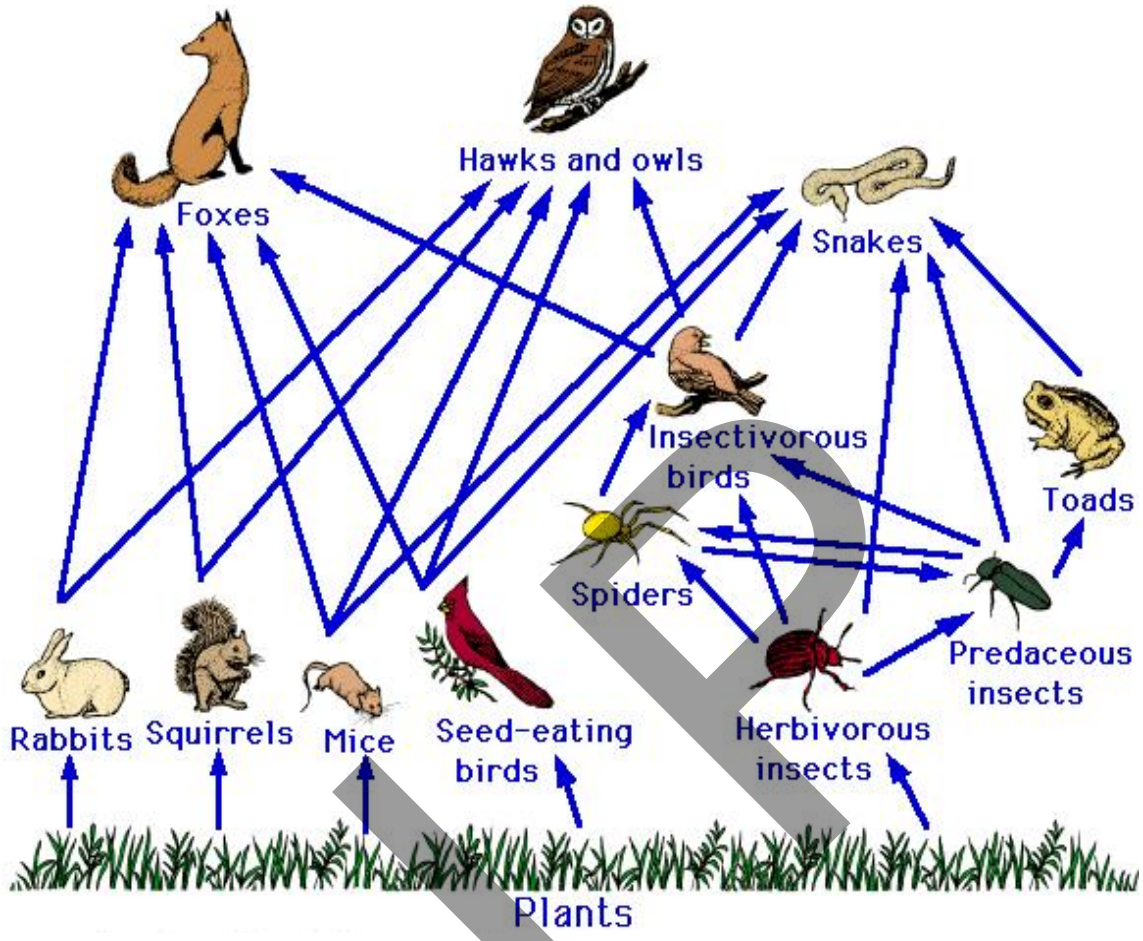


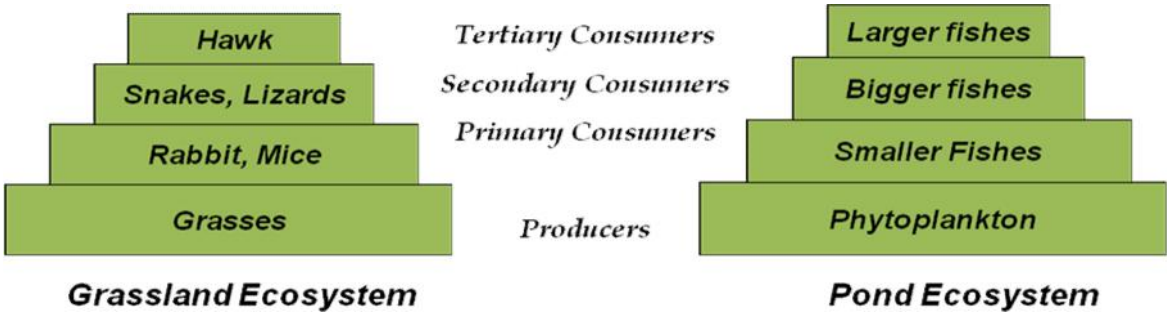
Fig.2.9 Food web in grassland ecosystem

2.10 ECOLOGICAL PYRAMIDS

- An"Ecological pyramid" is a graphical representation that shows the relative amounts of energy or matter contained within each tropic level in a food chain or food web.
- An ecological pyramid shows the relationship between consumers and producers at different tropic levels in an ecosystem
- There are three ecological pyramids recognized by ecologists:

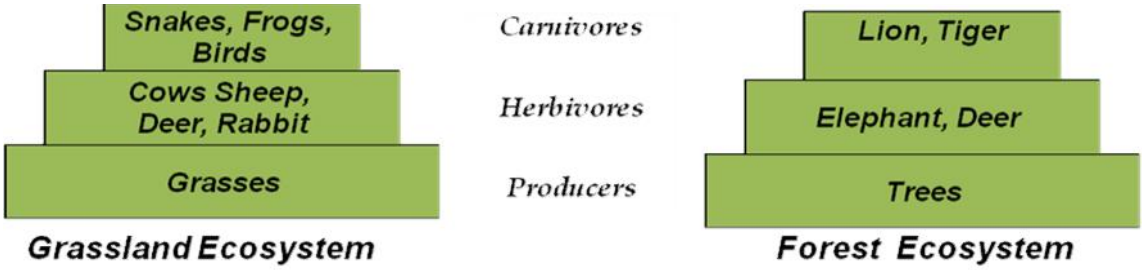
2.10.1 Pyramid of Numbers

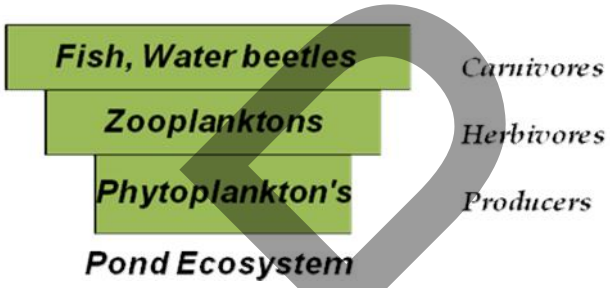
- ✓ Shows the relative number of individual organisms at each tropic level.



2.10.2 Pyramid of Biomass

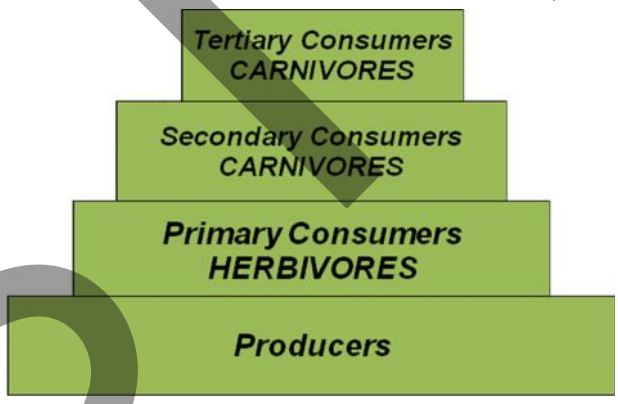
- A pyramid of biomass represents the total dry mass (in grams per square meter of area) of all the organisms in each tropic level at a particular time.





2.10.3 Pyramid of Energy

- A pyramid of biomass represents the rate of energy flow and/or productivity at successive tropic levels. The pyramids of energy are always upright.



2.11 NUTRIENT CYCLES

- Nutrient cycles involve storage and transfer of nutrients through different components of the ecosystem, so that the nutrients are repeadly used.
- The cyclic movements of chemical elements of the biosphere between the organisms and environment are referred as **"BIOGEOCHEMICAL CYCLES"**

Gaseous cycle: Those elements in which the reservoir is the air or the oceans (via evaporation). Gaseous cycles include those of Carbon, Nitrogen, Oxygen, Carbon, and Water.

Sedimentary cycle: Those elements which are received from the Earth's crust. Sedimentary cycles include those of iron, calcium, phosphorus, and other more earth bound elements.

2.11.1 NITROGEN CYCLE

- Nitrogen is crucial for all organisms
  - Nucleic acids

- Proteins
- Chlorophyll

- Nitrogen- 78% in Atmosphere
- N2 is very stable and must be broken apart by organisms, combined with other atoms into a usable form.
- Nitogen cycle completes in 5 steps:

1) Nitrogen Fixation

Conversion of $N_2 \rightarrow NH_3$

- Combustion, volcanic action, Lightning, Industrial processes (making fertilizer). Bacteria (Azotobactor, Clostridium, Nostoc etc.)

2) Nitrification

Conversion of $NH_3 \rightarrow NO_3$

Soil bacteria convert in a two step process.

3) Assimilation

Roots absorb NH_3, NH_4, or NO_3 and incorporate them into nucleic acids and protein.

4) Ammonification

Amino acids and nucleotides are broken down into waste products NH_3 or NH_4

5) Denitrification

The reduction of NO_3 to N_2 .Denitrifying bacteria return some of the nitrogen to the atmosphere

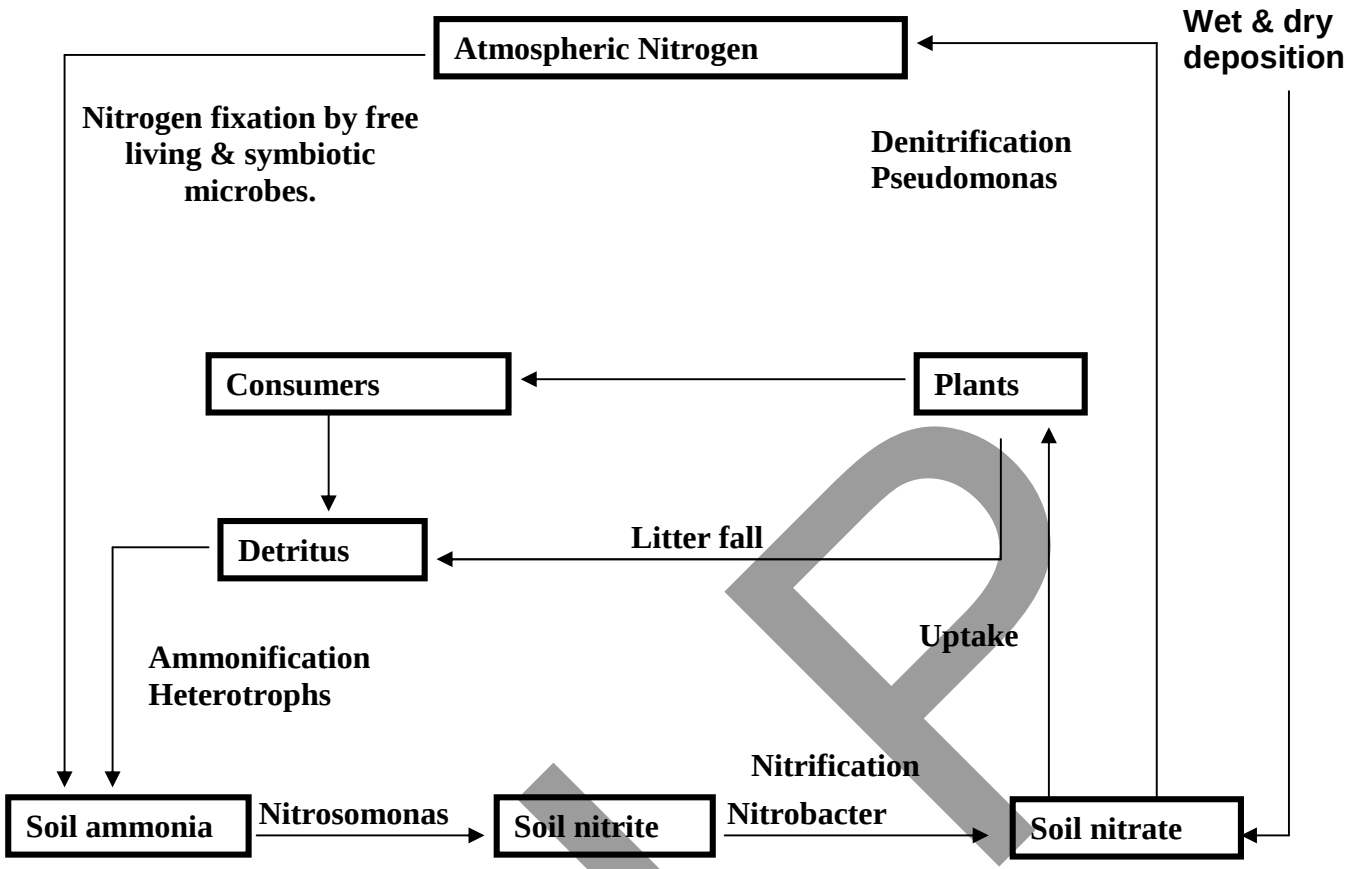


Fig.2.11.1 Nitrogen Cycle

2.11.2 CARBON CYCLE

- Carbon enters plants, etc., as CO_2
  - Bacteria process carbon in a fashion that allows it to be recycled.
  - Obtain energy from the molecules, and convert carbohydrates to carbon dioxide as a result of respiration.
- Photosynthesis removes carbon from the abiotic environment (fixes carbon into organic molecules)
- Carbon moves through food chain through consumption of one organisms by another
- Cellular respiration, combustion, and erosion of limestone return carbon to the atmosphere, water and abiotic environment.

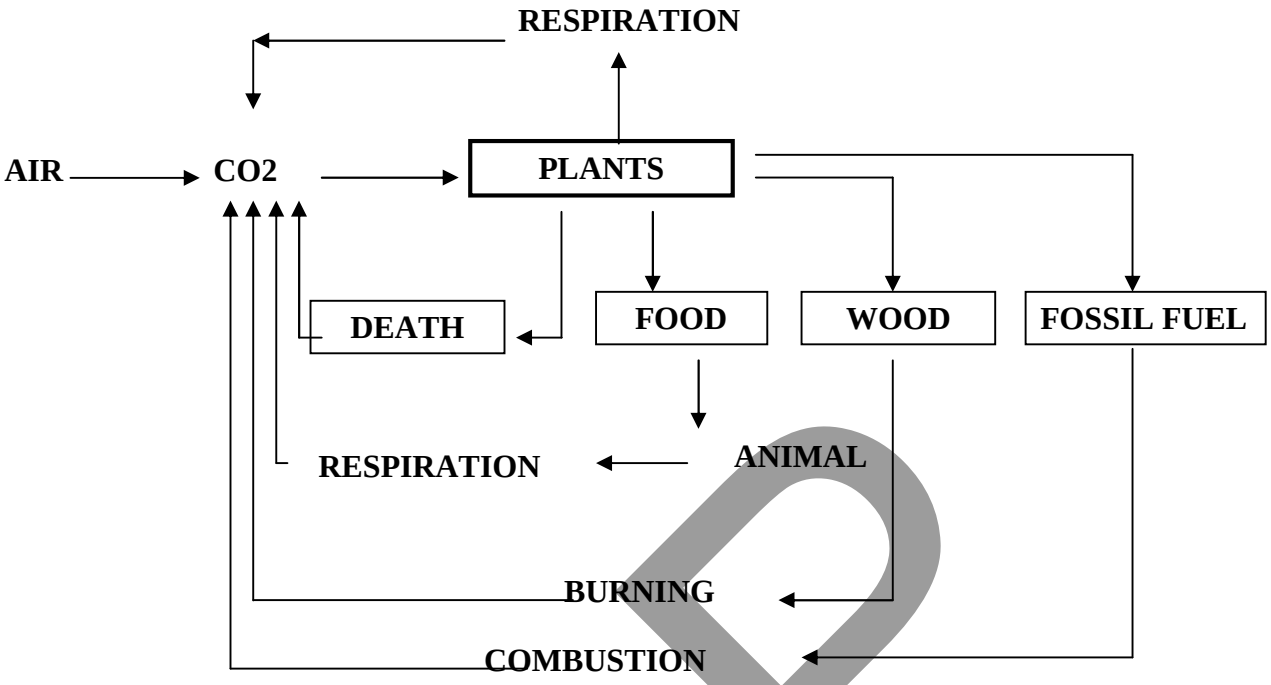


Fig.2.11.2 Carbon Cycle

The source of atmospheric carbon dioxide is variable but only plants can utilize atmospheric carbon directly

2.11.3 PHOSPHOROUS CYCLE

- ❖ The only cycle that does not have a gaseous state
- ❖ Inorganic phosphate PO_4^{3-} is released from rocks and sediments through the action of erosion.
- ❖ Soil PO_4^{3-} is absorbed by plants and incorporated into nucleic acids, phospholipids and ATP.
- ❖ Animals obtain most of their PO_4^{3-} by consumption of other animals and from water.
- ❖ PO_4^{3-} is released to the soil again by decomposers.
- Dissolved PO_4^{3-} gets absorbed by algae and aquatic plants
- Decomposers break down waste and returns PO_4^{3-} to sediments on the seabed.
- Some returns to terrestrial environment through geologic processes and via seabirds. Guano

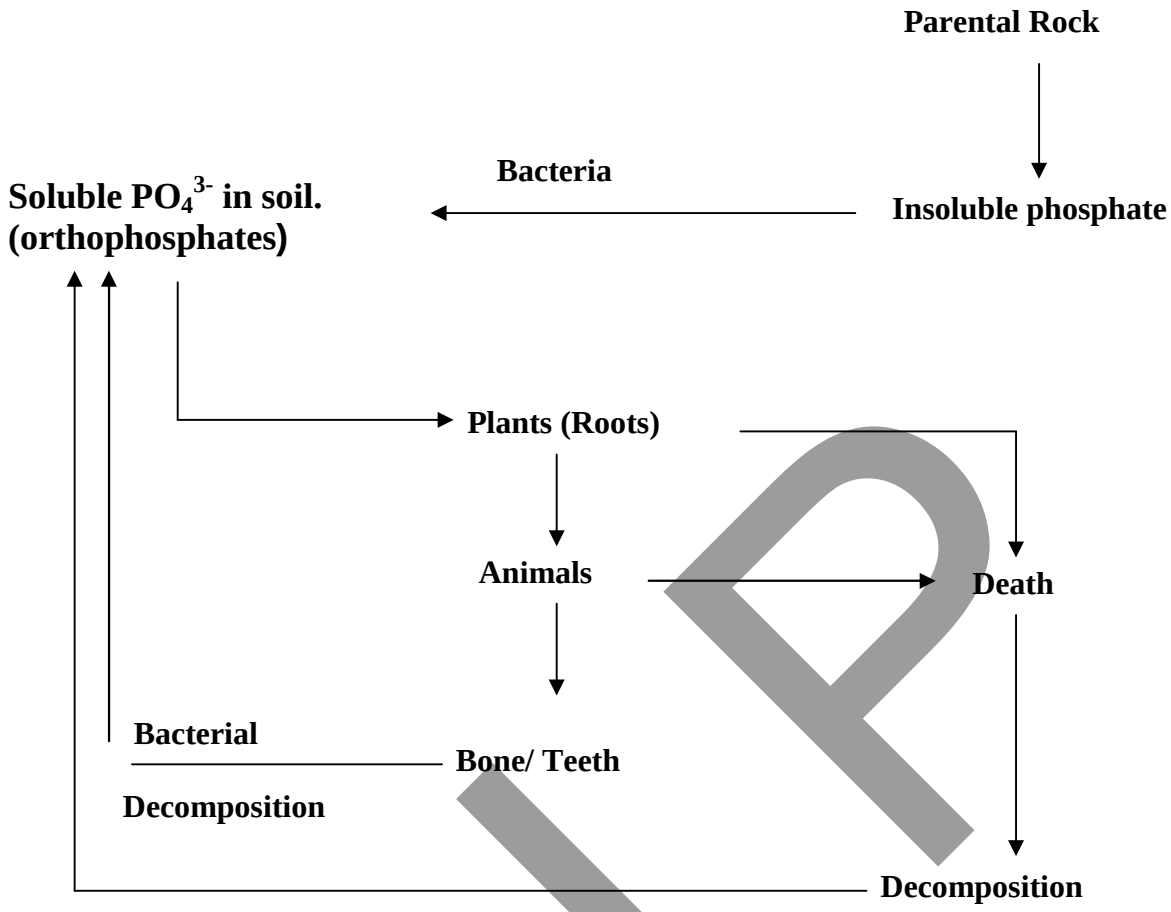


Fig.2.11.3 Phosphorus Cycle

2.12 ECOLOGICAL SUCCESSION

- Ecological succession is defined as, "A change in the community in which new populations of organisms gradually replace existing ones".
- There are two types of ecological succession:

1) Primary Succession

- Occurs where there is no soil, e.g. after a volcanic eruption or a glacial retreat.
- "Pioneer organisms"
- Simple plants first – no or shallow roots.
- Gradual influx of more complicated and larger plants as the habitat changes
- Unfavorable for life at first.
- Ends with a "climax community" – ecosystem stays constant, provided there are no changes in abiotic influences.

2) Secondary Succession

- Community development in the areas that were previously occupied by a other community.
- Occurs after a disturbance. E.g., loss of trees after disease, Fire or wind, deforestation etc.
- Conditions are favorable for as soil and nutrients are already present.
- More rapid than primary succession.

Primary Succession Vs Secondary Succession

Primary	Secondary
➢ No soil.	➢ Soil already exists.
➢ Pioneer species.	➢ Seeds have suitable soil conditions.
➢ Weathering & decomposition	➢ Occurs much faster.
➢ Humus and sand increase over time.	➢ Climax community.
➢ End = Climax community.	

2.13 BIODIVERSITY

- ❖ Biodiversity is the variety and differences among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part.
- ❖ It is virtually synonymous with “Life on earth”.
- ❖ Biologists most often define "biological diversity" or "biodiversity" as the "totality of genes, species, and ecosystems of a region".
- ❖ The biodiversity found on Earth today consists of many millions of distinct biological species, which is the product of nearly 3.5 billion years of evolution.

