BP 206 T. ENVIRONMENTAL SCIENCES (Theory) 30 hours

Scope: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives: Upon completion of the course the student shall be able to**:**

Create the awareness about environmental problems among learners.

Impart basic knowledge about the environment and its allied problems.

Develop an attitude of concern for the environment.

Motivate learner to participate in environment protection and environment improvement.

Acquire skills to help the concerned individuals in identifying and solving environmental problems.

Strive to attain harmony with Nature.

Course content:

Unit-I 10hours

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources:

Natural resources and associated problems

Forest resources; b) Water resources; c) Mineral resources; d) Food resources;

e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

Unit-II 10hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems: Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit- III 10hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

Recommended Books (Latest edition):

Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore

Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,

Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

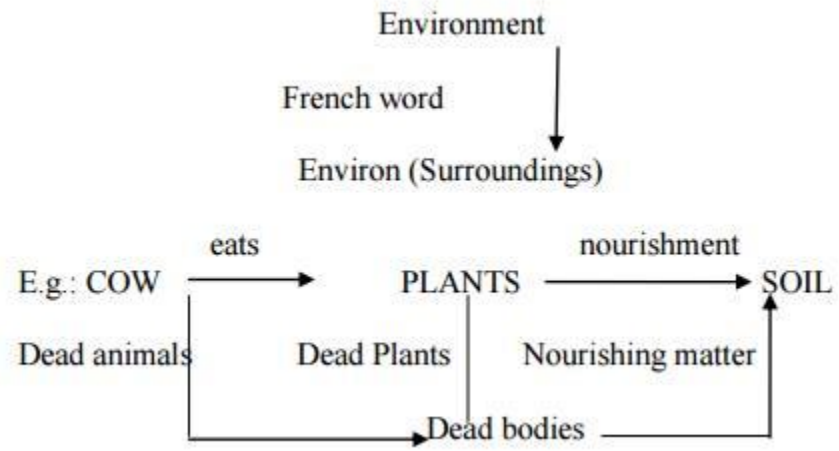
Clark R.S., Marine Pollution, Clanderson Press Oxford

Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p

De A.K., Environmental Chemistry, Wiley Eastern Ltd. Down of Earth, Centre for Science and Environment

UNIT I

INTRODUCTION



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

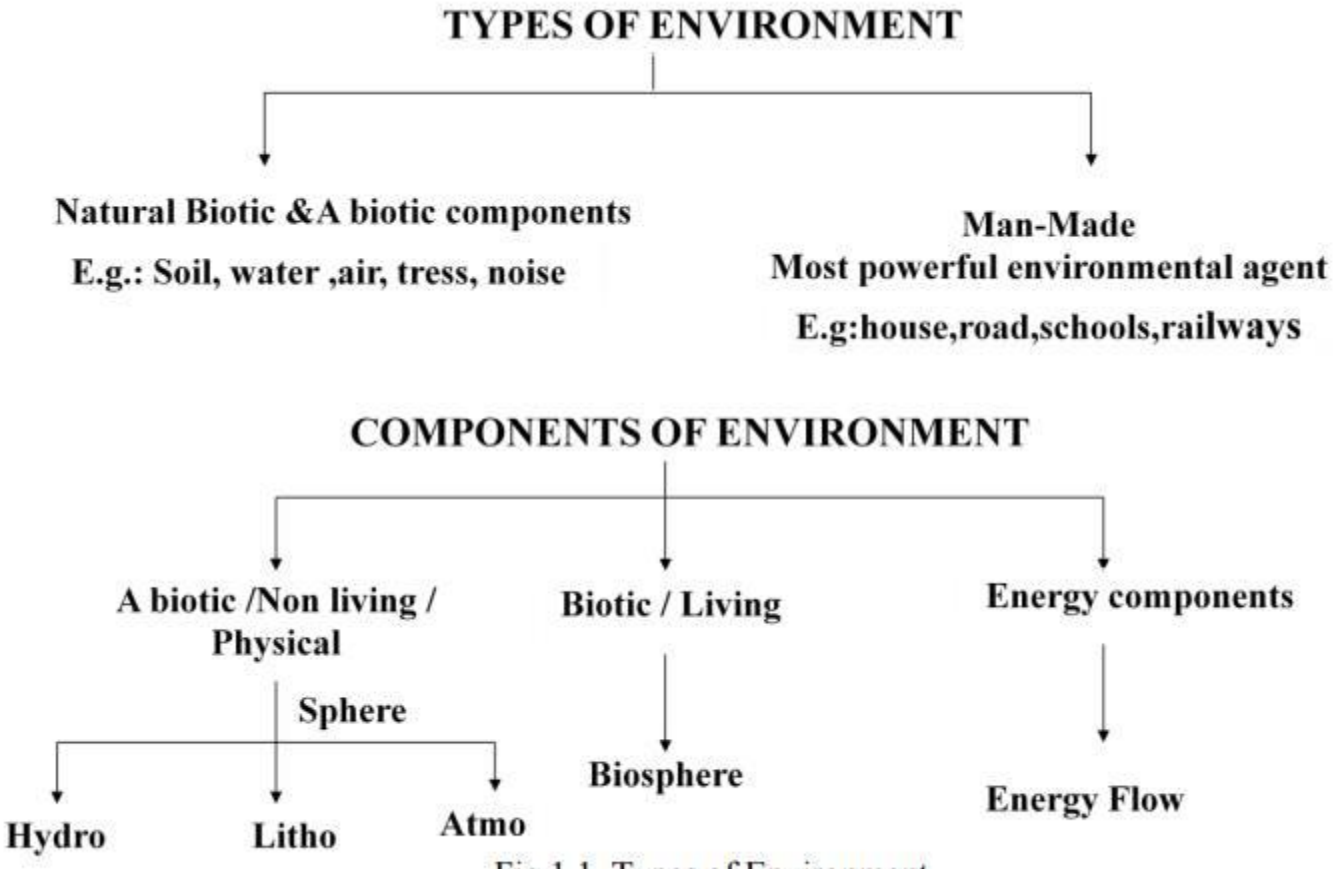


Fig 1.1. Types of Environment

SCOPE

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

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

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

NEED FOR PUBLIC AWARENESS

- Public awareness very essential to help understand pros and cons of environmental problems.
- The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and popularly known as Earth summit followed by the world summit on sustainable Development in 2002, have highlighted key issues of global environmental concern.
- Environmental pollution cannot be removed by laws alone.

- The proper implementation and especially public participation are important aspects.

- Public participation is possible only when the public is aware about the ecological and environmental issues.

- A drive by the government to ban the littering of polythene cannot be successful until the public understands the environmental implications of the same.

- The public has to be educated about the fact that if we are degrading our environment we are actually harming ourselves.

NATURAL RESOURCES

1.1 NATURAL RESOURCES

Any component of the environment which has intrinsic value of its own is called as resource. Any component which can be transferred in a way such that it becomes more valuable and useful is termed as resource.

1.1.1 PREREQUISITE DISCUSSIONS

The main problem associated with natural resources is unequal consumption. A major part of natural resources are consumed in the 'developed' world. The 'developing nations' also over use many resources because of their greater human population.

However, the consumption of resources per capita (per individual) of the developed countries is up to 50 times greater than in most developing countries. Advanced countries produce over 75% of global industrial waste and greenhouse gases.

Energy from fossil fuels consumed in relatively much greater quantities in developed countries. Their per capita consumption of food too is much greater as well as their waste. The USA for example with just 4% of the world's population consumes about 25% of the world's resources.

Producing animal food for human consumption requires more land than growing crops. Thus countries that are highly dependent on non-vegetarian diets need much larger areas for pastureland than those where the people are mainly vegetarian.

Our natural resources can be compared with money in bank. If we use it rapidly the capital will be reduced to zero. On the other hand if we use only the interest, it can sustain us over the longer term. This is called sustainable utilization or development.

The quality of human life and the quality of ecosystems on earth are indicators of the sustainable use of resources. There are clear indicators of sustainable lifestyles in human life. The natural reserves are stock supply, which man utilizes for sustenance and welfare.

1.2 FOREST RESOURCES

A forest can be defined as a biotic community predominant of trees, shrubs or any other woody vegetation usually in a closed canopy. It is derived from latin word '*foris*' means '*outside*'.

India's Forest Cover is 6,76,000 sq.km (20.55% of geographic area). Scientists estimate that India should ideally have 33% of its land under forests. Today we only have about 12% thus we need not only to protect our existing forests but also to increase our forest cover.

1.2.1 Forest Functions:

1) Protective and ameliorative functions
a. Watershed protection
b. Erosion control
c. Land bank
d. Atmospheric regulation
2) Productive functions
a. Fodder for cattle
b. Fuel wood and charcoal
c. Poles for building homes
d. Food: (consumptive use)
e. Sericulture & Apiculture
f. Medicinal plants for traditional medicines

3) Recreational and educational functions
4) Development functions
a. Employment functions
b. Revenue

1.2.2 Commercial uses

❖ Man depends heavily on a larger number of plant and animal products from forests for his daily needs.

• The chief product that forests supply is wood, which is used as fuel, raw material for various industries as pulp, paper, newsprint, board, timber for furniture items, other uses as in packing articles, matches, sports goods etc.

• Indian forests also supply minor products like gums, resins, dyes, tannins, fibers,etc.

• Many of the plants are utilized in preparing medicines and drugs; Total worth of which is estimated to be more than $300 billion per year.

• Many forests lands are used for mining, agriculture, grazing, and recreation and for development of dams.

1.2.3 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.

1.2.4 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.

1.2.5 Ecological Significance of Forests

1) Balances CO_2 and O_2 levels in atmosphere.
2) Regulates earth temperature and hydrological cycle
3) Encourage seepage and reduces runoff losses, prevents drought
4) Reduces soil erosion (roots binding), prevents siltation and landslides thereby floods
5) Litter helps in maintaining soil fertility
6) Safe habitat for birds, wild animals and organisms against wind, solar radiation and Rain

1.3 DEFORESTATION

Deforestation refers to the loss of forest cover; land that is permanently converted from forest to agricultural land, golf courses, cattle pasture, home, lakes or desert. The FAO (Food and Agriculture Organization of the UN) defines tropical deforestation as "change of forest with depletion of tree crown cover more than 90%" depletion of forest tree crown cover less than 90% is considered forest degradation

Deforestation

1.1.1 Causes for Deforestation

☐ Agriculture: Conversion of forests to agricultural land to feed growing numbers of people

☐ Commercial logging: Destroys

☐ The cash crop economy: Raising cash crops for increased economy.

☐ Mining

☐ Increase in population: The needs also increase and utilize forests resources.

☐ Urbanization & industrialization

☐ Mineral exploration

☐ Construction of dam reservoirs

☐ Infrastructure development

☐ Forest fires

☐ Human encroachment & exploitation

☐ Pollution due to acid rain

1.1.2 Environmental effects /Consequences of deforestation

☐ Food problems

☐ Ecological imbalance

☐ Increasing CO2

☐ Floods leading to soil erosion

☐ Destruction of resources

☐ Heavy siltation of dams

☐ Changes in the microclimate

☐ Loss of biodiversity

☐ Desiccations of previously moist forest soil

☐ Environmental pollution

☐ Global warming

1.1.3 CONSERVATION

Conservation derived from two Latin words, *con* – together, *servare* – to keep or guard measures, *i.e.* an act of preservation or to keep together.