2.13.1 Levels of Biodiversity

1) Genetic diversity

- ❖ It is a level of biodiversity that refers to the total number of genetic characteristics in the genetic makeup of a species.
- ❖ It is distinguished from genetic variability, which describes the tendency of genetic characteristics to vary.

2) Species diversity

- ❖ It refers to the variety of species within a region.
- ❖ Species diversity is an index that incorporates the number of species in an area and also their relative abundance.
- ❖ It is generally a much more useful value than species richness.

3) Community and Ecosystem diversity

- ❖ Ecosystem diversity refers to the diversity of a place at the level of ecosystems. This has 3 perspective:
- ❖ Alpha Diversity: Within community diversity. Alpha diversity refers to the diversity of organisms sharing the same Community/Habitat.
- ❖ Beta Diversity: Between community diversity. It refers to the diversity of organisms sharing two habitats.
- ❖ Gamma Diversity: Diversity of the habitat over the total landscape or geographical area is called gamma diversity.

2.13.2 Values of Biodiversity

Food: About 80,000 edible plants and about 90% of present day food crops have been domesticated from wild.

Drugs & Medicines: About 75% of world's population depends on plants or plant extracts.

Fuel: Forests have been used since ages for fuel wood. Fossil fuels are also products of Biodiversity.

Social Value: Many of the plants like Tulsi, Lotus, Peepal etc are considered holy and sacred.

- About 2.1 million species have been identified till date, while many more species are believed to exist.
- According to UNEP estimate, approximately 9.0 – 52 million of species exist on Earth
- India's position is 10th in the world & 4th in Asia in terms of Plant diversity.

2.14 HOT- SPOTS OF BIODIVERSITY

- A biodiversity hotspot is a biogeographic region with a significant reservoir of biodiversity that is threatened with destruction.
- An area is designated as a hot spot when it contains at least 0.5% of plant species as endemic.
- There are 25 such hot spots of biodiversity on a global level, out of which two are present in India.
- These are: Indo- Burma (earlier The Eastern Himalayas) ,The western Ghats & Sri Lanka..
- These hot spots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity.

2.14.1 Criteria for determining hot-spots

- No. of Endemic Species i.e. the species which are found no where else.
- Degree of threat, which is measured in terms of Habitat loss.

E.g. Indo- Burma (Eastern Himalayas) Hotspot

- The hotspot includes all of Cambodia, Vietnam & Laos, and nearly the entire areas of Thailand, Myanmar & Bhutan as well as part of Nepal, far eastern India and extreme southern China.
- In addition, it covers several offshore Islands including Mainan Islands in the south China Sea and Andaman & Nicobar Islands in Indian Ocean.
- Indo-Burma is one of the most threatened biodiversity hotspots, due to the rate of resource exploitation and habitat loss.

E.g. Western Ghats and Sri Lanka

- Western Ghats and Sri Lanka, also known as the "Sahyadri Hills" encompasses the montane forests in the southwestern parts of India and on the neighboring Islands of Sri Lanka.
- The entire extent of hotspot was originally about 1,82,500 square kms, but due to tremendous population pressure, now only 12,445 square Km or 6.8% is in pristine condition.
- The important populations include Asian elephant, Indian tigers and the endangered lion tailed macaque.

2.15 THREATS TO BIODIVERSITY

- Extinction is a natural event and, from a geological perspective, routine.
- In last century, human impact has been so severe that thousands of species and varieties are becoming extinct annually.
- Some of the main causes are:
- Habitat loss, degradation, fragmentation.
- Habitat loss & degradation are major causes of species extinction, affecting 89% of all threatened birds, 83% of mammals & 91% of all threatened plants assessed globally (IUCN, 2000)
- The main causes of habitat are agriculture activities, Mining, development of human settlement, industry etc.
- According to ICUN, UNEP report, more than 50% of wildlife habitat has been destroyed in 49 out of 61 old world tropical countries.

2.16 POACHING OF WILDLIFE

- Poaching is another threat that has emerged in recent decades as one of the primary reason for decline in number of species.
- Wildlife is sold and traded in many countries for live specimens, folk medicines, furs, Skin, and other products such as Ivory, horns etc amounting to millions of dollars.

2.17 MAN – WILDLIFE CONFLICTS

- The conflict between man and wildlife started with the evolution of man, but intensity increased due to the activities of modern man
- Due to the lack of stable food and disruption of movement, wild animals came out of forest area and attack the agricultural field and humans and in turn got killed by the humans.

2.17.1 Introduction of Exotic species

- Organisms introduced into habitats where they are not native are termed as exotics.
- They can be thought of as Biological Pollutants and are considered to be among the most damaging agents of habitat alteration and degradation the world.

2.17.2 Climate change

A changing global climate threatens species and ecosystems.

- The distribution of species (biogeography) is largely determined by climate.
- Climate change may simply shift these distributions but, for a number of reasons, plants and animals may not be able to adjust.

2.18 ENDANGERED SPECIES

- According to The International Union of Conservation of Nature and Natural Resources (IUCN), the species that considered in imminent danger of extinction and whose survival is unlikely, if factors causing their decline continue to operate.
- Out of about 47,000 species of plants in our country, 7000 are endemic
- India contains 172 species of animals considered globally threatened by IUCN, or 2.9% of the world's total number of threatened species.
- These include 53 species of mammals, 69 birds, 23 reptiles and 3 amphibians

- As many as 3,000- 4,000 higher plants may be under high degree of threat in India
- Thus Indian subcontinent has about 62% endemic flora, restricted mainly to Himalayas, khasi Hills & Western Ghats.
- Sapria himalayana, Uvaria lurida, Napenthes khasians etc. are some endemic flora of our country.
- A large number out of a total of 81,000 species of animals in our country is endemic. About 62% amphibians and 50% lizards are endemic to western Ghats.
- Golden monkey, Niligiri Langur, Indian Wolf, Red Fox, Himalayan Brown Bear, Great Indian One Horned Rhinoceros, White Winged Wood Duck, Black Necked Crane, Indian Pea Fowl, Gharial, Indian egg eating Snake, Indian Salamandar etc. are some examples of endemic animal species of India.

2.19 CONSERVATION OF BIODIVERSITY

- The convention on Biological Diversity held in June, 1992 stressed the need of the conservation of Biodiversity for sustainable development and perpetuation of human beings on earth.
- Conservation is defined as " the management of human use of the biosphere so that it may yield the greatest sustainable benefit to the present generation while maintaining its potential to meet the needs and aspirations of the future generations".
- The two basic approaches to wildlife conservation in protected habitats are:

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

2.19.1 In- situ conservation

- It simply means conservation of species in its natural ecosystem or even in man made ecosystems.
- This strategy emphasizes protection of total ecosystem through a network of "protected area".
- Protected Areas: an area of land and/or sea specially dedicated to the protection and maintenance of biological diversity and managed through legal effective means.
- There are different categories of protected areas which are managed with different objectives. These include; Biosphere reserves, National parks, Wild Life Sanctuaries etc.
- At present we have 11 major biosphere reserves, 80 National parks, 420 wildlife sanctuaries in our country covering 4% of the geographic area.
- The JIM CORBETT National Park was 1st national park established in India.

What is Difference among Biosphere reserves, National parks, Wild Life Sanctuaries ?

Examples of Biosphere reserves of India:

1. Nilgiri- 5,520 sq.km
2. Nanda Devi- 5,860.69 sq. km
3. Manas – 2837 sq. km
4. Gulf of Mannar – 10,500 sq. km
5. Great Nicobar – 885 sq. km
6. Panchmarhi – 4,926.28 Sq Km

Examples of some National park in India

1. Kaziranga- Assam, Gir National Park- Gujarat, Periyar – Kerala, Sariska – Rajasthan

Examples of some Wild Life Sanctuaries of India:

1. Ghana Bird sanctuaries
2. Hazaribagh sanctuaries
3. Abohar wild life sanctuaries
4. Jaldapara wild life sanctuaries
5. Mudamalai wild life sanctuaries

2.19.2 Ex- situ conservation

- It is defined as "the conservation of component of biological diversity (Sample of genetic diversity, particularly of endangered species) outside their natural habitats".
- It involves maintenance and breeding of endangered plant and animal species under partially or wholly controlled conditions. E.g. Zoos, Botanical Gardens, Aquaria, Nurseries, DNA bank, Seed bank, Gene bank etc.
- There are more than 1500 Botanical gardens in the world containing more than 80,000 species.
- There are more than 800 zoos around the world with about 3,000 species of mammals, birds, reptiles and amphibians.

Review questions:

1. Define Environmental science.
   Environmental science is the study of the environment, its biotic and abiotic components and their interrelationships.

2. What are the important components of environment?
   Abiotic or non-living components Biotic or living component Energy component

3. What are the processes involved in hydrological cycle?
   Continuous evaporation, transpiration, precipitation of surface run off and ground water

4. Define biogeochemical cycle. Give example.
   The continuous circulation of all the essential elements and compounds required for life, from the environment to the organism and back to the environment.e.g., carbon cycle.

5. What are the functions of lithosphere? It is a home for human beings and wild lives.

   It is a store house minerals and organic matters

6. Mention the various types of public participation.
   - Pressure group
   - Watch dog
   - Advisory council
   - Enforcing the environmental laws

7. Explain biosphere?

   The part of lithosphere, hydrosphere and atmosphere in which living organisms live and interact with one another is called biosphere.

ENVIRONMENTAL POLLUTION

CHAPTER 3

3.1 Introduction

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

3.1.1 Types of pollutants

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

3.1.2 Classification of Pollution

- ✓ Air pollution
- ✓ Water pollution
- ✓ Soil pollution
- ✓ Marine pollution
- ✓ Noise pollution
- ✓ Thermal pollution and
- ✓ Nuclear hazards

3.2 AIR POLLUTION

The presence of one or more contaminants like dust, smoke, mist and odor in the atmosphere which are injurious to human beings, plants and animals.

3.2.1 Sources of air pollution

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

3.2.2 Classification

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

3.2.3 Control Measures

1. **Source control**
   - ❖ Use only unleaded petrol

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

2. Control measures in Industrial centers

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

3.3 WATER POLLUTION

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

3.3.1 Types, effects and sources of water pollution

1. Infectious agents: Bacteria, viruses, protozoa and parasitic worms.

Sources: Human and animal wastes.

Effects: Variety of diseases.

2. Oxygen demanding wastes: Animal manure and plant debris that can be decomposed by aerobic bacteria.

Sources: Sewage, paper mills, and food processing facilities.

Effects: Wastes can degrade quality by depleting water of dissolved oxygen.

3. In organic Chemicals: Water soluble inorganic chemicals. Compounds of toxic metals such as lead, arsenic and selenium. Salts such as Nacl in ocean water.

Effects: Genetic mutations, birth defects and certain cancers.

4. Thermal pollution (Heat)

Example: Excessive heat.

5. Human source

- Water cooling of electric power plants and some types of industrial plants. Almost all of all water withdrawn in United States for cooling electric power plants.

3.3.2 Effects

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

3.3.3 Control measures of water pollution

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

3.4 SOIL POLLUTION

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

3.4.1 Types

1. Industrial wastes

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

2. Urban wastes

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

3. Agricultural practices

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

4. Radioactive pollutants

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

5. Biological agents

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

3.4.2 Control measures of soil pollution

The pressure on intensification of farm activities increases for two reasons

- ✓ Population growth
- ✓ Decrease of the available farm land due to urbanization
- ✓ Forestry and farm practices
- ✓ Proper dumping of unwanted materials
- ✓ Production of natural fertilizers
- ✓ Proper Hygienic condition
- ✓ Public awareness
- ✓ Recycling and Reuse of wastes
- ✓ Ban on Toxic chemicals.

3.5 MARINE POLLUTION

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

Source of marine pollution

The coastal zones contain rich heritage, coral reefs, wetlands, and sea grass beds.

3.5.1 Effects of marine pollutants

- ➢ The presence of heavy metals and organic pollutants cause more damage in birds as thinning of eggshell and tissue damage of egg.
- ➢ Oil spilling causes abnormally low body temperature in birds resulting in hypothermia.
- ➢ Oil films are able to retard significantly the rate of oxygen uptake by water.

3.5.2 Control measures of marine pollution

- ❖ Plants for conserving marine biodiversity must be taken into account of human needs.
- ❖ People should be educated about marine ecosystems and the benefits offered by them.

- ❖ Local communities must be involved in protecting and managing their coastal resources. Social and economic incentives must be offered for conserving and sustainable use of marine resources.
- ❖ Governments must manage their own water while extending cooperation to the neighboring states.

3.6 NOISE POLLUTION

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

3.6.1 Types of noise

- Industrial noise
- Transport noise
- Neighborhood noise

3.6.2 Effects of Noise pollution

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

3.6.3 Control and preventing measures

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

3.7 THERMAL POLLUTION

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

3.7.1 Sources of thermal pollution

- ✓ Nuclear power plants
- ✓ Coal fired power plants
- ✓ Industrial effluents
- ✓ Domestic sewage

- ✓ Hydro – electric power.

3.7.2 Effects of thermal pollution

- Reduction in dissolved oxygen
- Increase in Toxicity
- Interference with biological activities
- Interference with reproduction
- Direct mortality
- Food storage for fish.

3.7.3 Control measures of thermal pollution

- ➢ Cooling towers - This is used as a coolant wet cooling tower, dry cooling tower.
- ➢ Cooling ponds and spray ponds.
- ➢ Artificial lakes – The heated effluents can be discharged into the lake at one end and the water for cooling purposes from the other end.

3.8 NUCLEAR HAZARDS

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

3.8.1 Sources of Nuclear Hazards

Natural Sources – This is in space which emits cosmic rays.

Man made Sources – (Anthropogenic sources) these are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits.

3.8.2 Effects of Nuclear Hazards

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

3.8.3 Control measures

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

3.9 SOLID WASTE MANAGEMENT

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

3.9.1 Types of solid wastes

1. Urban wastes

Sources

- ✓ Domestic wastes – Food waste, Cloth, Waste paper.
- ✓ Commercial wastes – Packing material, cans, bottles, polythene.
- ✓ Construction Wastes – Wood, concrete debris.
- ✓ Bio medical wastes – Anatomical wastes, infectious wastes.

2. Industrial wastes

Sources

- ✓ Nuclear power plants – generates radioactive wastes
- ✓ Thermal power plants – produces fly ash in large quantities

3. Chemical industries

Produces large quantities of hazardous and toxic materials

3.9.2 Steps involved in solid waste management

- ✓ Reduce, Reuse and Recycle of materials – raw materials re usage should be reduced, reuse of waste materials should be reduced and recycling of the discarded materials into new useful products should also be reduced.
- ✓ Discarding wastes
- ✓ Land fill: Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thick refuse, covered with selected earth fill of 20cm thickness
- ✓ Incineration: It is a hygienic way of disposing the solid waste. It is a thermal process and is very effective for detoxification of all combustible pathogens
- ✓ Composting: It is another popular method practiced in many cities in our country. In this method, bulk organic waste is converted into fertilizing manure by biological action.

3.9.3 Role of an individual in prevention of pollution

- Plant more trees
- Help more in pollution prevention than pollution control
- Use water, energy and other resources efficiently
- Purchase recyclable, recycled and environmentally safe products
- Reduce deforestation
- Remove NO from motor vehicular exhaust
- Use of eco friendly products.

3.9.4 Case studies

- Effluents treatment at MRL, Chennai
- The Bhopal gas tragedy
- Arsenic pollution in ground water
- Soft drink bottling unit
- Mercury wastes
- Palar river pollution
- The miniamatta epidemic (marine pollution)

3.10 DISASTER MANAGEMENT

Hazard

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

Disaster

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

Types

Natural disasters – refers to those disasters that are generated by natural phenomena.

Man made disasters – refers to the disasters resulting from man made hazards.

3.11 FLOODS

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

3.11.1 Causes of floods

- Heavy rain, rainfall during cyclone causes floods
- Sudden snow melt also raises the quantity of water in streams and causes flood
- Sudden and excess release of impounded water behind dams
- Clearing of forests for agriculture has also increased severity of floods.

3.11.2 Flood Management

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

3.12 CYCLONES

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

Cyclone is measured by Saffir-Simpson scale.

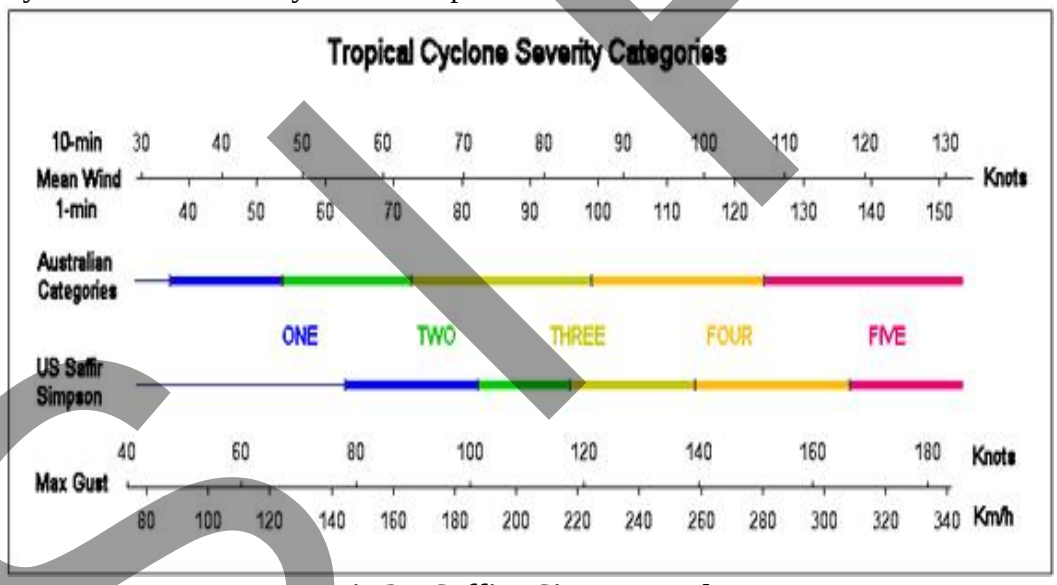


Fig.3.1 Saffir –Simpson scale

3.12.1 Effect

- ✓ The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy.
- ✓ Cyclone occurrence slows down the developmental activities of the area.

Table 3.1 Classification of cyclones based on their speed

Category	Strongest Gust (km/h)	Typical Effects (indicative only)
1 (Tropical Cyclone)	Less than 125 (Gales)	Negligible house damage. Damage to some crops, trees and caravans. Craft may drag moorings.
2 (Tropical Cyclone)	125-169 (Destructive winds)	Minor house damage. Significant damage to signs, trees and caravans. Heavy damage to some crops. Risk of power failure. Small craft may break moorings.
3 (Severe Tropical Cyclone eg. *Roma*)	170-224 (Very destructive winds)	Some roof and structural damage. Some caravans destroyed. Power failure likely.
4 (Severe Tropical Cyclone eg. *Tracy*)	225-279 (Very destructive winds)	Significant roofing loss and structural damage. Many caravans destroyed and blown away. Dangerous airborne debris. Widespread power failures.
5 (Severe Tropical Cyclone eg. *Vance*)	More than 280 (Very destructive winds)	Extremely dangerous with widespread destruction.

3.12.2 Cyclone management

- Satellite images are used by meteorological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
- Radar system is used to detect the cyclone and is being used for cyclone warning.

3.12.3 Case studies

Cyclone in Orissa – 1999

- ✓ Two cyclones in Orissa occurred on 18th and 29th October 1999.In the coastal area of Orissa, a powerful cyclone storm hit with a wind velocity of about 260 km/hr. Nearly 14-30 districts of Orissa were in severe damage.
- ✓ It has been reported that nearly 15 millions of people were affected and 90-95% of the crop yield was affected. About 11,500 local schools have been damaged.

3.13 LAND SLIDES

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

3.13.1 Causes

- ❖ Movement of heavy vehicles on the unstable sloppy regions.

- ❖ Earthquake, shocks, vibrations and cyclone.

3.13.2 Effects of landslides

1. Block roads and diverts the passage.
2. Soil erosion increases.
3. Causes damages to houses, crops and live stock.

3.14 EARTH QUAKES

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

3.14.1 Causes

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

3.14.2 Severity of an earthquake: Generally it is measured by its magnitude on Richter scale.

Richter Scale	Severity of earthquake
Less than 4	Insignificant
4- 4.9	Minor
5- 5.9	Damaging
6- 6.9	Destructive
7- 7.9	Major
More than 8	Great

3.14.3 Effect

- Damage the settlements and transport systems
- Collapses houses and their structures
- Deformation of ground surface
- Tsunami

3.14.4 Earthquake Management

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

3.15 TSUNAMI

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

3.15.1 Causes of tsunami

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

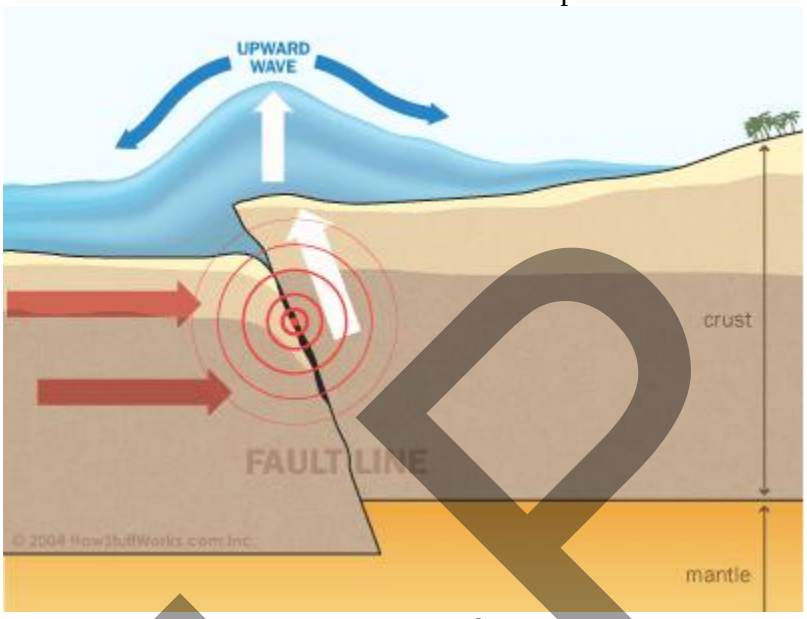


Fig.3.1 Formation of Tsunami

3.15.2 Concept of Tsunami

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

3.15.3 Effects on Tsunami

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

3.15.4 Tsunami Management

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

3.15.5 Case studies

Tsunami- Japan 2011, India 2004.