Concepts in conservation

• Restraining cutting of trees and submerging the forests

• Reforestation

• Afforestation

• Control forest diseases and forest fire

• Recycling forest products

• Replacing forest products

1.4 TIMBER EXTRACTION AND MINING

The major activities in forest area are

1) Timber extraction

2) Mining

The important effects of timber extraction are
i) Thinning of forests
ii) Loss of biodiversity, particularly tree breading species
iii) Soil erosion and loss of soil fertility
iv) Migration of tribal people from one place to another in search of new forest
v) Extinction of tribal people and their culture
Mining is a process of removing ores from area which is very much below the ground level. Mining is done for the extraction of several minerals of metals like Fe, Mn, Au, Ag, etc. The minerals are especially found in thick forests.
Mining can be carried out in two ways
1) Surface mining
2) underground mining or sub-surface mining
The effects of under ground mining on forest reserves are comparatively less than that of surface mining.

1.5 DAMS – BENEFITS AND PROBLEMS

River valley projects with big dams are considered to play a key role in the development of a country. India has large number of river valley projects.
1. These dams are regarded as symbol of national development.
2. Provides large scale employment of tribal people and increase the std. of living of them
1. Contribute for economic uplift and growth
4. Help in checking flood
5. Generate electricity
6. Reduce power and water shortage
7. Provide irrigation water
8. Provide drinking water to remote areas
9. Promote navigation and fishery.

1.6 CASE STUDIES

1.6.1 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 arev losing their fertility.

1.6.2 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.

1.6.3 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.

1.7 WATER RESOURCES

Water is an indispensible resource. Around 97% of world surface is covered with water. Most of the animals and plants have 60-65% of water in their body.

Unique features of water:

☐ High specific heat

☐ High latent heat of vapourisation

☐ Good solvent for oxygen, nutrients and pollutants

☐ Anomalous expansion on freezing

☐ High surface tension

Global distribution of water is very much random depending on the geographical conditions. The availability of water decreases in the following order.

☐ Tropical rain forest

☐ Temperate regions

☐ Deserts

Water is used for domestic, irrigation and also industrial purposes. Out of the total available water 75% is used for agriculture, 20% for industrial usage.
In our country ~93% of water is used for agricultural purposes.
Ground water: 9.86% of fresh water is ground water and it is 35-50% greater than surface water.
Aquifer: The layer of soil which is permeable has the ability to store water is called an aquifer. It is generally made up of gravel, sand etc.
Unconfined aquifer: it is covered by permeable layer. The recharge of this layer is by rainfall or snowmelt.
Confined aquifer: sandwiched between impermeable layers. The recharge is through unconfined aquifer layers.
Water Cycle

1.7.1 OVER UTILIZATION OF GROUND WATER

Over utilization of water leads to rapid depletion of water resources, ground subsidence, lowering of water table and water logging.
Reasons: Economic development, rapid industrial growth and population explosion. The use of ground water and surface water rates which are higher than that of recharge ultimately leads to

• Water scarcity

• Water logging

• Salination

• Alkalization

• Water pollution or contamination

• Creates declining of water levels

• Crops failure and reduction in agricultural production

• Over pumping of ground water create drought, famine and food shortage

• Over pumping of ground water sea water intrusion in coastal aquifers

• Land subsidence may due to over pumping of ground water

Clean water is universal right. It is the responsibility of everyone to ensure the purity of water. Water is a valuable commodity and it has to be conserved.
Surface water: When evaporation and transpiration rates are lower than the rainfall, surface water body like lake, river, pond, streams etc. are formed.
Flood: over flow of water, whenever the water in flow is greater than the carrying capacity of the channels flood occurs.

1.7.2 Causes:

☐ Heavy rainfall, snow melt, sudden release of water from dams.

☐ Prolonged down pour leading to overflowing of rivers and lakes

☐ Reduction in carrying capacity due to obstructions or sediments etc.

☐ Deforestation, overgrazing, mining increases water run off

☐ Removal of dense forests from hilly regions

1.7.3 Effects:

☐ Submerges the flooded area

☐ Loss of soil fertility due to soil erosion

☐ Extinction of civilization at costal area

1.7.4 Flood management:

☐ Dams and reservoirs can be constructed

☐ Embankments and proper channel management

☐ Flood way should not be encroached

☐ Forecasting or flood warning

☐ Decrease of run off by infiltration through afforestation or rain water harvesting etc.

1.7.5 DROUGHT

Unpredictable delay in climatic condition occurring due to monsoon rain failure.
Types:

• Meterological: in order of month or year, actual moisture supply at a given place consistently falls below critical level.

• Hydrological: deficiency in surface and subsurface water supplies

• Agricultural: inadequate soil moisture to meet the need of a particular crop at particular time or susceptibility of crops during different stages in its development

• Socioeconomic: reduction in the availability of food and social securing of people

1.7.6 Causes:

☐ Deforestation and lesser rainfalls coupled with cutting of trees for timber leads to desertifictation.

☐ Over drafting of ground water, subsidence of soil, drying of wetlands

☐ Pollution of soil with solid waste, industrial effluents etc makes land useless and dry

☐ Population explosion in man and livestock leads to enhanced requirement of timber, fuel wood, grazing

☐ Shifting cultivation

1.7.7 Effects:

• Increase of water in stream pond

• Ground water table get declined

• Loss of agricultural crops

• Loss of biodiversity

• Government spent a lot of money as drought relief fund

1.7.8 Control measures:

☐ Rain water harvesting

☐ Watershed management

☐ Prevent deforestation

☐ Encourage afforestation

1.8 CONFLICTS OVER WATER

Due to increase in population and decrease in water resources conflicts over water starts Conflicts over the water around world was classified as

☐ Control of water resources

☐ Military food resources

☐ Political resources

☐ Terrorism

☐ Military targets

☐ Development disputes

1.8.1 Causes:

Conflicts through use

1. Shipping traffic in international water
2. Dam construction
1. Construction of power stations
4. Conflicts through pollution-rhine river,Europe
5. Distributional conflict-relative storage

1.8.2 Conflicts management:

☐ Enact laws to check practices to control water pollution

☐ Sharing river solved by interlinking river

☐ Power must be given to national water authority

1.9 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.

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.

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

• 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

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.

1.10 MINERAL RESOURCES

Minerals are naturally occurring substances with definite chemical and physical properties. Mineral is an element or inorganic compound that occurs naturally.

1.10.1 Uses of minerals

- 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

1.10.2 Environmental impacts of mineral extraction

Environmental impacts of over extraction of mineral resources:

Depending on the conditions of terrain and depth of ore deposits 2 types of mining operations are carried out.

1. Open cast mining
2. Underground mining.

In both types each steps in mining processing produce several environmental effects such as,

☐ Deforestation takes place due to removal of vegetal covers.

☐ Great volume of debris has been generated which disrupt the surface and ground water circulation. It also reduces the water carrying capacity of streams very close to mining area.

☐ The stacking of over burden and building of soil banks creates problems of landslides.

☐ Under ground fire in coalmines is a hazard that is difficult to control.

☐ Mining and ore processing normally causes air pollution and water pollution.

☐ The acid water generated in coalmines can pose a serious problem of water pollution, which adversely affects the flora and fauna.

☐ Deeper excavation of ground causes lowering of water table, which leads to drying of wells or sea water intrusion.

☐ In stone quarries, blasting of rocks not only annoying the people nearby, but also cause hazard from fly rocks and dusts and damage to buildings due to vibrations.

☐ The disposal of waste material produced after concentrations of ore create increase concentration of heavy metals and toxic elements in the environment.

1.10.3 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.

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

1.11 Case studies

1.11.1 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.

1.11.2 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.

1.12 FOOD RESOURCES

Problems Faced by Food Resources

Overgrazing

• Land degradation

• Soil erosion

• Loss of useful species

Modern agriculture

☐ High yield variety crops

☐ Micronutrients imbalance

☐ Nitrate pollution

☐ Eutrophication

☐ Pesticide related problems

☐ Water logging

☐ Salinity

1.12.1 WORLD FOOD PROBLEMS

☐ Problems mainly under nutrition and malnutrition

☐ Natural calamities:-famine, drought, earthquake, flood, gale, storm

☐ Disease and medical facilities

☐ Pest damage:-insects, bacteria, viruses, parasites consume 60% of world"s food production

☐ Hunger

☐ Population explosion in rural areas

☐ Environmental pollution

☐ Lack of water for irrigation

☐ Less rainfall due to deforestation

☐ Livestock overgrazing

☐ Overfishing

1.13 CHANGES CAUSED BY OVERGRAZING AND AGRICULTURE

Overgrazing: Process of eating away the vegetation along with its roots without giving a chance to regenerate

☐ Land degradation-leads to organically poor, dry, compacted soil cannot be used for further cultivation

☐ Soil erosion-cover of vegetation gets removed from soil

☐ Loss of useful species-good quality grasses and herbs with high nutritive value, when grazed lose even the root stocks which carry the reserve food for regeneration get destroyed which gives raise to secondary species like parthenium, Lantane, Xanthium etc

☐ To prevent –match the forage supplement to the herd"s requirement.eg.Switch grass

Modern agriculture: The practice through which specific plant species are cared and managed so as to obtain maximum yield of consumable parts of plants –agriculture makes use of hybrid seeds and selected and single crop variety, high tech equipment and lots of energy subsides in the form of fertilizers, pesticides and irrigation water e.g. green revolution

☐ Damage to soil

☐ Water contamination

☐ Water scarcity

☐ Global climate change

☐ Water logging-results when soil is over irrigated

☐ Soil salinity-increase plant productivity, interferes with water uptake by plants

☐ Fossil fuels and pesticides produce air pollution

1.11.1 Impacts related to high yielding varieties:

• Monoculture ie the same genotype is grown over vast areas. Disease spread easily

• Micronutrient imbalance e.g Zinc deficiency-affect soil productivity

• Nitrate pollution-nitrogenous fertilizers applied deep soil contaminates ground water. cause blue baby syndrome methaemoglobinemia- affects infants

• Eutrophication: Over nourishment of lakes due to agriculture field wash out-leads to algal bloom-dead organic matters increases due to decomposition-leads to oxygen demand

1.11.2 Problems associated with pesticide use:

☐ Evolution of genetic resistance

☐ Imbalance in ecosystem

☐ Creation of new pest

☐ Persistence, Bioaccumulation and Biomagnification

☐ Mobility through soil, water, air, washed away into rivers, streams, when it rains can harm fishes

☐ Creating super pest

☐ Death of non starget organisms

☐ Salinity

☐ Water logging

1.11.3 Water logging / salinisation:

Saturation of soil with irrigation water or excessive precipitation. So that water table rises close to surface.

Water logging results when soils are over irrigated without drainage. Occurs in clayey soil, soil root zone becomes saturated with so much water blocking oxygen supply for growth and soil becomes unsuitable.

Carbondioxide and ethylene accumulate around roots affect the plants.

1.14 ENERGY RESOURCES

Growing energy needs: Population explosion, Luxurious life, Industries, Agriculture, mining, transportation, lighting, cooling, heating, building all need energy. Fossil fuels like coal, oil, natural gas produce 95% of energy Sources of energy.

Primary

Renewable energy – resources which can be generated continuously in nature and are in exhaustible and can be used again endlessly.wood, Tidal, Solar, wind, hydropower, biomass, biofuel, geothermal, hydrogen

Non-renewable energy – Resources which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted.coal, petroleum, natural gas

Secondary: Petrol, electrical energy, coal burning

1.14.1 Use of alternate energy sources: Refers to energy sources which are not based on the burning of fossil fuels or the splitting of atoms.