Review questions

1. Give any three methods of air pollution control equipment.

- Catalytic converters
- Cyclone collectors
- Electrostatic precipitators

2. What is smog?
   It is a mixture of smoke and fog which forms droplets that remain suspended in the air.

3. What is point source of water pollution?
   Point source is discharge pollutants at specific locations through pipes, ditches into bodies of surface waters.

4. When a sound causes noise pollution?
   Noise beyond 120 dB

5. What are the types of solid waste?
   - Municipal waste
   - Industrial waste
   - Hazardous waste

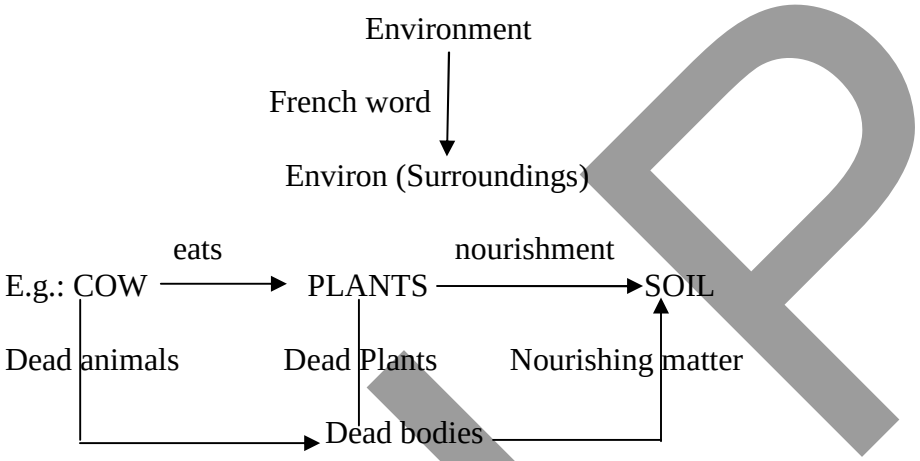
   What is waste minimization? Industrial manufacturing system the primary concern should be reducing the quantities of waste materials produced. This avoids the necessity to threat and disposal off such materials.

6. Name the chemical constituent of gas that caused death in Bhopal gas tragedy in India.
   Methyl iso cynaide.

7. Define the term Tsunami.
   It is a large wave that are generated in a water body where the sea floor deformed by seismic activity. This activity displaces the overlying water in the ocean

CHAPTER 5 INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES

1.1 INTRODUCTION



1.2 DEFINITIONS

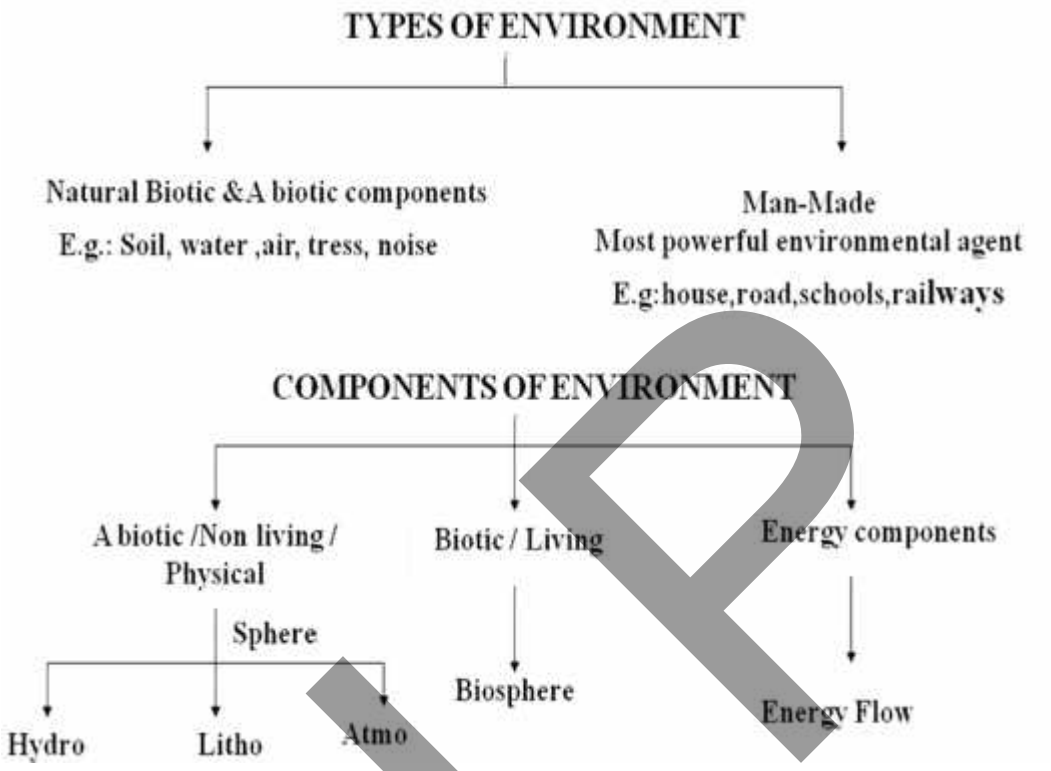
- **Environment** is derived from the French word **Environ** which means to encircle or surround.
- Environment is sum total of water, air, and land, inter-relationships among themselves and also with the human beings, other living organisms and property. The above definition given in Environment Act,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

➢ENVIRONMENT: **Living+ Non-living things Influencing one another**

➢ENVIRONMENTAL SCIENCE: **Study of biotic(biological)and a biotic (non-biological) components &relationships**

➢ENVIRONMENTAL ENGG: **Protection Enhancement=Quality, Public health, welfare environment**

➢ENVIRONMENTAL EDU/STUDIES: **Educating people=Preserving quality environment**



1.3 SCOPE

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

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

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

1.4 NEED FOR PUBLIC AWARENESS

- Public awareness very essential to help understand pros and cons of environmental problems.

- The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and popularly known as Earth summit followed by the world summit on sustainable Development in 2002, have highlighted key issues of global environmental concern.
- Environmental pollution cannot be removed by laws alone.
- The proper implementation and especially public participation are important aspects.
- Public participation is possible only when the public is aware about the ecological and environmental issues.
- A drive by the government to ban the littering of polythene cannot be successful until the public understands the environmental implications of the same.
- The public has to be educated about the fact that if we are degrading our environment we are actually harming ourselves.

1.5 NATURAL RESOURCES

Natural resources (economically referred to as land or raw materials) occur naturally within environments that exist relatively undisturbed by mankind, in a natural form.

1.5.1 FOREST RESOURCES

1.5.1.1Commercial uses

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

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

- ✓ **Tropical Rain Forests**: They are evergreen broadleaf forests found near the equator. They are characterized by high temperature, high humidity and high rainfall, all of which favor the growth of trees.
- ✓ **Tropical deciduous forests**: They are found a little away from the equator and are characterized by a warm climate the year round. Rain occurs only during monsoon.
- ✓ **Tropical scrub forests**: They are found in areas where the day season is even longer.
- ✓ **Temperate rain forests**: They are found in temperate areas with adequate rainfall. These are dominated by trees like pines, firs, redwoods etc.

- ✓ **Temperate deciduous forests**: They are found in areas with moderate temperatures.
- ✓ **Evergreen coniferous forests (Boreal Forests)**: They are found just south of arctic tundra. Here winters are long, cold and dry. Sunlight is available for a few hours only.

1.5.1.2 Ecological uses

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

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

1.5.2 over Exploitation of Forests

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

1.5.3 Deforestation

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

1.5.3.1 Causes of Deforestation

Major causes of deforestation are listed below:

- ➢ Development projects
- ➢ Shifting cultivation
- ➢ Fuel requirements cutting and burning
- ➢ Construction of dams
- ➢ Growing food needs.

1.5.3.2 Consequences of deforestation

Some of the effects of deforestation are listed below:

a) Effect on climate

Global warming
Less rainfall
Hot climate.

b) Effect on biodiversity

Loss of medicinal plants.
Loss of timber, fuel wood.

c) Effect on resources

Loss of land resource

Loss of soil fertility
Soil erosion
Drastic changes in biogeochemical cycles

d) Effect on economy

Increase in medicinal values
Demand of industrial products.

e) Effect on food

Loss of fruit production
Loss of root based foods.

1.5.4 Case Studies

Desertification in hilly regions of the Himalayas:

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

1.5.4.1 Disappearing Tea gardens in Chhota Nagpur

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

1.5.4.2 Waning rain fall in Udhagamandalam

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

1.6 TIMBER EXTRACTION

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

1.7 MINING

- Mining is the process of removing deposits of ores from substantially very well below the ground level.
- Mining is carried out to remove several minerals including coal.
- These mineral deposits invariably found in the forest region, and any operation of mining will naturally affect the forests.
- Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining.
- More than 80,000 ha of land of the country are presently under the stress of mining activities.

1.7.1 Effects of mining resources

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

1.8 DAMS AND THEIR EFFECTS ON FORESTS AND TRIBAL PEOPLE

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


1.8.1 Effects on Tribal people

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

1.8.2 Effects on forests

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

Eg:

The Narmada sagar project alone has submerged 3.5 lakh hectares of best forest comprising of rich teak and bamboo forests.

The Tehri dam submerged 1000 hectares of forest affecting about 430 species of plants according to the survey carried out by the botanical survey of India.

1.9 WATER RESOURCES

Water is an important component of all living beings. Nearly 80% of earth's surface is covered by water.

1.9.1 Uses of Water

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

1.9.2 Hydrological cycle

1. Evaporation
2. Precipitation
3. Transpiration

Evaporation

The transformation of water from liquid to gas phases as it moves from the ground or bodies of water into the overlying atmosphere. The source of energy for evaporation is primarily **solar radiation.** Evaporation often implicitly includes **transpiration** from plants, though together they are specifically referred to as **evapotranspiration**. Total annual evaporation amounts to approximately 505,000 km^3 (121,000 cu mi) of water, 434,000 km^3 (104,000 cu mi) of which evaporates from the oceans.

Precipitation

Condensed water vapor that falls to the Earth's surface .Most precipitation occurs as rain, but also includes snow, hail, fog drip, graupel, and sleet. Approximately 505,000 km^3 (121,000 cu mi) of water falls as precipitation each year, 398,000 km^3 (95,000 cu mi) of it over the oceans.

Condensation

The transformation of water vapor to liquid water droplets in the air, creating clouds and fog.

Transpiration

The release of water vapor from plants and soil into the air. Water vapor is a gas that cannot be seen.

Snowmelt

The runoff produced by melting snow.

Runoff

The variety of ways by which water moves across the land. This includes both surface runoff and channel runoff. As it flows, the water may seep into the ground, evaporate into the air, become stored in lakes or reservoirs, or be extracted for agricultural or other human uses.

Infiltration

The flow of water from the ground surface into the ground. Once infiltrated, the water becomes soil moisture or groundwater.

Subsurface Flow

The flow of water underground, in the vadose zone and aquifers. Subsurface water may return to the surface (e.g. as a spring or by being pumped) or eventually seep

into the oceans. Water returns to the land surface at lower elevation than where it infiltrated, under the force of gravity or gravity induced pressures. Groundwater tends to move slowly, and is replenished slowly, so it can remain in aquifers for thousands of years.

Sublimation

The state change directly from solid water (snow or ice) to water vapor.

Flow chart

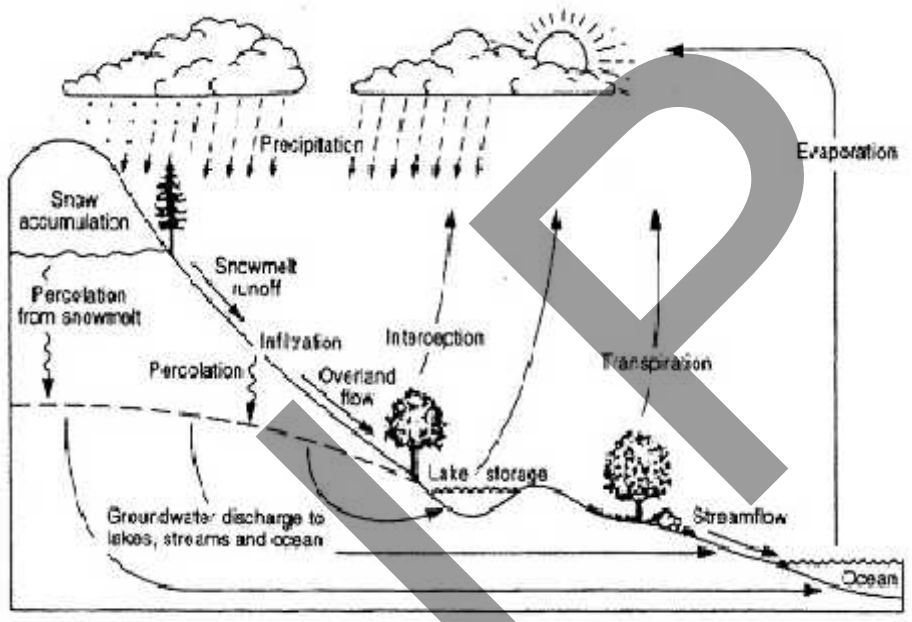


Fig.1.1 Water Cycle

1.10 OVER UTILIZATION OF SURFACE AND GROUND WATER

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

1.10.1 Effects of over exploitation of water

- **Subsidence:** When ground water withdrawal is more than its recharge rate, the sediments in the aquifer (a layer of rock that is highly permeable and contains water) get compacted, a phenomenon knows as ground subsidence. It results in

sinking of overlying land surface. Due to this structural damage in buildings, fracture in pipes etc., occurs.

- **Lowering of water table**: Mining of groundwater is done extensively for irrigating crop fields. However, excessive mining would cause lowering of water table.
- **Water logging**: When excessive irrigation is done with brackish water it raises the water table gradually leading to water-logging and salinity problems.

1.11 FLOODS AND DROUGHT

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

Fig.1.2 Drought

1.11.1 Causes of flood and drought

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

1.11.2 Preventive measures

- ▪ Clear knowledge in control of drought and desertification can be very useful for dealing with the problem.
- ▪ Carefully selected mixed cropping helps to optimize production and minimize the risks of crop failures.

- Social forestry and Wasteland development can prove quite effective to fight the problem, but it should be based on proper understanding of ecological requirement and natural process.

1.12 CONFLICTS OVER WATER

- Indispensability of water and its unequal distribution has often led to inter-state or international disputes. Issues related to sharing of river water have been largely affecting our farmers and also shaking our governments. Many countries are engaged in bitter rivalries over this precious resource.
- For instance,
- Argentina and Brazil, dispute each other's claims to the La Plata river,
- India and Pakistan fight over the rights to water from the Indus,
- Mexico and USA have come in conflict over the Colorado river,
- India and Bangladesh are fighting for Bhrahmaputra river, and
- Iran and Iraq contest for the water from Shatt-Al- Arab River.

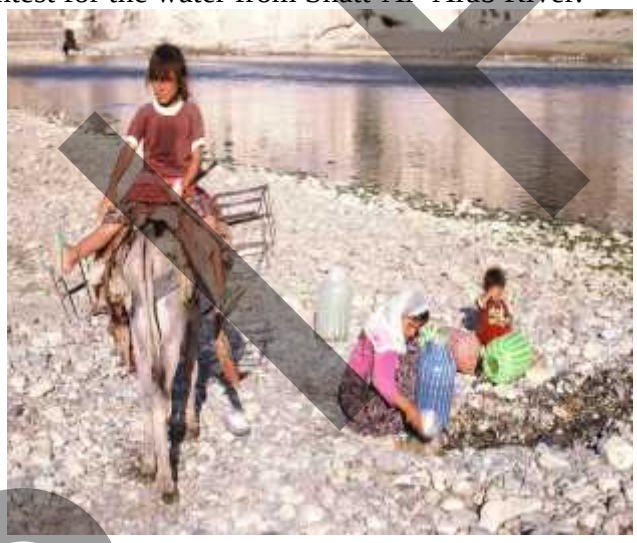


Fig.1.3 Conflicts of water

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

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

- Proper selection of crop varieties, optimum use of water, better rationing are suggested as some measures to solve the problem

1.13 BIG-DAMS –BENEFITS AND PROBLEMS

Dams are built across the river in order to store water for drinking, agricultural, industrial purpose. Now days they are mainly used for the hydropower production.

1.13.1 Benefits

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

1.13.2 Problems

- ✓ The impacts of big dams can be upstream as well as downstream levels. The upstream problems include the following:
- ✓ Displacement of tribal people
- ✓ Loss of forests, flora and fauna
- ✓ Changes in fisheries
- ✓ Saltation and sedimentation of reservoirs
- ✓ Loss of non-forest land
- ✓ Stagnation and water logging near reservoir
- ✓ Breeding vectors and spread of vector –borne diseases
- ✓ Reservoir induces seismicity causing earthquakes
- ✓ Microclimatic changes
- ✓ Growth of aquatic weeds

1.13.3 Downstream problems include the following

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

1.14 MINERAL RESOURCES

Minerals are naturally occurring substances with definite chemical and physical properties.

1.14.1 Uses of minerals

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

- ✓ Development of industrial plants and machinery

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

Table 1.1 Distribution and uses of major reserves and metals

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

Table 1.2 Major uses of some of the non metallic minerals

Non-metal mineral	Major uses
Silicate minerals	Sand and grovel for construction, bricks, paving etc.
Limestone	Used for concrete, building stone, used in agriculture for neutralizing acid soils, used

	in cement industry
Gypsum	Used in plaster wall-board, in agriculture
Potash, phosphorite	Used as fertilizers
Sulphur pyrites	Used in medicine, car battery, industry

1.14.2 Environmental impacts of mineral extraction

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

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

1.14.3 Impacts of mining: Mining is done to extract minerals from deep deposits in soil.

Environmental damages caused by mining activities are as follows:

- **Devegetation and defacing of lands:** Mining requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
- **Subsidence of land:** Subsidence of mining areas results in tilting of buildings, cracks in houses, buckling of roads, bending of rail tracks and leaking of gas from cracked pipe lines leading to serious disasters.
- **Groundwater contamination:** Mining pollutes the groundwater. Sulphur, usually present as an impurity in many ores is known to get converted into sulphuric acid through microbial action, thereby making the water acidic.
- **Surface water pollution:** The acid mine drainage often contaminates the nearby streams and lakes. The acidic water, radioactive substances like uranium, heavy metals also contaminate the water bodies and kill aquatic animals.
- **Air pollution:** In order to separate and purify the metal from other impurities in the ore, smelting is done which emits enormous quantities of air pollutants. Oxides of sulphur, arsenic, cadmium and lead etc. shoot up in the atmosphere near the smelters and the public suffers from several health problems.
- **Occupational Health Hazards:** Miners working in different type of mines suffer from asbestosis, silicosis, black lung disease.

1.14.4 Remedial measures

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

1.14.5 Case studies

1. Mining and quarrying in Udaipur

- Soap stones, building stone, and dolomite mines spread over 15,000 hectares in Udaipur have caused many adverse impacts on environment.
- About 150 tons of explosives are used per month in blasting.
- The Maton mines have badly polluted the Ahar river.
- The hills around the mines are suffering from acute soil erosion.
- The waste water flows towards a big tank of "Bag Dara".
- Due to scarcity of water people are compelled to use this effluent for irrigation purpose.
- The animals like tiger, lion, deer, and birds have disappeared from the mining area.

2. Mining in Sariska and Tiger Reserve in Aravallis

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

1.15 FOOD RESOURCES

1.15.1 World Food Problems

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

1.15.2 Impacts of overgrazing and agriculture

1.15.2.1 Overgrazing

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

Impact of overgrazing

- ✓ **Land degradation:** Overgrazing removes the grass cover. The humus content of the soil is decreased and it leads to poor, dry, compacted soil.
- ✓ **Soil erosion:** The soil roots are very good binders of soil. When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.
- ✓ **Loss of useful species:** Due to overgrazing the nutritious species like cenchrus, panicum etc. are replaced by thorny plants like Parthenium, Xanthium etc. These species do not have a good capacity of binding the soil particles and, therefore, the soil becomes more prone to soil erosion.

1.15.2.2 Agriculture

Traditional Agriculture and its impacts

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

1.15.2.3 Main impacts

- ➢ Deforestation
- ➢ Soil erosion
- ➢ Depletion of nutrients

1.15.2.4 Modern Agriculture and its impacts

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

1.15.2.5 Main impacts

- ✓ **Impacts related to high yielding verities (HYV**): The uses of HYVs encourage monoculture i.e. the same genotype is grown over vast areas. In case of an attack by some pathogen, there is total devastation of the crop by the disease due to exactly uniform conditions, which help in rapid spread of the disease.

1.15.3 Fertilizer related problems

- ✓ **Micronutrient imbalance:** Chemical fertilizers have nitrogen, phosphorus and potassium (N, P and K) which are essential macronutrients. Excessive use of fertilizers cause micronutrient imbalance. For example, excessive fertilizer use in

Punjab and Haryana has caused deficiency of the micronutrient Zinc in the soils, which is affecting productivity of the soil.

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

Fig.1.4 Blue baby syndrome

- ✓ **Eutrophication**: A large proportion of nitrogen and phosphorus used in crop fields is washed off along with runoff water and reach the water bodies causing over nourishment of the lakes, a process known as **Eutrophication.** (Eu=more, tropic=nutrition). Due to Eutrophication the lakes get invaded by algal blooms. These algal species grow very fast by rapidly using up the nutrients. The algal species quickly complete their life cycle and die thereby adding a lot of dead matter. The fishes are also killed and there is lot of dead matter that starts getting decomposed. Oxygen is consumed in the process of decomposition and very soon the water gets depleted of dissolved oxygen. This further affects aquatic fauna and ultimately anaerobic conditions are created where only pathogenic anaerobic bacteria can survive. Thus, due to excessive use of fertilizers in the agricultural fields the lake ecosystem gets degraded.