Solar energy:

☐ Total energy from sun per year-35,000 times the energy used by man

☐ Used to run car, power plants and spaceships

Energy harvesting devises:

☐ Solar heat collectors

☐ Solar cells

☐ Solar cooker

☐ Solar water heater

☐ Solar furnace

☐ Solar power plants

Wind energy:

Average wind velocity of earth -9 m/sec and power produced when a windmill is facing the wind od 10 miles/hr-50 watts.eg.largest wind farm-Kanyakumari in tamilnadu is generating 380 MW electricity

Wind energy offers many advantages, which explains why it's one of the fastest-growing energy sources in the world. Research efforts are aimed at addressing the challenges to greater use of wind energy. Read on to learn more about the benefits of wind power and some of the challenges it is working to overcome.

Advantages of Wind Power

Wind power is cost-effective. Land-based utility-scale wind is one of the lowest-priced energy sources available today, costing between two and six cents per kilowatt-hour, depending on the wind resource and the particular project's financing. Because the electricity from wind farms is sold at a fixed price over a long period of time (e.g. 20+ years) and its fuel is free, wind energy mitigates the price uncertainty that fuel costs add to traditional sources of energy.

Wind creates jobs. The U.S. wind sector employed more than 100,000 workers in 2016, and wind turbine technician is one of the fastest-growing American jobs of the decade. According to the Wind Vision Report, wind has the potential to support more than 600,000 jobs in manufacturing, installation, maintenance, and supporting services by 2050.

Wind enables U.S. industry growth and U.S. competitiveness. Wind has an annual economic impact of about $20 billion on the U.S. economy, The United States has a vast domestic resources and a highly-skilled workforce, and can compete globally in the clean energy economy.

It's a clean fuel source. Wind energy doesn't pollute the air like power plants that rely on combustion of fossil fuels, such as coal or natural gas, which emit particulate matter, nitrogen oxides, and sulfur dioxide—causing human health problems and economic damages. Wind turbines don't produce atmospheric emissions that cause acid rain, smog, or greenhouse gases.

Wind is a domestic source of energy. The nation's wind supply is abundant and inexhaustible. Over the past 10 years, cumulative wind power capacity in the United States increased an average of 30% per year, and wind now has the largest renewable generation capacity of all renewables in the United States.

It's sustainable. Wind is actually a form of solar energy. Winds are caused by the heating of the atmosphere by the sun, the rotation of the Earth, and the Earth's surface irregularities. For as long as the sun shines and the wind blows, the energy produced can be harnessed to send power across the grid.

Wind turbines can be built on existing farms or ranches. This greatly benefits the economy in rural areas, where most of the best wind sites are found. Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land, providing landowners with additional income.

CHALLENGES OF WIND POWER

Wind power must still compete with conventional generation sources on a cost basis. Depending on how energetic a wind site is, the wind farm might not be cost competitive. Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a higher initial investment than fossil-fueled generators.
Good wind sites are often located in remote locations, far from cities where the electricity is needed. Transmission lines must be built to bring the electricity from the wind farm to the city. However, building just a few already-proposed transmission lines could significantly reduce the costs of expanding wind energy.
Wind resource development might not be the most profitable use of the land. Land suitable for wind-turbine installation must compete with alternative uses for the land, which might be more highly valued than electricity generation.
Turbines might cause noise and aesthetic pollution. Although wind power plants have relatively little impact on the environment compared to conventional power plants, concern exists over the noise produced by the turbine blades and visual impacts to the landscape.
Turbine blades could damage local wildlife. Birds have been killed by flying into spinning turbine blades. Most of these problems have been resolved or greatly reduced through technological development or by properly siting wind plants.

Hydro power:

☐ Comes from damming of rivers and utilization of high pressure, its kinetic energy is transformed into turbine blades and used to generate electricity

☐ Minimum water falls height-10 m

☐ Hydro power potential of India-4x1011KW/Hr

Definition

Hydropower or hydroelectricity refers to the conversion of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the sun.

Historically, one of the first uses of hydro power was for mechanical milling, such as grinding grains. Today, modern hydro plants produce electricity using turbines and generators, where mechanical energy is created when moving water spins rotors on a turbine. This turbine is connected to an electromagnetic generator, which produce electricity when the turbine spins.

Hydro plant facilities can be categorized into three sizes: large (>30 MW), small (100 kW - 30 MW), or micro (<100 kW.
Hydropower is the largest contributor of all renewable energy sources and accounts for 6.7% of worldwide electricity production [2][4]. Further growth of this mature technology may be possible, though many countries have already developed cost-effective sites[1].

Hydropower is an abundant, low cost source of power (where applicable), despite high upfront buidling costs[2]. It is also a flexible and reliable source of electricity compared to other renewable options, as it may be stored for use at a later time. Dammed reservoirs can also help with flood control, be a reliable water supply, and may be used for recreational purposes.

Tidal Energy:

Uses the natural motion of tides to fill reservoirs which are then slowly discharged

through electricity producing turbines.
Tidal energy is power produced by the surge of ocean waters during the rise and fall of tides. Tidal energy is a renewable source of energy.

Tidal energy is produced by the surge of ocean waters during the rise and fall of tides. Tidal energy is a renewable source of energy.

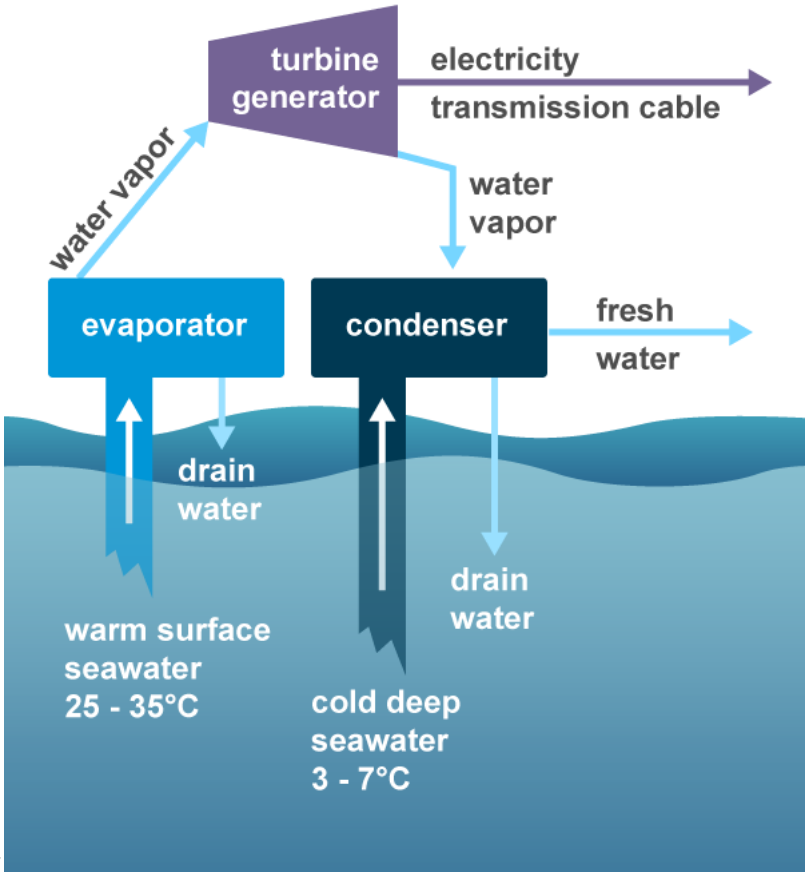
During the 20th century, engineers developed ways to use tidal movement to generate electricity in areas where there is a significant tidal range—the difference in area between high tide and low tide. All methods use special generators to convert tidal energy into electricity.

Tidal energy production is still in its infancy. The amount of power produced so far has been small. There are very few commercial-sized tidal power plants operating in the world. The first was located in La Rance, France. The largest facility is the Sihwa Lake Tidal Power Station in South Korea. The United States has no tidal plants and only a few sites where tidal energy could be produced at a reasonable price. China, France, England, Canada, and Russia have much more potential to use this type of energy.

Ocean thermal energy:

Energy available due to the difference in water temperature. The surface of the
tropical ocean and at deeper level is called OTE. A difference of 200c or more is required for operating OTE power plants.
Ocean thermal energy conversion produces energy from temperature differences in ocean waters
Ocean thermal energy conversion (OTEC) is a process or technology for producing energy by harnessing the temperature differences (thermal gradients) between ocean surface waters and deep ocean waters.

Energy from the sun heats the surface water of the ocean. In tropical regions, surface water can be much warmer than deep water. This temperature difference can be used to produce electricity and to desalinate ocean water. Ocean Thermal Energy Conversion (OTEC) systems use a temperature difference (of at least 77° Fahrenheit) to power a turbine to produce electricity. Warm surface water is pumped through an evaporator containing a working fluid. The vaporized fluid drives a turbine/generator. The vaporized fluid is turned back to a liquid in a condenser cooled with cold ocean water pumped from deeper in the ocean. OTEC systems using seawater as the working fluid can use the condensed water to produce desalinated water.



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Geothermal energy:

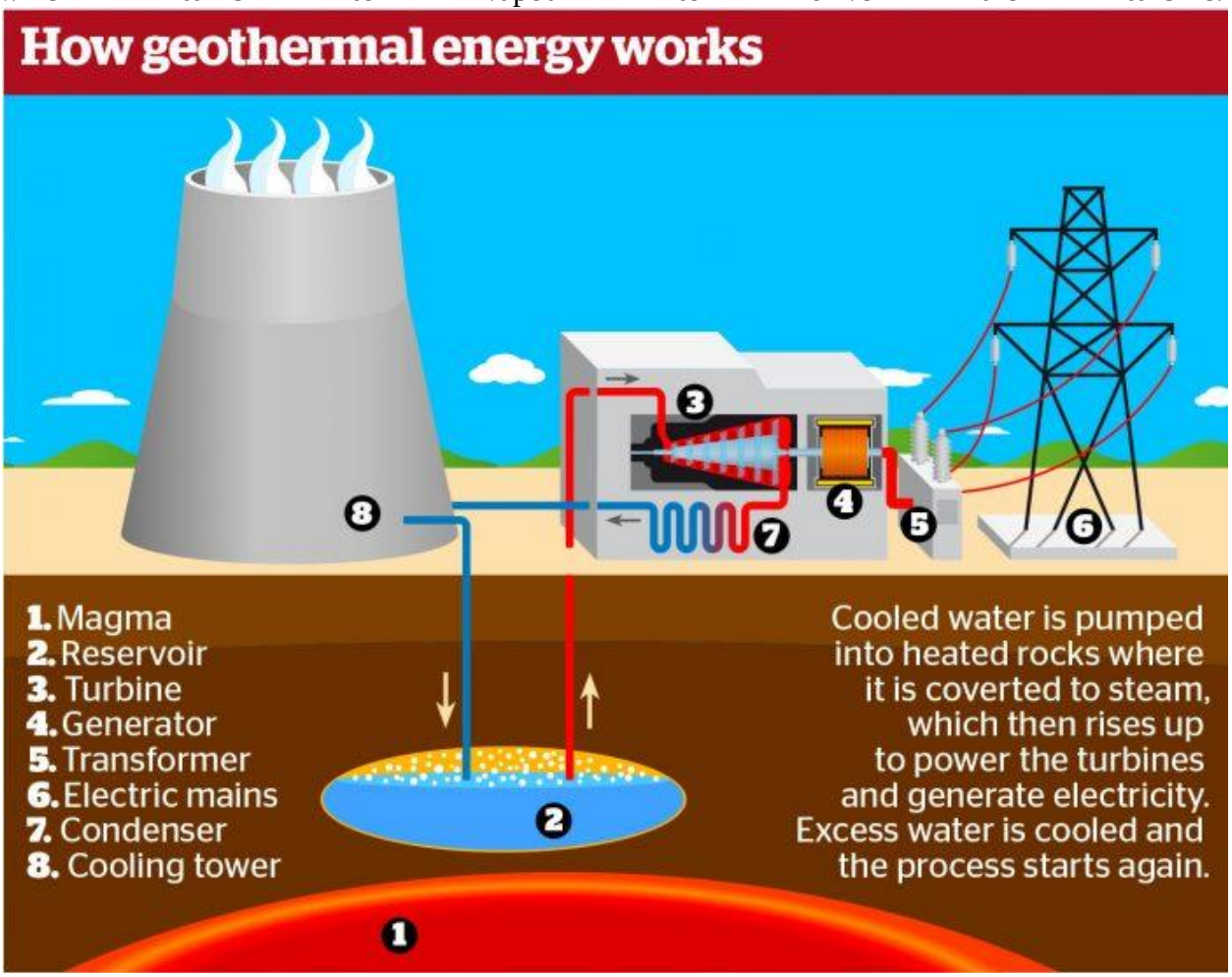
Energy harassed from the hot rocks inside earth. E.g. Natural geysers in Manikaran