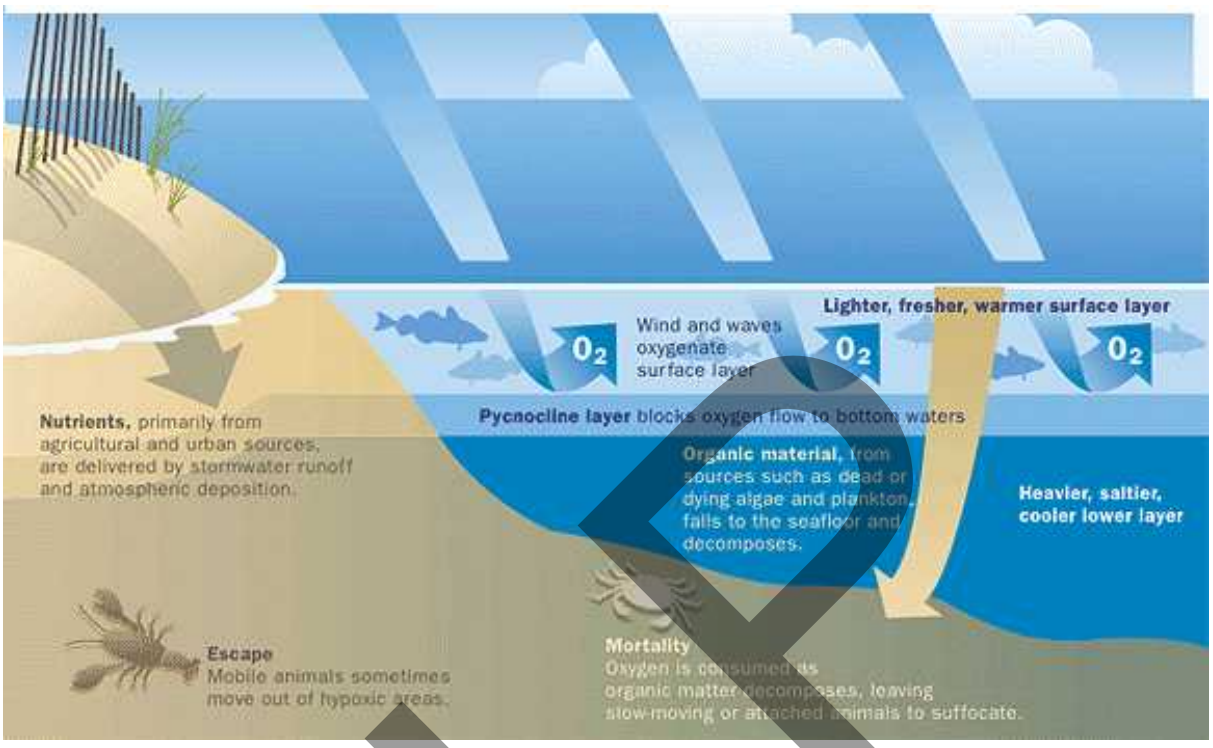


Fig.1.5 Eutrophication

- ✓ **Pesticide related problems**: Thousands of types of pesticides are used in agriculture. The first generation pesticides include chemicals like sulphur, arsenic, lead or mercury to kill the pests. They have number of side effects as discussed below:
- ✓ **Creating resistance in pests and producing new pests**: About 20 species of pests are now known which have become immune to all types of pesticides and are known as "Super pests".
- ✓ **Death of non-target organisms**: Many insecticides not only kill the target species but also several non-target species that are useful to us.
- ✓ **Biological magnification**: Many of the pesticides are non-biodegradable and keep on accumulating in the food chain, a process called biological magnification. This is very harmful.

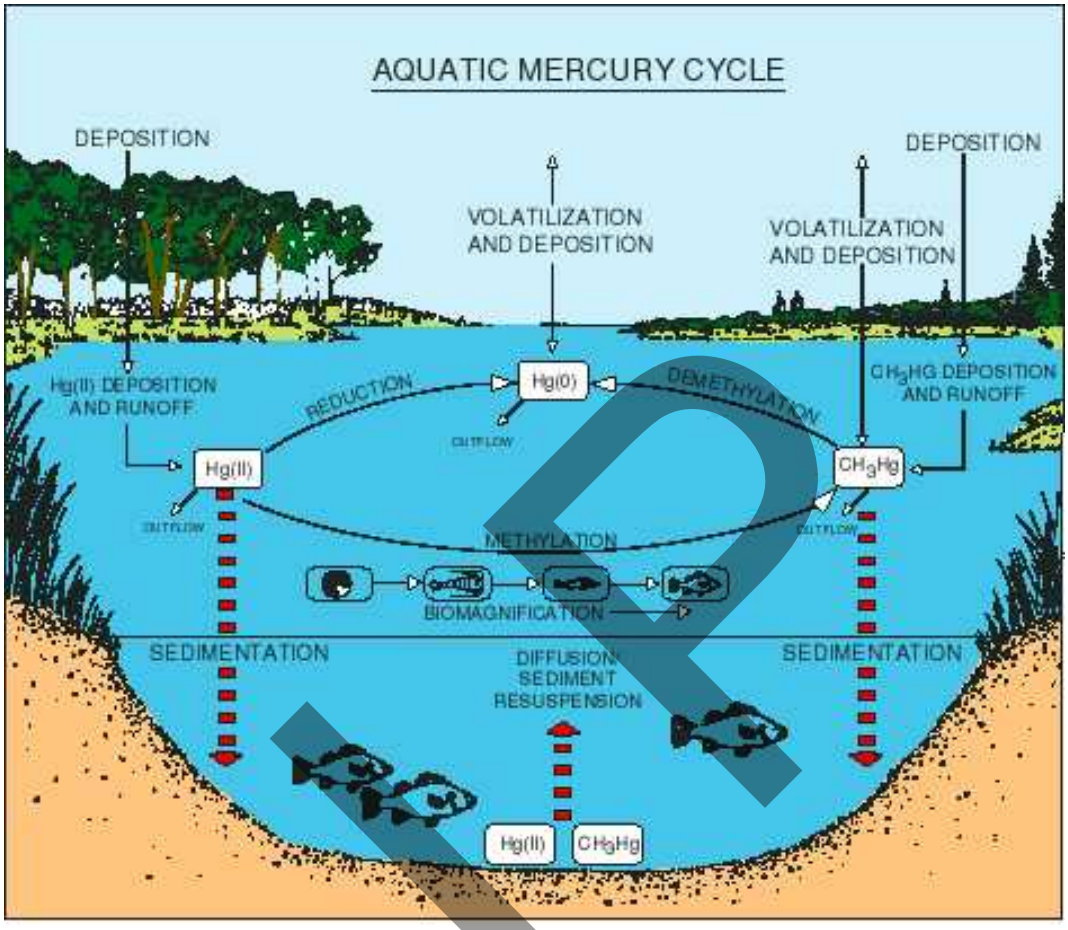


Fig.1.6 Biomagnification

- ✓ **Water Logging**: Over irrigation of croplands by farmers for good growth of their crop usually leads to water logging. Inadequate drainage caused excess water to accumulate underground and gradually forms a continuous column with the water table. Under water-logged conditions, pore-spaces in the soil get fully drenched with water and the soil- air gets depleted. The water table rises while the roots of plants do not get adequate air for respiration, Mechanical strength of the soil declines, the crop plants get lodged and crop yield falls. In Punjab and Haryana, extensive areas have become water-logged due to adequate canal water supply or tube-well water. Preventing excessive irrigation, sub-surface drainage technology and bio-drainage with trees like Eucalyptus are some of the remedial measures to prevent water-logging.
- ✓ **Salinity Problem**: At present one third of the total cultivable land area of the world is affected by salts. Saline soils are characterized by the accumulation of soluble salts like sodium chloride, sodium sulphate, calcium chloride, magnesium chloride etc. in the soil profile. Their electrical conductivity is more than 4 ds/m. So dic soils have carbonates and bicarbonates of sodium, the pH usually exceed 8.0 and the exchangeable sodium percentage (ESP) is more than 15%.

1.15.3.1 Remedy

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

1.15.4 Case studies

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

1.16 ENERGY RESOURCES

1.16.1 Definition

Energy may be defined as, “any property, which can be converted into work.”
(or)
Energy is defined as, “the capacity to do work.”

- Forms of energy, some of immediately used to do work; others require some process of transformation
- Life is unthinkable without energy.
- All the developmental activities in the world are directly or indirectly dependent upon energy.
- Energy production and energy utilization are the indicators of a country’s progress.

1.16.2 Development of energy

- ✓ The first form of energy is the fire.
- ✓ The early man discovered fire and used it for cooking and heating purposes
- ✓ Wood is the main source of energy, which is later replaced by coal.
- ✓ Coal is now being replaced by the oil and gas.
- ✓ Now due to insufficient availability and price hike, people started of thinking and using several alternative sources of energy.

Wood→coal→oil→alternate energy (solar, wind, tidal energy)

1.16.3 Growing energy Needs

- Energy is essential to all human societies.

- All industrial process like, mining, transport, living, heating and cooling in buildings, all require energy.
- With the demands of growing population, the world is facing further energy deficit,
- Our life style is also changing from al simple way of life to luxurious life style. At present 95% of the commercial energy is available only from the fossil fuels like coal, oil and natural gas, and are not going to last for many years. It would be really ironic if fuel becomes more expensive than food.

1.16.4 Energy Distribution –World Scenario

- U.S.A and Canada 5% of the world's population- consume 25% of the available world's energy resources.
- It has been observed, that in U.S.A and Canada an average person consumes 300 GJ (Giga Joules; equal to 60 barrels of oil) per year.
- But in poor countries like Bhutan, Nepal and Ethiopia, an average person consumes less than 1 GJ per year.
- So a person in a developed country consumes almost as much energy in a single day as one person consumes in a whole year in a poor country.
- From the above scenario it is clear that our life style and standard of living are closely related to energy needs.

1. Renewable energy resources (or) non-conventional energy resources

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

Example: Wood, solar energy, wind energy, hydropower energy, etc.,

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.

2. Non- Renewable energy resources (or) Conventional energy resources

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

Example: Coal, petroleum, natural gas, and nuclear fuels.

- Even our renewable resources can become non-renewable if we exploit them to such extent their rate of consumption exceeds their rate of regeneration.
- Wood is renewable resources but not coal-why?
- Wood is renewable resources because we can get new wood by growing sapling into a tree within 15-20 years.
- But the formation of coal from trees has taken million of years and cannot be regenerated in our life time.

1.16.5 RENEWABLE ENERGY RESOURCES

- Renewable resources are parts of our natural environment and form our eco-system

1.16.1 SOLAR ENERGY

- The energy that we get directly from the sun is called solar energy.
- The nuclear fusion reactions occurring inside the sun release enormous amount of energy in the form of heat and light.
- The solar energy received by the near earth space is approximately1.4 kJ/s/m^2 known as solar constant.

1.16.2 Methods of Harvesting Solar Energy

1. Solar cells (or) photovoltaic cells (or) PV cells

- ✓ Solar cells consist of a p-type semiconductor (such as Si doped with B) and n-type semi-conductor (Si doped with P).
- ✓ They are in close contact with each other.
- ✓ When the solar rays fall on the top layer of p-type semi-conductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into n-type semi-conductor.
- ✓ There by potential difference between two layers is created, which causes flow of electrons (ie.,an electric current)

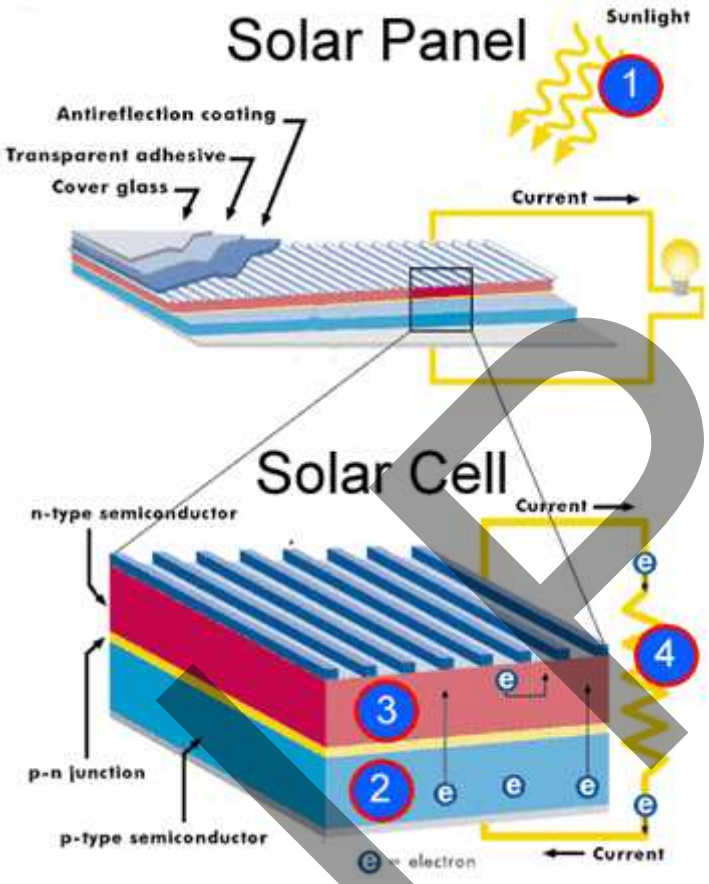


Fig.1.7 Solar cell

Uses

- Used in calculators, electronic watches. Street lights, water pumps to run radios and TVs.

Solar Battery

- ✓ When a large number of solar cells are connected in series it form a solar battery.
- ✓ Solar battery produce more electricity which is enough to run water pump, to run street-light, etc.,
- ✓ They are used in remote areas where conventional electricity supply is a problem.

2. Solar heat collectors

Solar heat collectors consists of natural materials like stones, bricks, (or) materials like glass, which can absorb heat during the day time and release it slowly at night.

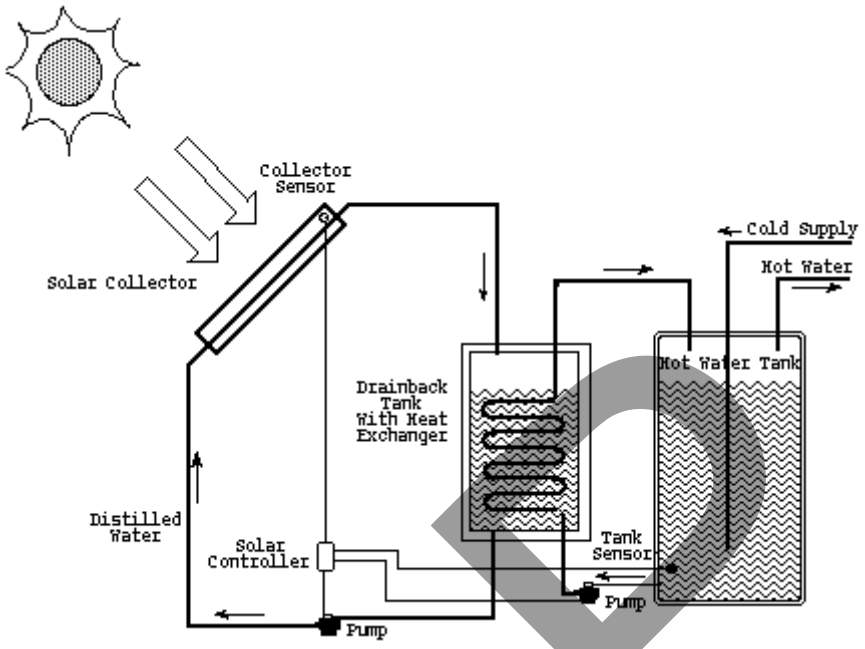


Fig. 1.8 Solar heat collector

Uses

Used in cold places, where houses are kept in hot condition using solar heat collectors.

3. Solar water heater

It consists of

- An insulated box inside of which is painted with black paint.
- Provided with a glass lid to receive and store solar heat.
- Inside the box it has black painted copper coil, through which cold water is allowed to flow in, which gets heated up and flows out into a storage tank.
- From the storage tank water is then supplied through pipes.

1.17 WIND ENERGY

Definition

Moving air is called wind.

- ✓ Energy recovered from the force of the wind is called wind energy.
- ✓ The energy possessed by wind is because of its high speed.
- ✓ The wind energy is harnessed by making use of wind mills.

1.17.1 Harvesting of wind energy

1. Wind Mills

The strike of blowing wind on the blades of the wind mill makes it rotating continuously.

The rotational motion of the blade drives a number of machines like water pump, flour mills and electric generators.

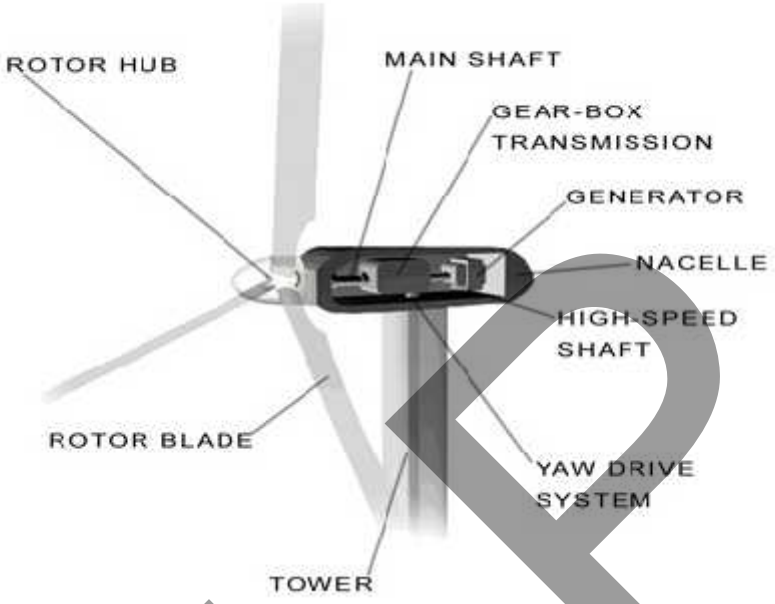


Fig. 1.9 Wind mill

2. Wind farms

When a large number of wind mills are installed and joined together in a definite pattern it forms a wind farm.

The wind farms produce a large amount of electricity.

Conditions

The minimum speed required for satisfactory working of a wind generator is 15 km/hr.

Advantages

It does not cause any air pollution

It is very cheap.

1.18 OCEAN ENERGY

It can be generated by following ways.

1. Tidal energy (or) Tidal power

Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.

- ✓ The “high tide” and “low tide” refer to the rise and fall of water in the oceans.
- ✓ The tidal energy can be harnessed by constructing a tidal barrage.
- ✓ During high tide, the sea-water is allowed to flow into the reservoir of the barrage and rotates the turbine, which intern produces electricity by rotating the generators.
- ✓ During low tide, when the sea level is low, the sea water stored in the barrage reservoir is allowed to flow into the sea and again rotates the turbine.

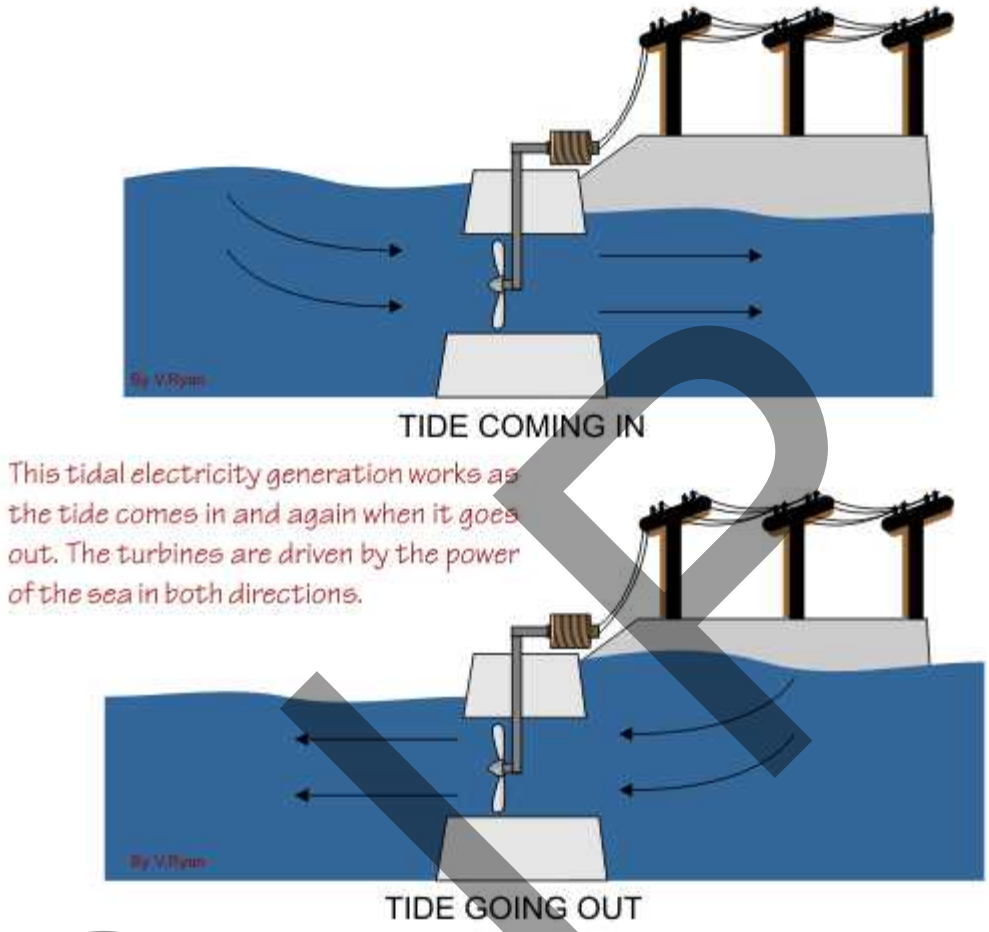


Fig. 1.10 Tidal energy

2. Ocean thermal energy (OTE)

There is often large temperature difference between the surface level and deeper level of the tropical oceans.

- ✓ This temperature difference can be utilized to generate electricity.
- ✓ The energy available due to the difference in temperature of water is called ocean thermal energy.

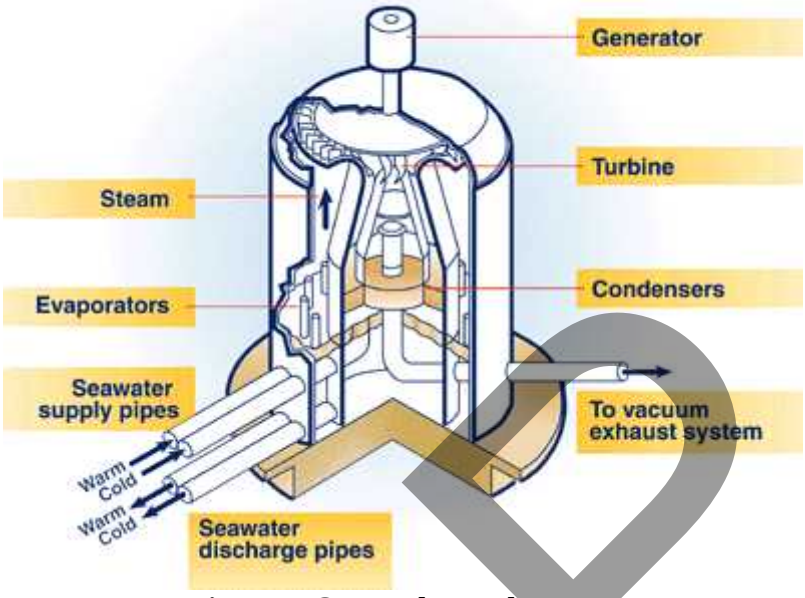


Fig. 1.11 Ocean thermal energy

Condition

The temperature difference should be of 20^0C or more is required between surface water and deeper water.

Process

- ✓ The warm surface water of ocean is used to boil a low boiling liquid like ammonia.
- ✓ The high vapour pressure of the liquid, formed by boiling is then to turn the turbine of the generator and generates electricity.
- ✓ The cold water from the deeper ocean is pumped to cool and condense the vapour into liquid.

3. Geo-thermal Energy

1. Temperature of the earth increases at a rate of 20-75^0C per km, when we move down the earth surface.

2. High temperature and high pressure steam fields exists below the earth's surface in many places.

3. The energy harnessed from the high temperature present inside the earth is called geothermal energy.

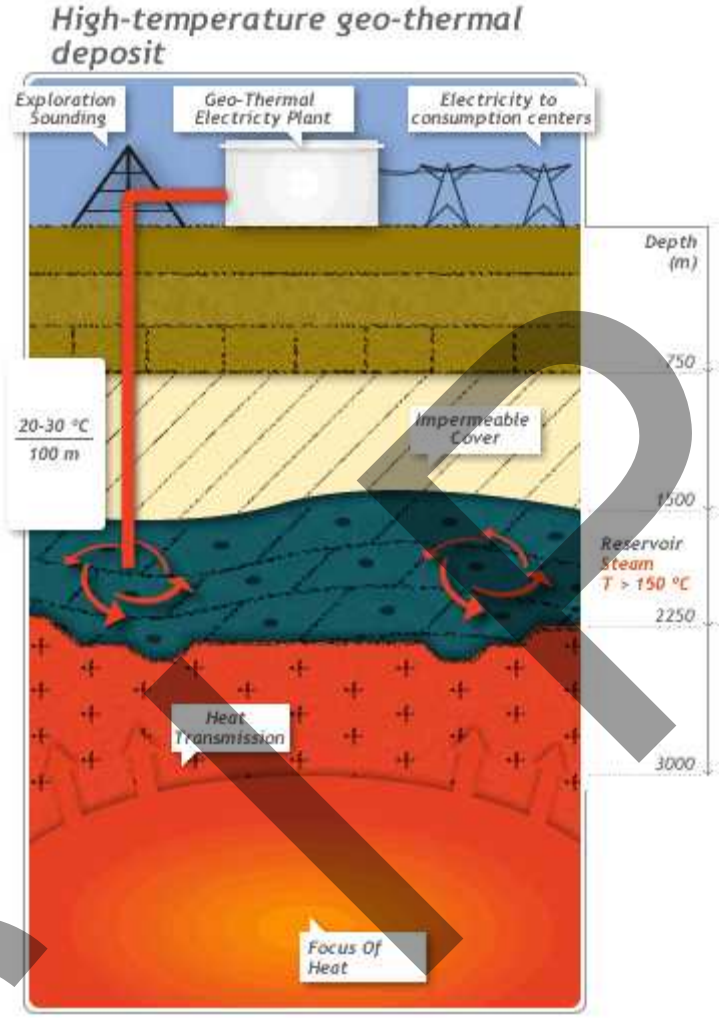


Fig. 1.12 Geothermal energy

1. Natural geysers

In some places, the hot water (or) steam comes out of the ground through cracks naturally in the form

2. Artificial geysers

In some places, we can artificially drill a hole up to the hot region and by sending a pipe in it, we can make the hot water or steam to rush out through the pipe with very high pressure.

Thus, the hot water (or) steam coming out from the natural (or) artificial geysers is allowed to rotate the turbine of a generator to produce electricity.

1.19 BIOMASS ENERGY

Biomass is the organic matter, produced by plants or animals, used as sources of energy.

Most of the biomass is burned directly for heating, cooling and industrial purposes.

Eg: Wood, crop residues, seeds, cattle dung, sewage, agricultural wastes.

1. Biogas

- ✓ Mixture of methane, carbondioxide, hydrogen sulphide, ete.
- ✓ It contains about 65% of methane gas as a major constituent
- ✓ Biogas is obtained by the **anaerobic fermentation** of animal dung or plant wastes in the presence of water.

2. Bio fuels

Biofuels are the fuels, obtained by the **fermentation** of biomass.

Eg: Ethanol, Methanol

(a)Ethanol

Ethanol can be easily produced from the **sugarcane**. Its calorific value is less when compared to petrol, and produces much less heat than petrol.

(b)Methanol

Methanol can be easily obtained from **ethanol or sugar**-containing plants. Its calorific value is also too low when compared to gasoline and diesel.

(c)Gasohol

Gasohol is a mixture of **ethanol+gasoline**.

- ✓ In India trial is being carried out to use Gasohol in cars and buses.
- ✓ Gasohol is common fuel in Brazil and Zimbabwe for running cars and buses.
- ✓ Methanol is very useful since it burns at a lower temperature than gasoline or diesel. Due to its high calorific value, hydrogen can serve as an excellent fuel.
- ✓ Moreover it is non-polluting and can be easily produced.
- ✓ Presently H_2 is used in the form of liquid hydrogen as a fuel in spaceships.

3. Hydrogen Fuel

Hydrogen can be produced by **thermal dissociation** or **photolysis** or **electrolysis** of water.

It possesses high calorific value.

It is non polluting, because the combustion product is water.

$2H_2+O_2$---->$2H_2O$+150KJ

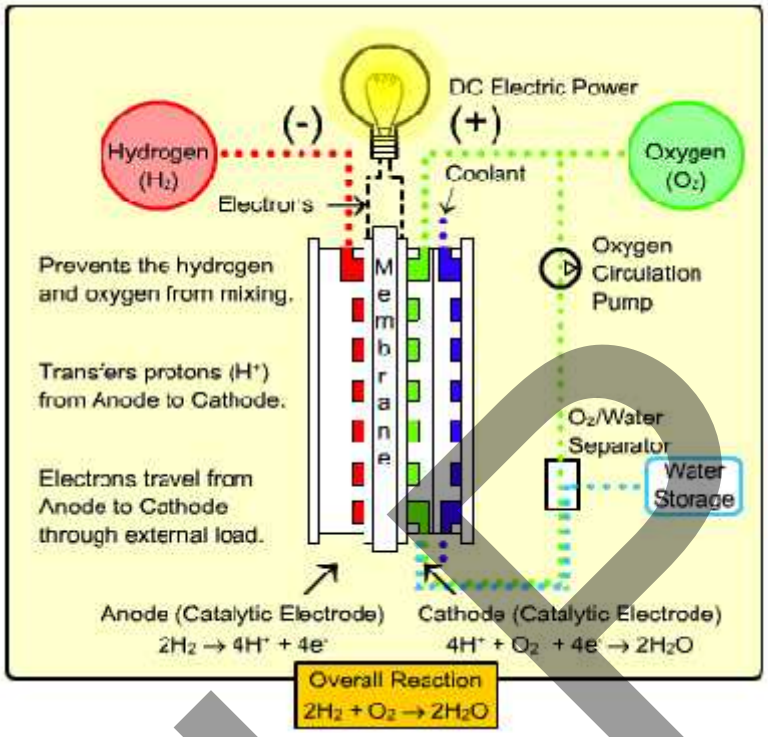


Fig. 1.13 Hydrogen fuel cell

Disadvantages of hydrogen fuel

1. Hydrogen is highly inflammable and explosive in nature
2. Safe handling is required
3. It is difficult to store and transport.

1.20 NON-RENEABLE ENERGY SOURCES

1.20.1 Coal

Coal is a solid fossil fuel formed in several stages as buried remains of land plants that lived 300-400 million years ago were subjected to intense heat and pressure over millions of years.

Various stages of coal

Wood ⟶ Peat ⟶ Lignite ⟶ Bituminous coal ⟶ Anthracite

1. The carbon content of Anthracite is 90% and its calorific value is 8700 k.cal.
2. The carbon content of bituminous, lignite and peat are 80, 70 and 60% respectively
3. India has about 5% of world's coal. Indian coal is not good because of poor heat capacity.

Disadvantages

1. When coal is burnt it produces CO_2 causes global warming
2. Since coal contains impurities like S and N, it produces toxic gases during burning.

1.20.2 Petroleum

Petroleum or crude oil = hydrocarbons +small amount S, O, N.

Occurrence

The fossil fuel formed by the decomposition of dead animals and plants that were buried under lake and ocean at high temperature and pressure for million years

Fractional distillation

Hydrocarbons are separated by fractioning the crude oil.

Petroleum World Scenario

1. 67% oil reserves.
2. 25% of the oil reserves in Saudi Arabia.

At the present rate of usage, the world's crude oil reserves are expected to get exhausted in just 40 years.

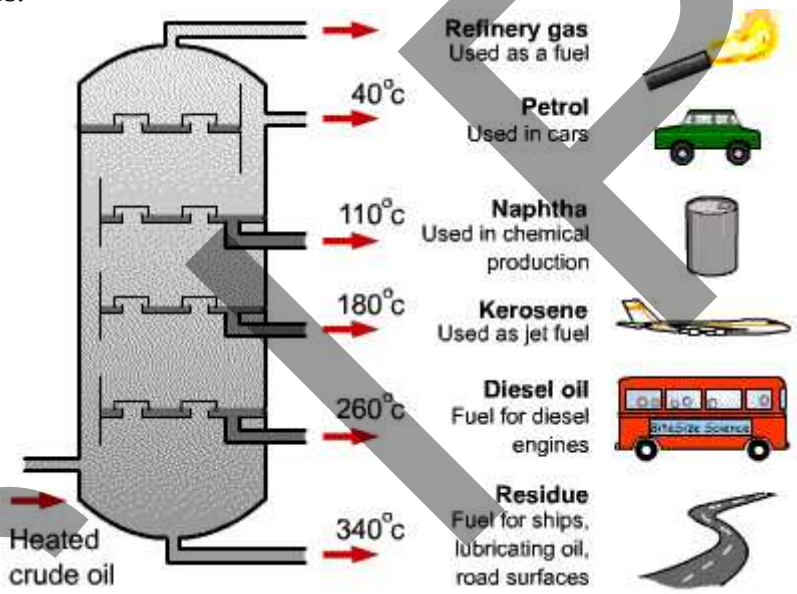


Fig. 1.14 Fractionating column

1.20.3 LPG (Liquefied Petroleum Gas)

1. The petroleum gas, **converted into liquid** under high pressure as LPG
2. LPG is colorless and odorless gas.
3. During bottling some **mercaptans** is added, to detect leakage of LPG from the cylinder.

1.20.4 Natural Gas

1. Mixture of **50-90% methane** and small amount of other **hydrocarbons.**
2. Its calorific value ranges from 12,000-14,000 k-cal/$m^{3.}$

(i)Dry gas

If the natural gas contains lower hydrocarbons like methane and ethane, it is called dry gas.

(ii)Wet gas

If the natural gas contains higher hydrocarbons like propane, butane along with methane it is called wet gas.

Occurrence

Formed by the decomposition of dead animals and plants, those were buried under lake and ocean, at high temperature and pressure for millions of years.

1.21 NUCLEAR ENERGY

Dr. H. Bhabha –father. India has 10 nuclear reactors, which produce 2% of India's electricity.

1.21.1 Nuclear Fission

Heavier nucleus is split into lighter nuclei, on bombardment by fast moving neutrons, and a large amount of energy is released.

Eg:

Fission of U^{235}

When U^{235} nucleus is hit by a thermal neutron, it undergoes the following reaction with the release of 3 neutrons.

$$U_{92}^{235} + n^{1}_{0} \rightarrow Ba^{139}_{56} + Kr^{94}_{36} + 3n^{1}_{0} + \text{Energy}$$

- ✓ Each of the above 3 neutrons strikes another U^{235} nucleus causing (3x3) 9 subsequent reactions.
- ✓ These 9 reactions further give rise to (3x9) 27 reactions.
- ✓ This process of propagation of the reaction by multiplication in threes at each fission is called **chain reaction.**

Fission reaction of U^{235} is given below.

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

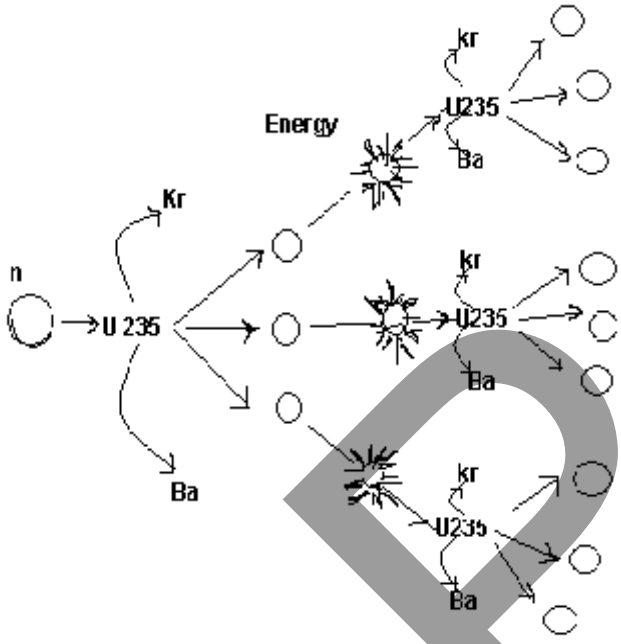


Fig. 1.15 Nuclear fission-chain reaction

1.21.2 Nuclear fusion:

Lighter nucleuses are combined together at extremely high temperatures to form heavier nucleus and a large amount of energy is released.

Eg:

Fusion of H^2_1 .Two hydrogen-2 (Deuterium) atoms may fuse to form helium at 1 billion^{0}C with the release of large amount of energy

$$_1H^2 + _1H^2 \rightarrow {}_3He^2 + {}_0n^1 + \text{energy}$$

Nuclear power of India

- ✓ Tarapur(Maharashtra),
- ✓ Ranapratap Sagar (Rajasthan)
- ✓ Kalpakkam (Tamilnadu)
- ✓ Narora (U.P).

1.22 USES OF ALTERNATE (RENEWABLE) ENERGY SOURCES

Why Alternate (Renewable) Energy Sources are required?

The importance of solar energy can be emphasized particularly in view of the fact that fossil fuels and other conventional sources are not free from environmental implications.

- **least pollution, safety and security** snags and are **universally available** have the best enhance of large scale utilization in future
- **Hydro-electric power** generation is expected to upset the ecological balance existing on earth

- Besides space heating, hydel power plants critically pollute the aquatic and terrestrial biota.
- **Radioactive pollutants** released from nuclear power plants are chronically hazardous.
- The commissioning of boiling water power reactors (BWRS) have resulted in the critical accumulation of large number of long lived radionuclides in water\
- The **dangerous radiowaste** cannot be buried in land without the risk of polluting soil and underground water.
- Nor the waste can be dumped into the rivers without poisoning aquatic life and human beings as well
- The burning of **coal, oil, wood, dung cakes and petroleum** products has well debated environmental problems. The smoke so produced causes respiratory and digestive problems leading to lungs, stomach and eye diseases.
- The **disposal of fly ash** requires large ash ponds and may pose a severe problem considering the limited availability of land. Thus the non-conventional sources of energy are needed.

Objectives

- ✓ To provide more energy to meet the requirements of increasing population.
- ✓ To reduce environmental pollution
- ✓ To reduce safety and security risks associated with the use of nuclear energy.

1.23 LAND RESOURCES

- ➢ It provides food, fibre, wood, medicine and other biological materials
- ➢ Soil is the mixture of inorganic materials (rocks and minerals) and organic materials (dead animals and plants).
- ➢ Top soil is classified as renewable resources.

Uses of land resources

- ❖ Land provide, food, wood, minerals, etc., for us
- ❖ Land nurtures the plants and animals that provide our food and shelter.
- ❖ Land is used as watershed or reservoir
- ❖ Land acts as a dust bin for most of the wastes, created by the modern society.
- ❖ Land is used for construction of buildings, industries.

1.23.1 LAND DEGRADATION

Process of degradation of soil or loss of fertility of the soil.

Harmful effects of land degradation

- The soil texture and soil structure are deteriorated
- Loss of soil fertility, due to loss of invaluable nutrients
- Increase in water logging, salinity, and alkalinity and acidity problems.
- Loss of economic social and biodiversity.

Causes of land degradation

1. Population

Land resources degraded by over population &over exploitation.

2. Urbanization

Urbanization leads to deforestation, reduces the land

3. Fertilizers and pesticides

Increased applications of fertilizers and pesticides leads to pollution of land and water and soil degradation.

4. Damage of top soil

Increase in food production generally leads to damage to top soil through nutrient depletion.

5. Water-logging

Soil erosion, salination and contamination of the soil with industrial wastes all cause land degradation.

6. Soil erosion

Soil erosion is the process of removal of superficial layer of the soil from one place to another.

Harmful effects of soil erosion

1) Soil fertility is lost because of loss of top soil layer.
2) Loss of its ability to hold water and sediment.
3) Sediment runoff can pollute water and kill aquatic life.

Types of soil erosion

(i)Normal erosion

Gradual removal of top soil by the **natural process.**

The rate of erosion is slower.

(ii)Accelerated erosion

Caused by man-made activities

The rate of erosion is much faster than the rate of formation of soil.

Man induced landslides

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

Causes of soil erosion

(i)Water

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

(ii)Wind

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

(iii)Biotic agents

- Overgrazing, mining and deforestation are the major biotic agents, cause soil erosion.
- Deforestation without reforestation, overgrazing by cattle, surface mining without land reclamation, irrigation techniques that lead to salt build- up, water logged soil, make the top soil vulnerable to erosion.
- .
- 35% of world soil erosion is due to overgrazing.
- 30% of world soil erosion is due to deforestation.

(iv) Landslides

-Causes soil erosion.

(v)Construction

-Construction of dams, buildings, roads removes the protective vegetal cover and leads to soil erosion.

Control of soil erosion (or) soil conservation practices

.

1. Conservational till farming (or) no-till-farming

- In tradition method, the land is ploughed and soil is broken up and leveled to make a planting surface.
- This disturbs the soil and makes it susceptible to erosion
- However, no-till-farming causes minimum disturbance to the top soil
- Here the tilling machines make slits in the unploughed soil and inject seeds, fertilizers and water in the slit. So the seed germinates and the crop grows.

2. Contour farming

- It involves **planting crops** in rows across the contour of **gently sloped land.**
- Each row acts as a small dam to hold soil and to slow water runoff.

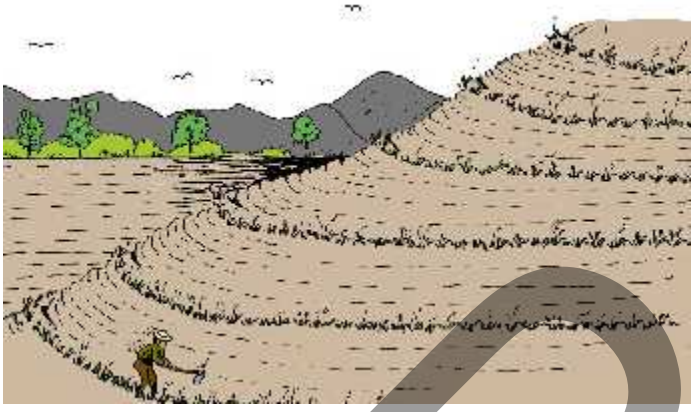


Fig. 1.16 Contour farming

3. Terracing

- It involves conversion of **steep slopes into broad terraces**, which run across the contour.
- This retains water for crops and reduces soil erosion by controlling runoff.

Fig. 1.17 Terracing

4. Alley cropping (or) Agro forestry

- It involves **planting crops in strips** or **alleys between rows** of **trees of shrubs** that can provide fruits and fuel wood.
- Even when the crop is harvested, the soil will not be eroded because trees and shrubs still remain on the soil and hold the soil particles.

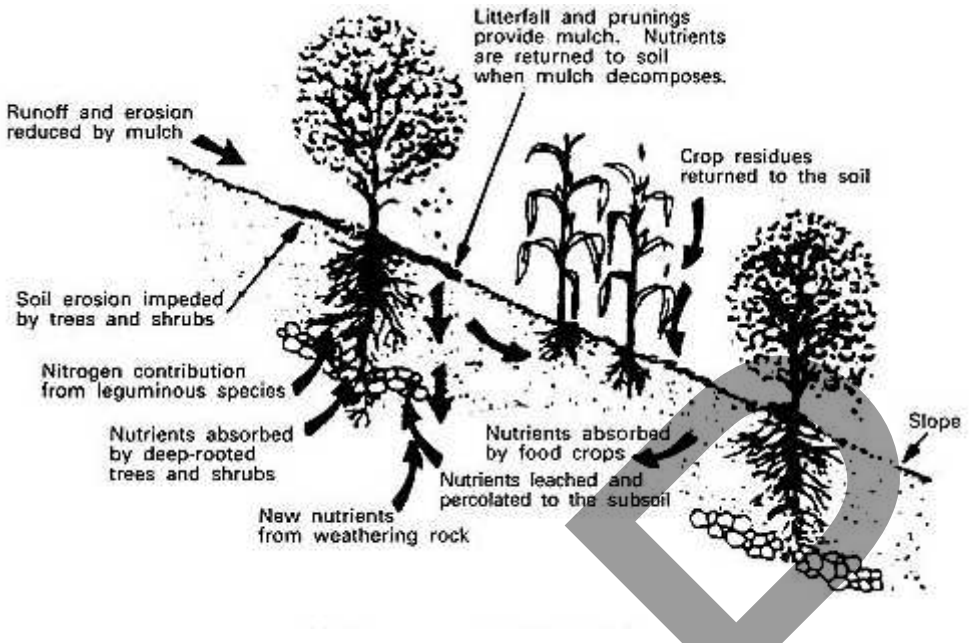


Fig. 1.18 Alley cropping

5. Wind breaks or shelter belts

- The **trees** are planted in long rows along the boundary of cultivated lands, which **block the wind** and **reduce soil erosion**.
- Wind breaks help in retaining soil moisture, supply of some wood for fuel and provide habitats for birds.