Geothermal energy is the heat that comes from the sub-surface of the earth. It is contained in the rocks and fluids beneath the earth's crust and can be found as far down to the earth's hot molten rock, magma.

To produce power from geothermal energy, wells are dug a mile deep into underground reservoirs to access the steam and hot water there, which can then be used to drive turbines connected to electricity generators. There are three types of geothermal power plants; dry steam, flash and binary.

Dry steam is the oldest form of geothermal technology and takes steam out of the ground and uses it to directly drive a turbine. Flash plants use high-pressure hot water into cool, low-pressure water whilst binary plants pass hot water through a secondary liquid with a lower boiling point,

which turns to vapour to drive the turbine.



1.15 LAND RESOURCE

Land is critically important national resource which supports all living organisms including plants and animals. The soil profile of land determines its ability to serve socioeconomic needs.

It has been estimated that more than 5000 million tonnees of top soil is eroded annually along with 5 million tones of nutrients. About 1/3 of this is lost in sea while the rest in reservoirs and rivers leading to flood.

About 38% of the area in India suffers from moderate to high degree of water based erosion. The per capita availability of land in the country has declined from 1.37 hectare in 1901 to 0.33 hectare in 2000. All these lands cannot be utilized for agricultural purpose. Some land would be required for other activities (to maintain urban area).

Effective steps have to be taken for preventing diversion of land suitable for sustainable farming to non-farm uses. Simultaneously, degraded lands and waste lands have to be improved by ecological restoration. The Department of Land Resources was setup in April 1999 by ministry of Rural Development to act as nodal agency for land resource

management.

1.15.1 Land Degradation:

Land degradation is defined as the reduction in soil capacity to produce in terms of quality, quantity goods and services. The definition is also based on

1. Sustainability or ability to produce continuously and indefinitely.
2. Quality of land resource that makes it sustainable or resistant to degradation
1. Carrying capacity or the number of people and animals the land can normally support without significant stress.

Landscapes generally undergo degradation but are usually compensated by nature"s inherent recovering ability. Whenever degradation occur exceeding nature's restorative capacity, the result will be a disaster.

1.15.2 Man induced landslides:

The hill slopes are prone to land slides, landslips, rockslides etc. These hazardous features have reduced the overall progress of the region as they obstruct the roads, communication media and water flow. There are two types of slides

1. Slides due to natural factors
2. Slides induced by man and his activities

Some of the human activities that cause land sliding are

- Massive deforestation
- Erratic agricultural practices
- Road building
- Unscientific quarrying etc.
- Engineering. Constructions

1.15.3 Soil erosion:

1. Terracing: Terracing reduces soil erosion on steep slopes by concerting the land into a series of broad, level terraces. This retains water for crops at each level and reduces soil erosion by water run off.
2. Contour Farming: This method is adopted for gently sloped land. This involves planting crops in rows across the contour of gently sloped land.
1. Alley Cropping or Agro forestry: In this method crops are planted together in strips or alleys between trees and shrubs that can provide fruits and fuel wood. The trees and shrubs provide shade which reduce water loss by evaporation and preserve soil moisture.
4. Wind Breaks or Shelter Belts: Wind breaks and shelter belts or trees are established to reduce wind erosion and also for retaining soil moisture.

1.16 ROLE OF INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES

☐ Natural resources-forest,water,soil,food,mineral and energy

☐ Overuse of these resources cause problems

1.16.1 Conserve water:

☐ Don‟t keep water taps running

☐ Install water saving toilets

☐ Check forwater leaks

☐ Reuse soapy water

☐ Use drip and sprinkling irrigation

☐ Conserveenergy

☐ Turn off lights, fan when not in use

☐ Use solarcooker for cooking

☐ Try riding bicycle

1.16.2 Protect soil:

☐ Don't uproot plants

☐ Grow grass which binds soil andprevent erosion

☐ Make compost

☐ Use green manure

☐ Don‟t over irrigate

☐ Use mixed cropping

1.17 EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLE

☐ Most developed countries like USA, Canada, Japan, Australia have 22% of natural resources, use 88%.73%of its energy and command 85%of its income

☐ Less developed countries has 78% of population, 12% Usage of natural resources, 27% of energy, 15% of income

☐ Gap arises due to increase in population distribution of resources and wealth

☐ Problem solved by equitable distribution of resources and wealth

☐ Global consensus has to be reached for more balanced distribution of basic resources like safe drinking water, food, fuel etc. So poor low developed countries able to sustain their life

☐ Two basic causes of unsustainability are over population in poor countries and over consumption of resources by rich countries generate wastes

☐ Rich countries lower down their consumption level

☐ Poor countries fulfilled by providing them resources

GLOSSARY

Advanced waste water treatment: Removel of any dissolved or suspended contaaminants

beyond secondary treatment.
Biota: All the species of plants and animals indigenous to a certain area.
DDT: An organochloride used as an insecticide.
EPA: The U.S. Environmental Protection Agency.
Erosion: The wearing of land surface by wind or water.
Liner: Barrier designed to prevent the leaching of contents from a land fill.
MLSS: Mixed liquor suspended solids.
Mobile source: A moving source of pollution, such as car or truck.
Nutients: Essential element or compounds in the development of living things.
Rubbish: Solid waste that doesnot contain food waste.
Sludge: The treatment process as particles in waste -> solids.