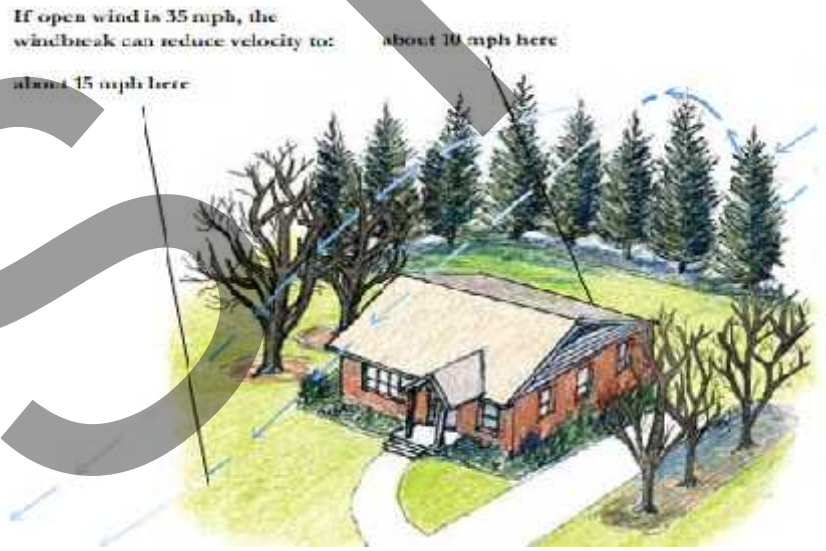


Fig. 1.19 Wind breaks

1.24 DESERTIFICATION

- Progressive destruction or degradation of arid or semiarid lands to desert.
- Desertification leads to the conversion of range lands or irrigated croplands to desert.
- Desertification is characterized by devegetation, depletion of ground water, salination and soil erosion.

Harmful effect of desertification

- Around 80% of the **productive land** in the arid and semi-regions are **converted into desert.**
- Around 600 million people are threatened by desertification.

Causes of Desertification

(a)Deforestation

- The process of denuding and degrading a forest land initiates a desert.
- If there is no vegetation to hold back the rain water, soil cannot soak and groundwater level do not increases.
- This also increases, soil erosion, loss of fertility.

(b)Over grazing

- The increase in cattle population heavily grazes the grass land or forests and as a result denudes the land area.
- The denuded land becomes dry, loose and more prone to soil erosion and leads to desert.

(c)Water management

Over utilization of ground water, particularly in the coastal regions, is resulting in saline water intrusion into aquifers which is unfit for irrigation.

(d)Mining and quarrying

These activities are also responsible for loss of vegetal cover and denudation of extensive land area leading to desertification.

(e)Climate change

Formation of deserts may also take place due to climate change, ie., failure of monsoon, frequent droughts.

(f)Pollution

Excessive use of fertilizers and pesticides and disposal of toxic water into the land also leads to desertification.

1.25 LANDSLIDES

Landslides are the downward and outward movement of a slope composed of earth materials such as rock, soil, artificial fills. Other names of landslides are **rockslide, debris slide, slump**, **earth flow and soil creep.**

Man induced landslides

During **construction of roads and mining activities** huge portions of **fragile mountainous areas are cut and thrown into adjacent areas and streams**. These land masses weaken the already fragile mountain slopes and lead to landslides called man induced landslides.

Causes of landslides

1. Removal of vegetation

In the sloppy area creates soil erosion, which leads to landslides.

2. Underground mining

Cause subsidence of the ground.

3. Transport

Due to the movement of buses and trains in the unstable sloppy region cause landslides.

4. Addition of weight

Addition of extra weight (or) construction on the slope areas leads to landslide.

5. Ground water level

Over exploitation of ground water also leads to landslides.

Harmful effect of landslides

- Landslide increases the turbidity of nearby streams, thereby reducing their productivity.
- Destruction of communication links.
- Loss of habitat and biodiversity.
- Loss of infrastructure and economic loss.

1.26 CONSERVATION OF NATURAL RESOURCES - ROLE OF AN INDIVIDUAL

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

I. Conserve Water

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

II. Conserve energy

- Turn off lights, fans and other appliances when not in use.
- Obtain as much heat as possible from natural sources. Dry the clothes in sun instead of drier if it is a sunny day.
- Use solar cooker for cooking your food on sunny days which will be more nutritious and will cut down on your LPG expenses.

- Grow deciduous trees and climbers at proper places outside your home to cut off intense heat of summers and get a cool breeze and shade. This will cut off your electricity charges on coolers and air-conditioners.
- Try riding bicycle or just walk down small distances instead of using your car or scooter.

III. Protect the soil

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

IV. Promote Sustainable Agriculture

- Do not waste food. Take as much as you can eat
- Reduce the use of pesticides.
- Fertilize your crop primarily with organic fertilizers.
- Eat local and seasonal vegetables. This saves lot of energy on transport, storage and preservation.
- Control pests by a combination of cultivation and biological control methods.

1.27 EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLE

- There is a big divide in the world as North and South, the more developed countries (MDC'S) and less developed countries (LDC'S), the haves and the have nots.
- The MDC's have only 22% of world's population, but they use 88% of its natural resources, 73% of its energy and command 85% of its income.
- As the rich nations continue to grow, they will reach a limit.
- If they have a growth rat of 10% every year, they will show 1024 times increase in the next 70 years.
- Will this much of growth be sustainable? The answer is 'No' because many of our earth's resources are limited and even the renewable resources will become unsustainable if their use exceeds their regeneration.
- Thus, the solution to this problem is to have more equitable distribution of resources and wealth.

- We cannot expect the poor countries to stop growth in order to check pollution because development brings employment and the main problem of these countries is to tackle poverty.
- The poor in the LDC'S are at least able to sustain their life.
- Unless they are provided with such basic resources, we cannot think of rooting out the problems related to dirty, unhygienic, polluted, disease infested settlements of these people-which contribute to unsustainability.
- Thus, the two basic causes of unsustainability are over population in poor countries who have under consumption of resources and over consumption of resources by the rich countries, which generate wastes.
- In order to achieve sustainable life styles it is desirable to achieve a more balanced and equitable distribution of global resources and income to meet everyone's basic needs.
- The rich countries will have to lower down their consumption levels while the bare minimum needs of the poor have to be fulfilled by providing them resources.
- A fairer sharing of resources will narrow down the gap between the rich and the poor and will lead to sustainable development for all and not just for a privileged group.

Unit - IV

CHAPTER6 SOCIAL ISSUES AND THE ENVIRONMENT

4.1 Objectives

Developing and modernizing the technologies without losing our sound traditional values and practices is essential.

4.1.1 Sustainable development

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

4.1.2 True sustainable development

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

4.1.3 Dimensions of sustainable development

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

4.1.4 Aspects of sustainable development

- Inter-generational equity
- Intra-generational equity.

4.1.5 Approaches for sustainable development

- Developing appropriate technology - locally adaptable, eco-friendly, resource efficient and culturally suitable.
- Reduce, reuse, recycle [3R] approach – reduces waste generation and pollution
- Providing environmental education and awareness – changing attitude of the people

- Consumption of renewable resources – attain sustainability
- Conservation of non renewable resources – conserved by recycling and reusing
- Population control.

4.1.6 Urban problems related to energy

- Energy demanding activities
- Solution for urban energy problem.

4.2 WATER CONSERVATION

The process of saving water for future utilization.

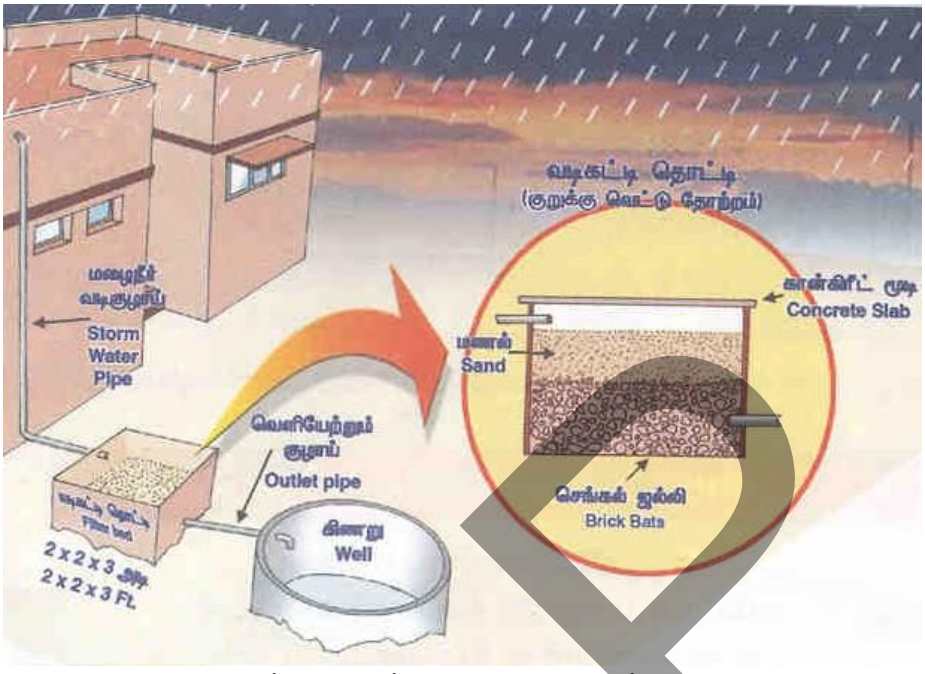


Fig.4.1 Rain Water Harvesting

4.2.1 Need for water conservation

- ✓ Changes in environmental factors
- ✓ Better lifestyles
- ✓ Increase in population
- ✓ Deforestation
- ✓ Over exploitation of ground water
- ✓ Agricultural and industrial activities.

4.2.2 Strategies of water conservation

- ➢ Reducing evaporation losses
- ➢ Reducing irrigation losses
- ➢ Re use of water
- ➢ Preventing of wastage of water
- ➢ Decreasing run-off losses
- ➢ Avoid discharge of sewage.

4.2.3 Methods of water conservation

Rain water harvesting- A technique of capturing and storing of rain water for further utilization.

4.2.4 Objectives of rain water harvesting

- ❖ Increasing demands
- ❖ Recharging the ground water
- ❖ Reducing the ground water
- ❖ Increase in hydro static pressure.

4.3 WATER SHED MANAGEMENT – The management of rainfall and resultant run-off.

4.3.1 Objectives

- To minimize of risk of floods
- For improving the economy
- For developmental activities
- To generate huge employment opportunities
- To promote forestry
- To protect soil from erosion.

4.3.2 Factors affecting watershed

- Unplanned land use
- Deforestation
- Droughty climates.

4.4 RESETTLEMENT AND REHABILITATION OF PEOPLE

4.4.1 Causes

- Due to Developmental activities
- Due to Disaster
- Due to conservation initiatives.

4.4.2 Rehabilitation issues

- ✓ Displacement of tribal's increases poverty
- ✓ Breakup of families
- ✓ Communal ownership of property
- ✓ Vanishing social and cultural activities
- ✓ Loss of identity between the people.

4.4.3 Case Studies

SardarSarovar Dam, the Theri dam Project, Pong Dam.

4.4.4 Environmental ethics

Refers to the issues, principles and guidelines relating to human interactions with their environment.

4.4.5 Environmental problems

- ❖ Deforestation
- ❖ Population growth
- ❖ Pollution due to effluent and smoke
- ❖ Water scarcity
- ❖ Land degradation.

4.4.6 Solutions

- Reducing the energy sources
- Recycle and reuse of waste products
- Soil degradation
- Sustainable development
- Protection of Bio – diversity
- Reducing the population.

4.5 CLIMATE

The average weather of an area.

4.5.1 Causes of climate change

- Presence of green house gases
- Depletion of ozone gases.

4.5.2 Effect of climate change

- Migration of animals
- Upsetting the hydrological cycles results in floods and droughts
- Changes in global pattern of winds.

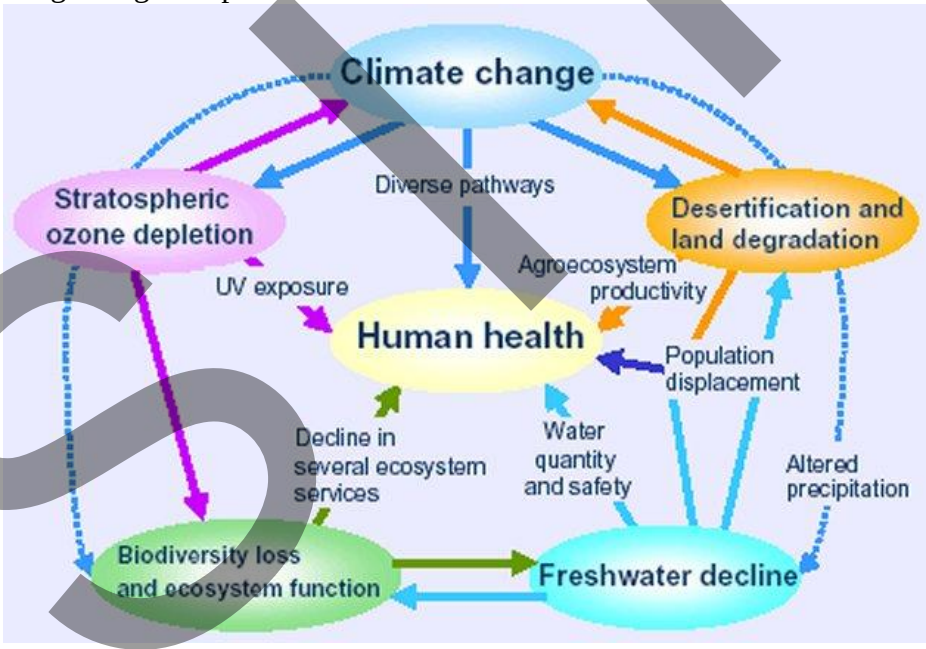


Fig.4.2 Climate Changes

4.5.3 Green house effect

The progressive warming of earth surface due to blanketing effect of man made CO_2 in the atmosphere.

Green house gases- causing global warming
CO_2, CH_4, N_2O, CFCs.

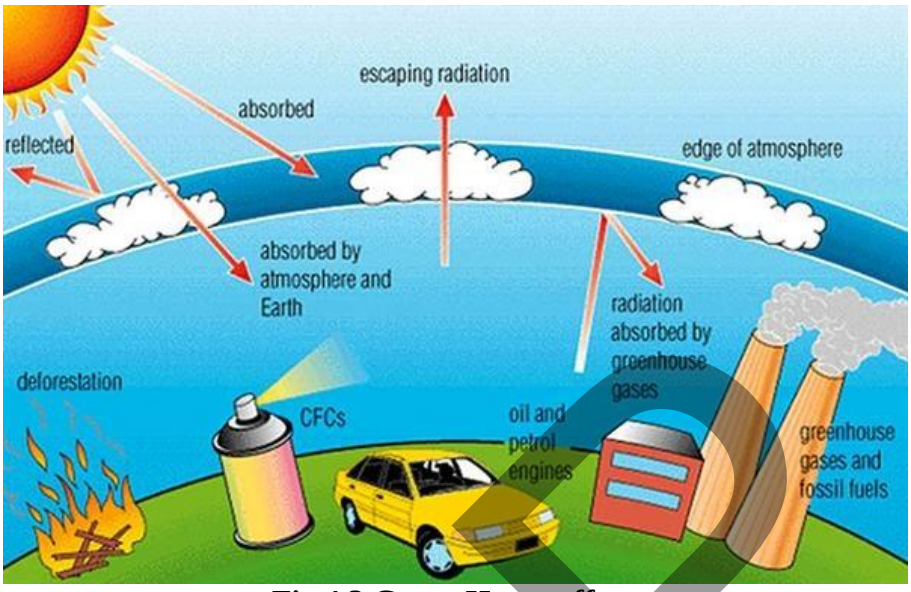


Fig.4.3 Green House effect

4.5.4 Effect on global warming

- Sea level
- Agriculture and forestry
- Water resources
- Terrestrial ecosystems
- Human health.

4.5.5. Measures

- Reducing CO_2 emission
- Utilizing renewable resources
- Plant more trees
- Adopt sustainable agriculture.

4.6 ACID RAIN

The precipitation of CO_2, SO_2, and NO_2 gases as pollutants in water.

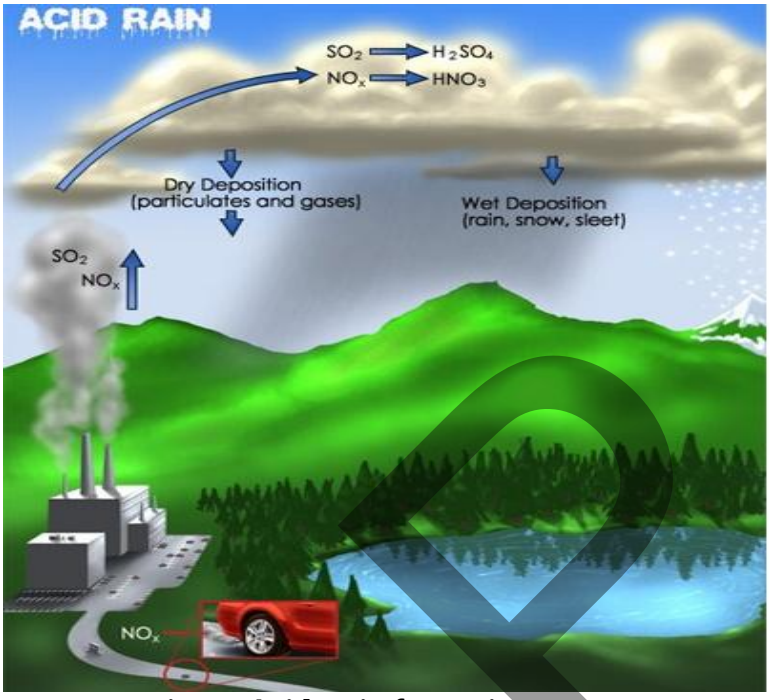


Fig.4.4 Acid Rain formation

4.6.1 Effects of acid rain

1. Human beings

- Destroy life – nervous, respiratory and digestive system
- Causes premature death from heart and lung disorders.

2. On Buildings

Corrosion - TajMahal, houses, statues, bridges, metals.

3. On terrestrial and Lake Ecosystem

- ➢ Reduces rate of photosynthesis, growth of crops, Fish population.
- ➢ And bio mass production.

4.6.2 Control measures

- ✓ Clean combustion technologies
- ✓ Using pollution control equipments
- ✓ Replacement of coal by natural gas
- ✓ Liming of lakes and soils.

4.7 OZONE LAYER DEPLETION

Ozone is formed in the stratosphere by photo - chemical reaction.

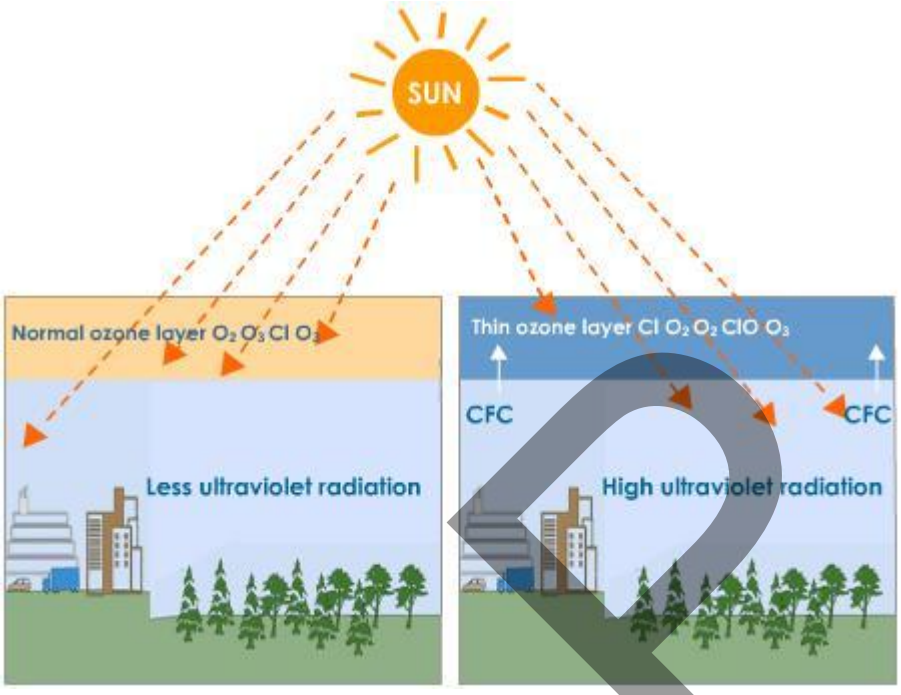


Fig.4.5 Depletion of Ozone layer

4.7.1 Ozone depleting chemicals

Chloro Fluro carbon, Hydro chloro fluoro carbon, Bromo fluoroCarbon.

4.7.2 Effects

- On human health – Skin cancer, cataracts, allergies etc.
- On aquatic systems- phyto plankton, fish
- On materials- paints, plastics
- On climate – increasing the average temperature of the earth surface.

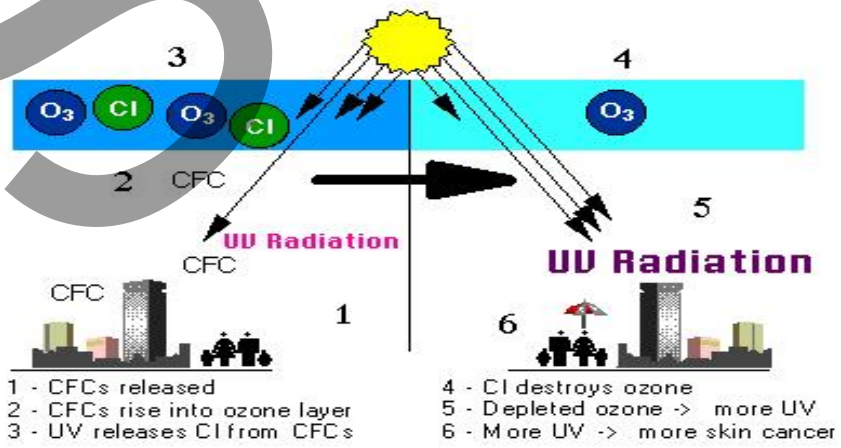


Fig.4.6Causes and Effects of O_3 depletion

4.7.3 Control Measures

- Replacing CFCs

- Use of methyl bromide – crop fumigant.

4.8 NUCLEAR ACCIDENTS AND HOLOCAUST

The release of large amounts of nuclear energy and radioactive products into the atmosphere.

Nuclear energy was researched by man as an alternate source of energy compared to fossil fuels. Although this did happen along with the benefits came its downfall. In the short history of nuclear energy there has been a number of accidents that have surpassed any natural calamity. A single nuclear accident causes loss of life, long term illness and destruction of property on a large scale.

Examples

1.THE CARELESS SITING OF INDUSTRIES-Bhopal gas tragedy

The careless siting of industries and relatively poor regulatory controls leads to ill health in the.The Bhopal gas tragedy on December 2nd 1984, where Union Carbide's Plant leaked 43 tons of Methyl Isocynate and other substances, used in the manufacture of pesticides is one of the worst industrial accidents in the recent past. Of the 5,20,000 people who were exposed to the gas - 8,000 died during the first week and another 8,000 later. The impact of the survivors is visible even today.

Fig.4.7 Bhopal gas tragedy plant

2. CHERNOBYL REACTOR INCIDENT

On April 25, 1986, Russian engineers and scientists begin preliminary tests on Chernobyl power plant's 4th reactor. In order to control the experiment, the automatic control system was shut down. After some work, stability was reached at very low power outputs. Unfortunately, manual control of the water pressure wasn't maintained. The reactor began to create excess heat. Without the automatic control, the control rods couldn't be reinserted in time; a deadly chain reaction had begun. Within a matter of 3-4 seconds, the reactor went from 5% output to 100 times its normal level. The water in the reactor flash-

boiled, creating an explosion that leveled thousands of tons of concrete and steel, including the housing for the reactor. The steam carried almost 70% of the nuclear material out of the reactor into the surrounding environment. Several thousand volunteers died on the scene, and it is estimated that 7,000 to 10,000 volunteers died in total, considering short and long-term effects. Thousands of miles from the scene, the birth defect rate became double the world average. It is also estimated that 150,000 were put at risk for thyroid cancer, and over 800,000 children were put at risk of contracting leukemia. 2 million acres of land (1/5 of the usable farmland in the Ukraine) was, and still is, completely unusable. It remains difficult to determine the scope of the disaster; radiation resulting from the event was detected all over the globe. It is estimated that it may cost up to $400 billion and will take up to 200 years to correct the damage done to the area, and to compensate those affected by the meltdown.

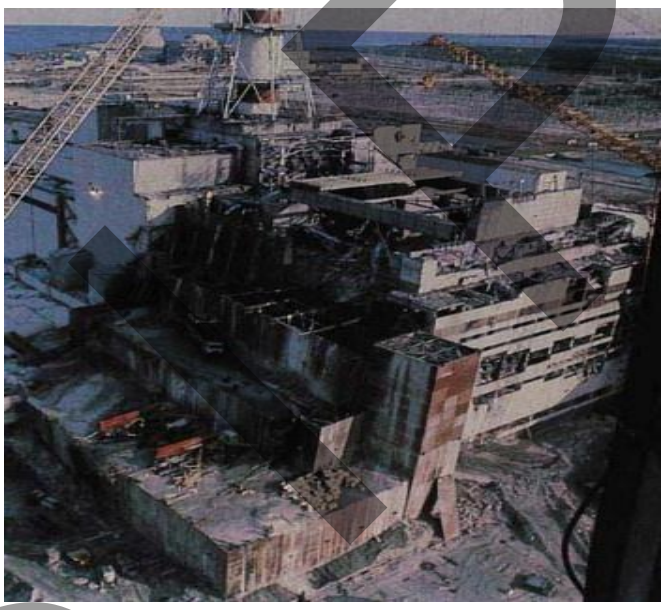


Fig.4.8 Chernobyl Reactor

4.8.1 Effects

- Nuclear winter
- Ignition of all combustible material

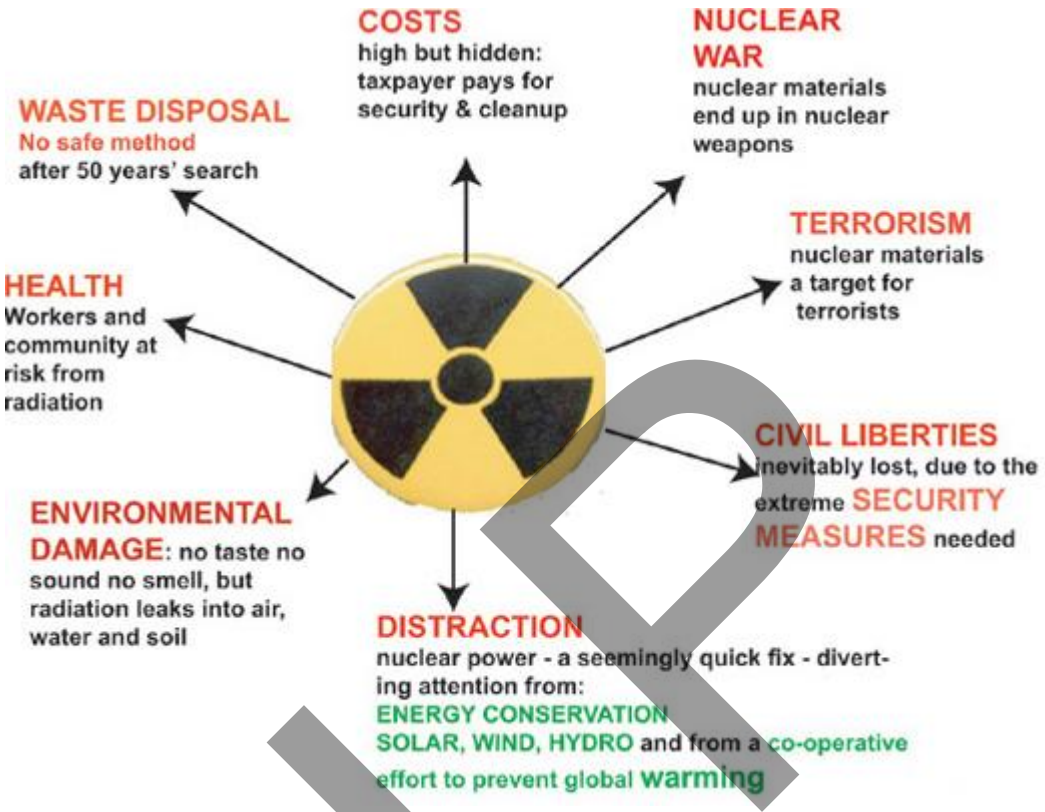


Fig.4.9 Effects of Nuclear Hazards

4.8.2 Control Measures

- Suitable precautions to avoid accident
- Constant monitoring of the radiation level
- Checks and control measures done by Atomic Energy Regulatory Board.

4.9 WASTE LAND RECLAMATION

Waste land: - The land which is not in use – unproductive, unfit for cultivation another economic uses.

4.9.1Types of waste land

1. Uncultivable waste land

– Barren rocky areas, hilly slopes, sandy deserts.

2. Cultivable waste land

- degraded forest lands, gullied lands. Marsh lands, saline land etc.

4.9.2 Causes for waste land formation

- Soil Erosion, Deforestation, Water logging, Salinity.
- Excessive use of pesticides.
- Construction of dams.
- Over-exploitation of natural resources.
- Sewage and industrial wastes.

- ❖ Mining
- ❖ Growing demands for fuel, fodder wood and food causes degradation and loss of soil productivity.

4.9.3 Objectives of waste land reclamation

- To improve the physical structure and quality of the soil
- To prevent soil erosion
- To avoid over – exploitation of natural resources
- To conserve the biological resources.

4.9.4 Methods of waste land reclamation

- ✓ Drainage
- ✓ Leaching
- ✓ Irrigation practices
- ✓ Green manures and bio fertilizers
- ✓ Application of Gypsum
- ✓ Afforestation programmes
- ✓ Social forestry programmes.

4.9.5 Consumerisation of Waste products

- Consumerisation – Consumption of resources.
- Traditionally favorable rights of sellers
- Right to introduce product, price, Incentives
- Traditionally buyer rights
- Right to buy, right to expect the product to perform as claimed

4.9.6 Important information to be known by buyers

- ➢ About ingredients,
- ➢ Manufacturing dates,
- ➢ Expiry date, etc.

4.9.7 Objectives of Consumerisation

- Improves rights and power of the buyers
- Making the manufacturer liable
- Reuse and recycle the product
- Reclaiming useful parts
- Reusable packing materials
- Health and happiness.

4.10 SOURCES OF WASTES

Glass, papers, garbage's, food waste, automobile waste, dead animals etc.

4.10.1 E – Waste

Computers, printers, mobile phones, Xerox machines, calculators etc.

4.10.2 Effects of wastes

- Dangerous to human life
- Degrade soil
- Cadmium in chips, Cathode ray tube, PVC causes cancer and other respiratory problems.
- Non biodegradable plastics reduce toxic gases.

4.10.3 Factors affecting consumerisation and generation of wastes

- ✓ People over – Population
- ✓ Consumption over – Population.

4.11 ENVIRONMENTAL LEGISLATION AND LAWS – IMPORTANT PROTECTION ACTS

- ❖ **Water Act 1974, 1978**-An Act to provide for the levy and collection of water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974.
- ❖ **Water amendment Act 1987**-As a result, some of thebasic principles of water law applicable today in India derive from irrigation acts. The early Northern India Canaland Drainage Act, 1873 sought, for instance, to regulate irrigation, navigation and drainage in Northern India.
- o One of the long-term implications of this act was the introduction of the right of the Government to ‘use andcontrol for public purposes the water of all rivers and streams flowing in natural channels, and of all lakes. The1873 act refrained from asserting state ownership over surface waters. Nevertheless, this act is a milestone sinceit asserted the right of the Government to control water use for the benefit of the broader public.
- o This wasprogressively strengthened. Thus, the Madhya Pradesh Irrigation Act, 1931 went much further and asserted directstate control over water: ‘All rights in the water of any river, natural stream or natural drainage channel, naturallake or other natural collection of water shall vest in the Government.

- ❖ **Air Act 1981**-An Act to provide for the prevention, control and abatement of air pollution, for the establishment, with a view to carrying out the aforesaid purposes, of Boards, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith.

    - Whereas decisions were taken at the United Nations Conference on the Hum an Environment held in Stockholm in June, 1972, in which India participated, to take appropriate steps for the preservation of the natural resources of the earth which, among other things, include the preservation

of the quality of air and control of air pollution; and whereas it is considered necessary to implement the decisions aforesaid in so far as they relate to the preservation of the quality of air and control of air pollution;

- Be it enacted by Parliament in the Thirty-second Year of the Republic of India

- **Wild life Act 1972-**It refers to a sweeping package of legislation enacted in 1972 by the Government of India. Before 1972, India only had five designated national parks. Among other reforms, the Act established schedules of protected plant and animal species; hunting or harvesting these species was largely outlawed. The Act provides for the protection of wild animals, birds and plants; and for matters connected therewith or ancillary or incidental thereto. Formalization of national parks, wildlife sanctuaries, conservation reserves and community reserves. Protection to habitat and wildlife within premises of such protected areas. Development of National Board for Wildlife and State Boards for Wildlife for identification of future protected areas. Up to April 2010 there have been 16 convictions under this act relating to the death of tigers.

- **Forest Act 1980 and Environment Act 1972**- Environment protection act 1986 (23 May 1986) I- it is a legislation which signifies the central government determination to take effective steps to protect the environment.

Stating that: No State Government or other authority shall make any order directing-

(i) that any reserved forest shall cease to be reserved;

(ii) that any forest land or any portion thereof may be used for any non-forest purpose;

(iii) that any forest land or any portion thereof may be assigned by way of lease or otherwise to any private person or to any authority, corporation, agency or any other organization not owned, managed or controlled by Government;

(iv) that any forest land or any portion thereof may be cleared of trees which have grown naturally in that land or portion, for the purpose of using it for reafforestat.

4.12 ISSUES INVOLVED IN ENFORCEMENT OF ENVIRONMENTAL LEGISLATION

- Drawbacks of wildlife protection Act
- Drawbacks of Forest Act 1980 and
- Drawbacks of Environment Act 1972.

4.13 PUBLIC AWARENESS

Our environment is presently degrading due to many activities like pollution, deforestation, overgrazing, rapid industrialization and urbanization.

4.13.1 Objectives of public awareness

- Create awareness among people of rural and city about ecological imbalances, local environment, technological development and various development plants.

- To organize meetings, group discussion on development, tree plantation programmes exhibitions.
- To learn to live simple and eco-friendlily manner.

4.13.2 Methods to create environmental awareness

- ✓ In schools and colleges
- ✓ Through mass – media
- ✓ Cinema
- ✓ Newspapers
- ✓ Audio - Visual media
- ✓ Voluntary organizations
- ✓ Traditional techniques
- ✓ Arranging competitions
- ✓ Leaders appeal
- ✓ Non – government organizations.

CHAPTER 7 HUMAN POPULATION AND ENVIRONMENT

5.1 Objectives

- To get a knowledge on human population and human rights.
- To educate the students on value education.
- To equip the students towards the modern technology with respect to environment and human health.

5.1.1 Population density

Number of individuals of the population per unit area or per unit volume.

5.1.2 Parameters affecting population size

- ✓ Birth rate
- ✓ Death rate or Mortality
- ✓ Immigration
- ✓ Emigration.

5.1.3 Population Growth

The rapid growth of the global population for the past 100 years from the difference between the rate of birth and death.

Table.5.1 Population statistics in India as on 2010

Rank	State or union territory	Population	%	Rural Pop.	Urban Pop.	Area km²	Density (per km²)	Area mi²	Density (per mi²)	Sex ratio
1	Uttar Pradesh	193,977,661	16.16%	131,658,339	34,539,582	240,928	690	93,022.8	1,787	898
2	Maharashtra	110,878,627	9.42%	55,777,647	41,100,980	307,713	315	118,808.7	815	922
3	Bihar	102,998,509	8.07%	74,316,709	8,681,800	94,163	881	36,356.5	2,283	921
4	West Bengal	90,176,197	7.79%	57,748,946	22,427,251	88,752	903	34,267.3	2,340	934
5	Andhra Pradesh	82,210,007	7.41%	55,401,067	20,808,940	275,045	277	106,195.5	718	978
6	**Tamil Nadu**	**62,405,679**	**6.07%**	**34,921,681**	**27,483,998**	**130,058**	**480**	**50,215.7**	**1,243**	**987**
7	Madhya Pradesh	60,348,023	5.87%	44,380,878	15,967,145	308,245	196	119,014.1	507	919
8	Rajasthan	56,507,188	5.49%	43,292,813	13,214,375	342,239	165	132,139.2	428	921
9	Karnataka	52,850,562	5.14%	34,889,033	17,961,529	191,791	276	74,050.9	714	965
10	Gujarat	50,671,017	4.93%	31,740,767	18,930,250	196,024	258	75,685.3	669	920
11	Orissa	36,804,660	3.58%	31,287,422	5,517,238	155,707	236	60,118.8	612	972
12	Kerala	31,841,374	3.10%	23,574,449	8,266,925	38,863	819	15,005.1	2,122	1,058
13	Jharkhand	26,945,829	2.62%	20,952,088	5,993,741	79,714	338	30,777.7	875	941
14	Assam	26,655,528	2.59%	23,216,288	3,439,240	78,438	340	30,285.1	880	935
15	Punjab	24,358,999	2.37%	16,096,488	8,262,511	50,362	484	19,444.9	1,253	876
16	Haryana	21,144,564	2.06%	15,029,260	6,115,304	44,212	478	17,070.3	1,239	861

17	Chhattisgarh	20,833,803	2.03%	16,648,056	4,185,747	135,191	154	52,197.5	399	989
18	Jammu and Kashmir	10,143,700	0.99%	7,627,062	2,516,638	222,236	46	85,805.8	118	892
19	Uttarakhand	8,489,349	0.83%	6,310,275	2,179,074	53,483	159	20,649.9	411	962
20	Himachal Pradesh	6,077,900	0.59%	5,482,319	595,581	55,673	109	21,495.5	283	968
21	Tripura	3,199,203	0.31%	2,653,453	545,750	10,486	305	4,048.7	790	948
22	Meghalaya	2,318,822	0.23%	1,864,711	454,111	22,429	103	8,659.9	268	972
23	Manipur[β]	2,166,788	0.21%	1,590,820	575,968	22,327	97	8,620.5	251	974
24	Nagaland	1,990,036	0.19%	1,647,249	342,787	16,579	120	6,401.2	311	900
25	Goa	1,347,668	0.13%	677,091	670,577	3,702	364	1,429.4	943	961
26	Arunachal Pradesh	1,097,968	0.11%	870,087	227,881	83,743	13	32,333.4	34	893
27	Mizoram	888,573	0.09%	447,567	441,006	21,081	42	8,139.4	109	935
28	Sikkim	540,851	0.05%	480,981	59,870	7,096	76	2,739.8	197	875
UT1	Delhi	13,850,507	1.35%	944,727	12,905,780	1,483	9,340	572.6	24,189	821
UT2	Puducherry	974,345	0.09%	325,726	648,619	479	2,034	184.9	5,268	1,001
UT3	Chandigarh	900,635	0.09%	92,120	808,515	114	7,900	44.0	20,462	777
UT4	Andaman and Nicobar Islands	356,152	0.03%	239,954	116,198	8,249	43	3,185.0	112	846
UT5	Dadra and Nagar Haveli	220,490	0.02%	170,027	50,463	491	449	189.6	1,163	812
UT6	Daman and Diu	158,204	0.02%	100,856	57,348	112	1,413	43.2	3,658	710
UT7	Lakshadweep	60,650	0.01%	33,683	26,967	32	1,895	12.4	4,909	948
Total	**India**	**1,206,610,32**	**100.00**	**742,490,639**	**286,119,68**	**3,287,24**	**313**	**1,269,21**	**810**	**933**

5.1.4 Causes of rapid population growth

- The rapid population growth is due to decrease in death rate and increase in birth rate.
- Availability of antibiotics, immunization, increased food production, clean water and air decreases the famine-related deaths.
- In agricultural based countries, children are required to help parents in the field that is why population increases in the developing countries.

5.15 Characteristics of population growth

- Exponential growth
- Doubling time
- Infant mortality rate
- Total fertility rate
- Replacement level
- Male/female ratio
- Demographic transition.

5.1.6 Variation of population based on age structure

1. Pyramid shaped – India, Bangladesh, and Ethiopia.

2. Bell shaped – France, USA, and UK.

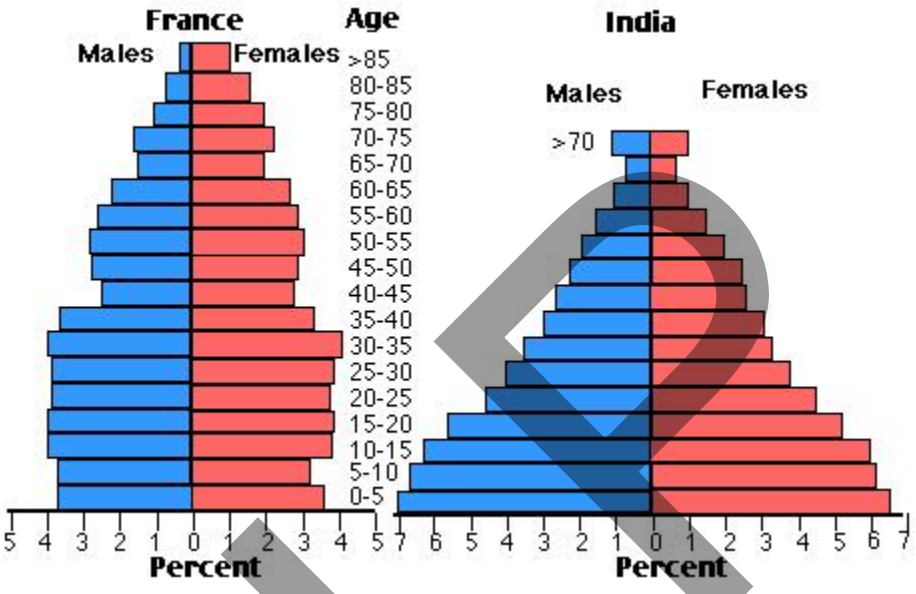


Fig. 5.1 Bell and Pyramid shaped Population structure

3. Urn shaped - Germany, Italy, and Japan.

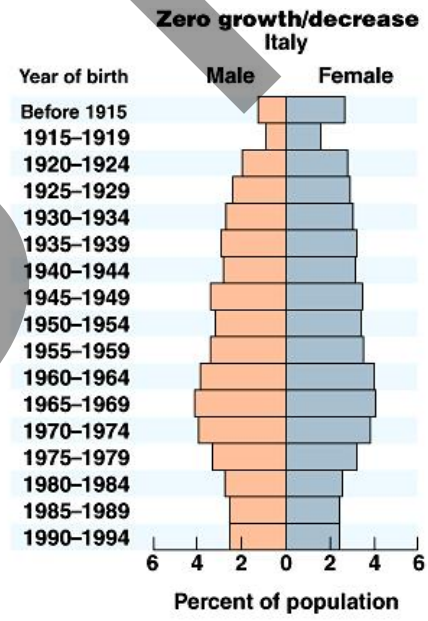


Fig. 5.2 Urn shaped Population structure

5.1.7 Population Explosion

The enormous increase in population due to low death rate and high birth rate.

5.1.8 Causes

Modern medical facilities, life expectancy, illiteracy.

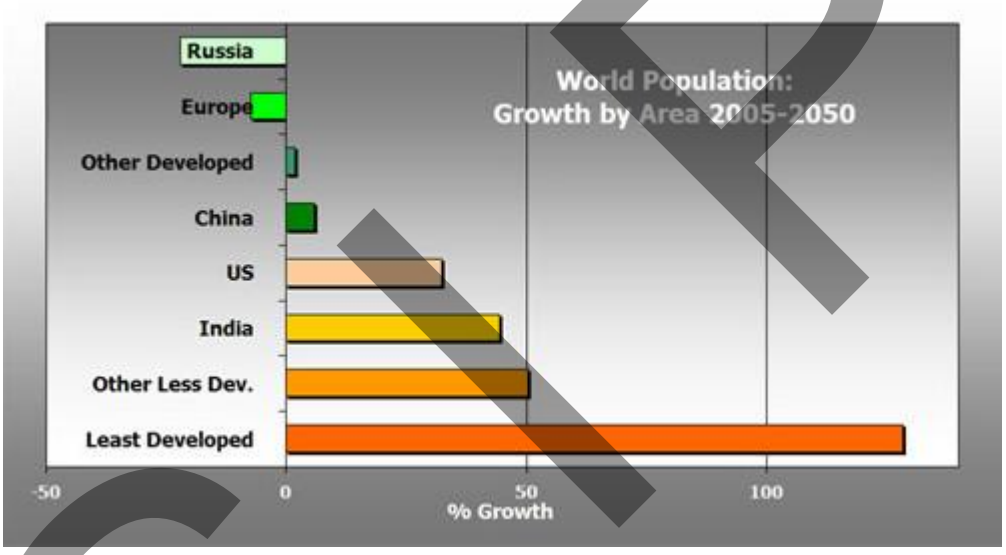


Fig. 5.3 World Population Growth

5.1.9 Effects

Poverty, Environmental degradation, over –exploitation of natural resources, threat, communal war.

5.1.10 Remedy

Through birth control programmes.

5.2 FAMILY WELFARE PROGRAMME

5.2.1 Objectives

- Slowing down the population explosion
- Over exploitation of natural resources

5.3 FAMILY PLANNING PROGRAMME

5.3.1Objectives

- Reduce infant mortality rate.
- Encourage late marriages.
- Improve women's health.
- Control of communal diseases.

5.4 ENVIRONMENT AND HUMAN HEALTH

1. Physical Hazards – Radioactive and UV radiations, Global warming, Chlorofluro carbons, Noise etc.
2. Chemical Hazards – Combustion of Fossil fuels, industrial effluence, pesticides, heavy metals.
3. Biological Hazards- Bacteria, Viruses, Parasites.

5.5 HUMAN RIGHTS

- Human right to freedom
- Human right to property
- Human right to freedom of religion
- Human right to culture and education
- Human right to constitutional remedies
- Human right to equality
- Human right against exploitation
- Human right to food and environment
- Human right to good health.
- To promote interdependence among Asian countries in all areas of cooperation by identifying Asia's common strengths and opportunities which will help reduce poverty and improve the quality of life for Asian people whilst developing a knowledge-based society within Asia and enhancing community and people empowerment;
- To expand the trade and financial market within Asia and increase the bargaining power of Asian countries in lieu of competition and, in turn, enhance Asia's economic competitiveness in the global market;
- To serve as the missing link in Asian cooperation by building upon Asia's potentials and strengths through supplementing and complementing existing cooperative frameworks so as to become a viable partner for other regions;
- To ultimately transform the Asian continent into an Asian Community, capable of interacting with the rest of the world on a more equal footing and contributing more positively towards mutual peace and prosperity.

5.6 VALUE EDUCATION

Education

It is nothing but learning about the particular thing through knowledge. We can identify our values and ourselves with the help of knowledge and experience.

5.6.1 Types

1. Formal education-Self related learning process.
2. Value education – Analyze based on instruments.
3. Value-based environment education- Based on environment.

5.6.2 Objectives

- ✓ To improve the integral growth of human begins.
- ✓ To create attitudes and improvement towards sustainable lifestyle.
- ✓ To increase awareness about our national history our cultural heritage, constitutional rights, national integration, community develo9pment and environment.
- ✓ To create and develop awareness about the values and their significance and role.
- ✓ To know about various living and non- living organisms and their interaction with environment.

5.6.3 Types of values

- ❖ Universal values-Importance of the human conditions.
- ❖ Cultural values-Right, wrong, good and bad.
- ❖ Individual values-Individual personality and experiences.
- ❖ Global values-Human civilization.
- ❖ Spiritual values-Self-restraint, discipline.

5.7 HIV /AIDS

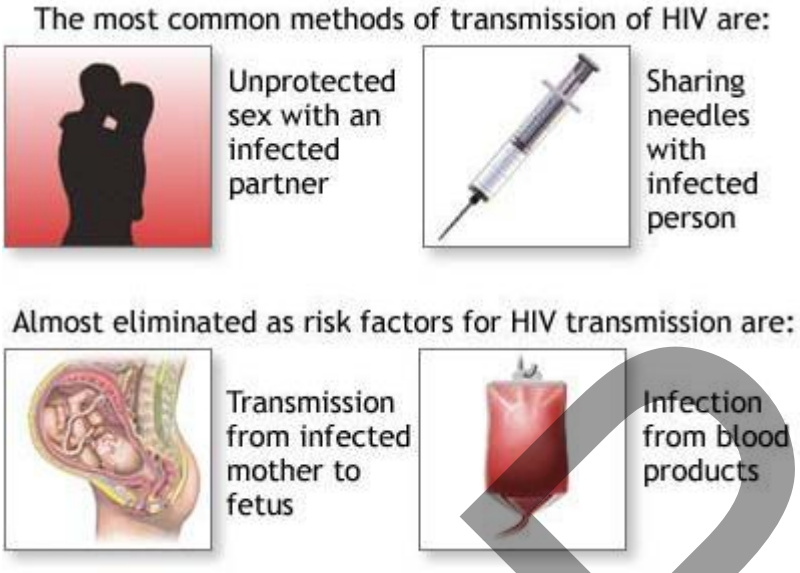
AIDS is the abbreviated form for **Acquired Immuno Deficiency Syndrome** caused by a virus called HIV (**Human Immune deficiency Virus**).

5.7.1 Origin of HIV/AIDS

1. Through African Monkey
   African monkey or Chimpanzees To human.
2. Through Vaccine Programme
   (a)Polio, small pox vaccine from monkey's kidney-Africa.
   (b) Hepatitis-B viral vaccine-Los Angles and New York.

5.7.2 Factors influencing modes of Transmission of HIV

1. Unprotected sex with infected person.
2. Using needles or syringes from HIV positive person.
3. During pregnancy, breast feeding HIV transmits from mother to infant babies.
4. Blood transfusion during accident and pregnancy.
5. Biologically the male to female transmission is 2 to 4 time more efficient than female to male transmission.
6. Women's cervical tissue is more vulnerable to HIV than men.



5.7.3 Factors not influencing transmission of HIV

1. Tears, food, air, cough, handshake and normal kissing.
2. Mosquito flies and insect bites.
3. Sharing of utensils, clothes, toilets and bathroom.

5.7.6 Effects

- Death
- Loss of labor
- Inability to work
- Lack of energy.

5.7.4 Functions of HIV in human body

White blood cells (WBC) are responsible for the formation of antibodies called T-helper cells'-helper cells are the key infection fighters in the immune system. Once HIV cells are enter into the boy they destroy the T-cells and cause many infection diseases.

5.7.5 Symptoms

I. Minor symptoms

- ✓ Persistent cough for more than one month.
- ✓ General skin disease.
- ✓ Viral infection.
- ✓ Fungus infection in mouth and throat.
- ✓ Frequent fever, headache and fatigue.

II. Major symptoms

- ✓ Diarrhea for more than one month.
- ✓ TB for more than one month.
- ✓ Fall of hairs.
- ✓ 10% of body weight loss within short period.

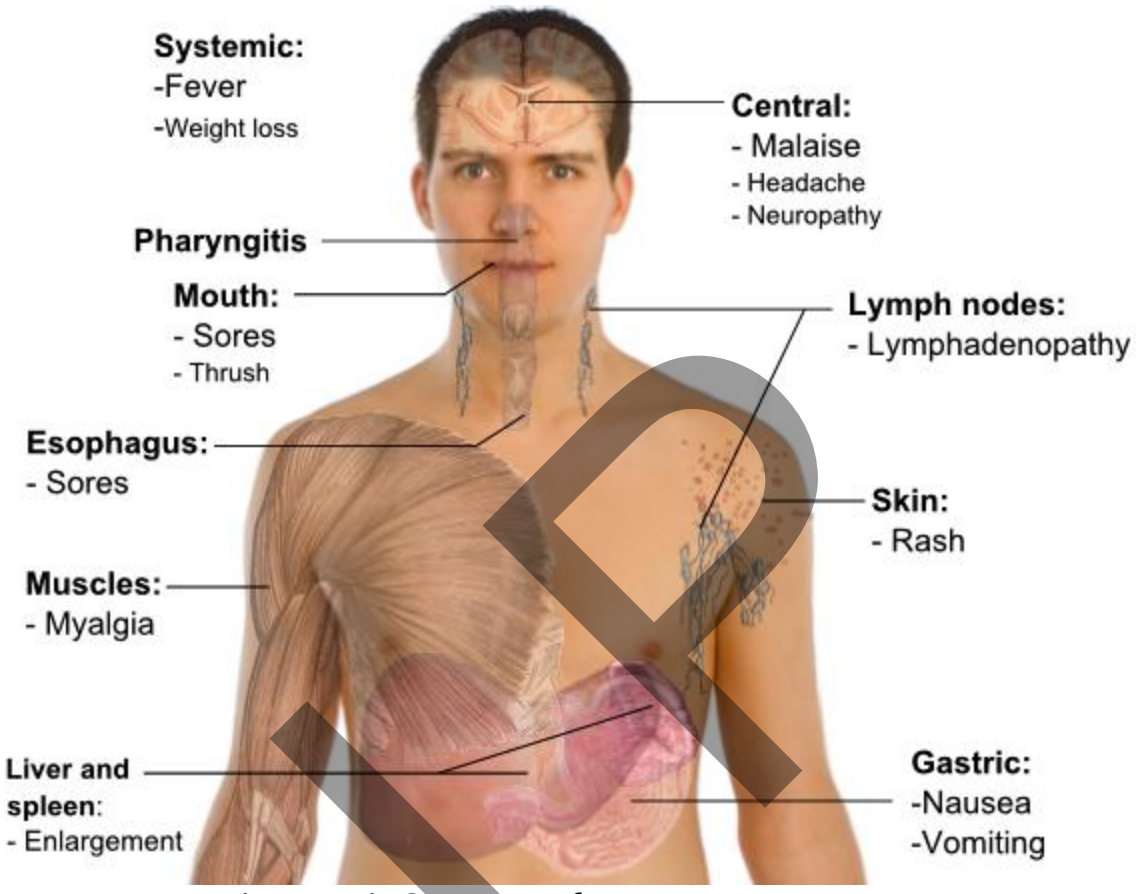


Fig.5.4 Main Symptoms of HIV

5.7.6 Mechanism of Infection

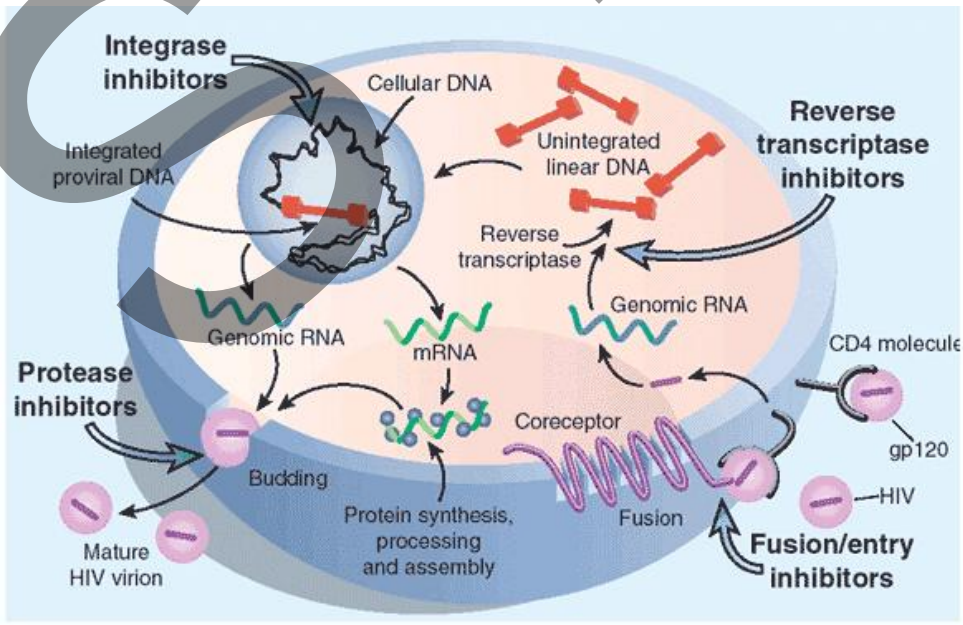


Fig.5.5 Mechanism of HIV infection

5.7.7 Control and Preventive measures

1. Education.
2. Prevention of Blood borne HIV transmission.
3. Primary health care.
4. Counseling services.
5. Drug treatment.

5.7.8 Scenario in India

Large number of cases has been reported in Maharashtra and Tamil Nadu.

5.7.9 World Scenario

Nearly 90% of the HIV affected peoples live in developing countries.13% of world's population live in Africa. About 3 million people so far died due to HIV in 2003.In the world AIDS ranking India is in 2nd place.

5.7.10 HIV symbol and World AIDS day

Fig.5.6 Symbol of HIV

5.8 WOMANS AND CHILD WELFARE

5.8.1 Objectives

- To provide education
- To impart vocational training
- To generate awareness
- To improve employment opportunities
- To restore dignity, equality and respect.

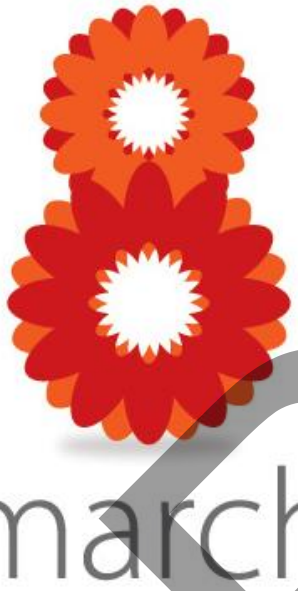


Fig.5.7 International women's day

5.9 ROLE OF INFORMATION TECHNOLOGY IN ENVIRONMENT

1. Remote sensing

Components - A platform, aircraft, a balloon, rocket and satellite.

Functions

- Origin of electro magnetic energy
- Transmission of energy
- Interaction of energy
- Detection of energy
- Preprocessing of data
- Data analysis and interpretation
- Integration and other applications.

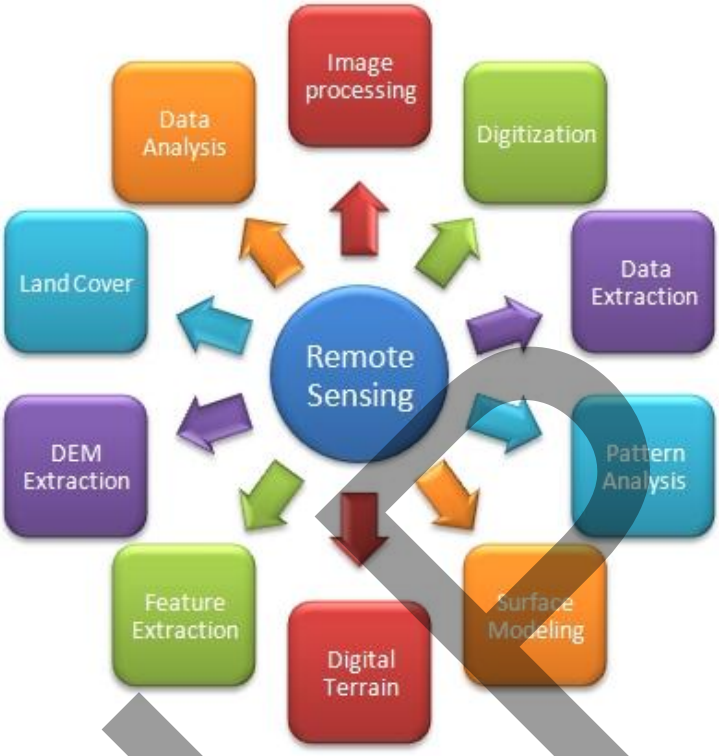


Fig.5.8 Functions of remote sensing

Applications

In agriculture, forestry, land cover, water resources.

2. Data Base- Collection of inter related data on various subjects.

Applications

- Ministry of environment and forest
- National management information system
- Environmental information system.

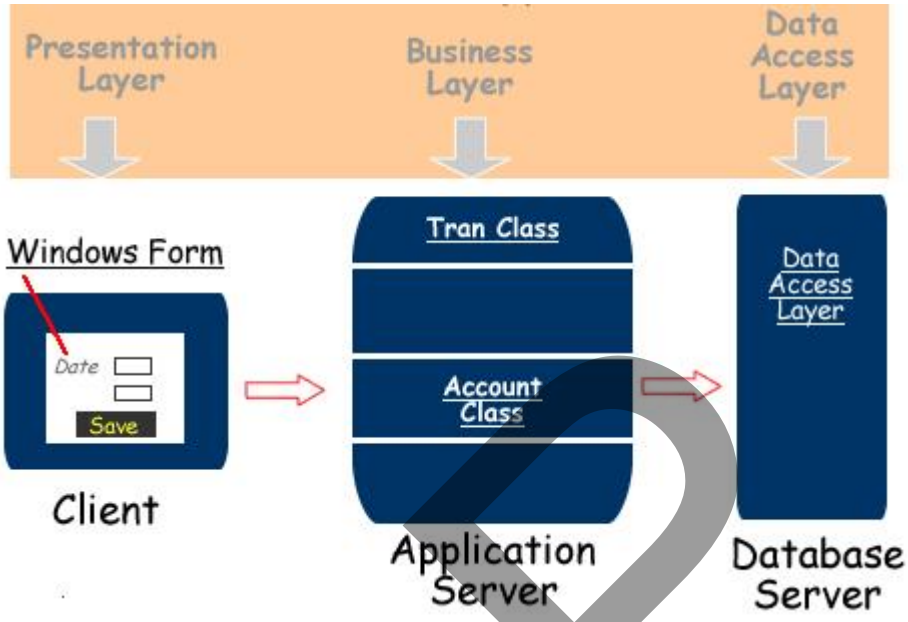


Fig.5.9 Applications of Database

3. Geographical information system (GIS)

It is a technique of superimposing various thematic maps using digital data on a large number of inter-related aspects.

Fig.5.10 GIS operations

Application

- Thematic maps are super imposed using soft wares.
- Interpretation of polluted zones
- To check unplanned growth and related environmental problems.

4. Satellite data

- Helps in providing reliable information and data about forest cover
- Provide information about forecasting weather
- Reserves of oil, minerals can be discovered.

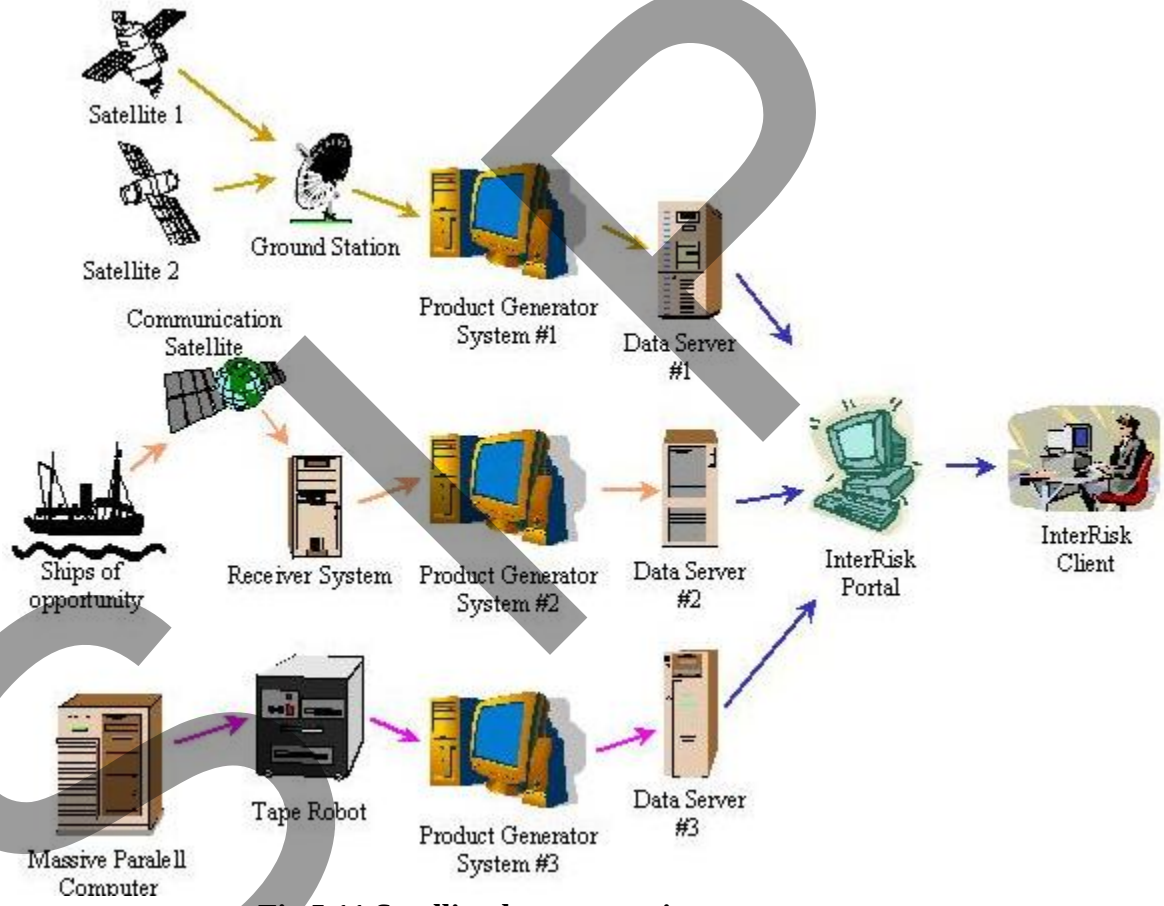


Fig.5.11 Satellite data processing

5. World Wide Web

It provides **Current data**.

Applications

- Online learning
- Digital files or photos, animations on environmental studies.

5.10 ROLE OF INFORMATION TECHNOLOGY IN HUMAN HEALTH

The health service technology involves three systems

- Finance and accounting
- Pathology
- Patient Administration – clinical system.

Applications

- Data regarding birth and death rates
- To monitor the health of the people effectively
- The information regarding the outbreak of epidemic diseases.
- Online Consultation
- Drugs and its replacement.