UNIT-II

ECOSYSTEM

Living organisms cannot be isolated from their non-living environment because the later provides materials and energy for the survival of the farmer.
An ecosystem is therefore defined as a natural functional ecological unit comprising of living organisms and their non-living environment that interact to form a stable self supporting system.

PREREQUISITE DISCUSSIONS

EO Wilson is an entomologist who envisioned that biological diversity was a key to human survival on Earth. He wrote 'Diversity of life' in 1993, which was awarded a prize for the best book published on environmental issues.
He emphasised the risks to mankind due to manmade disturbances in natural ecosystems that are leading to the rapid extinction of species at the global level.
An Indian ornithologist and naturalist, Salim Ali known as the "birdman of India", was among the first Indians to conduct systematic bird surveys across India.
He was instrumental in creating the Bharatpur bird sanctuary (Keoladeo National Park) and prevented the destruction of what is now the Silent Valley National Park. He was awarded India's second highest civilian honour, the Padma Vibhushan in 1976.
His autobiography, **Fall of a sparrow**, should be read by every nature enthusiast. He was our country's leading conservation scientist and influenced environmental policies in our country for over 50 years.

2.2.2 CONCEPTS

Ecology is the study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

Structure of Ecosystem

2. Abiotic or non-living components or physical components
2. Biotic or Living components
3. Energy components

Function of organisms in an ecosystem

☐ Producer (autotrophy): make food; plants, algae

☐ Consumer (heterotrophy): eat other organisms

☐ Decomposer: eat dead organic matter; bacteria and fungi

Classes of Consumers

• Herbivore – primary consumer – eats plants

• Carnivores – secondary – meat eaters; eat herbivores

• Tertiary – feed on carnivores

• Omnivores – eat plants/animals

2.2.3 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.

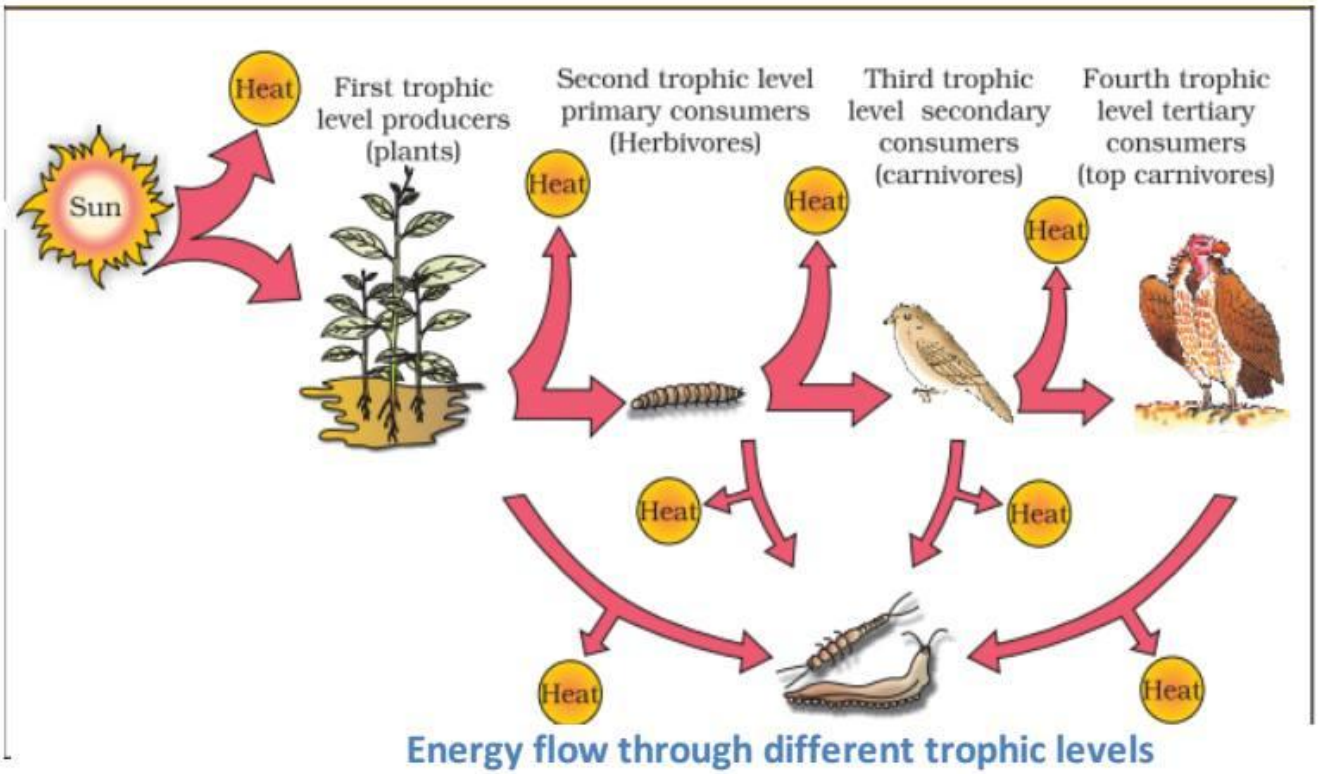
• Glucose is stored as starch in plants

• 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.



Energy Flow

• 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.

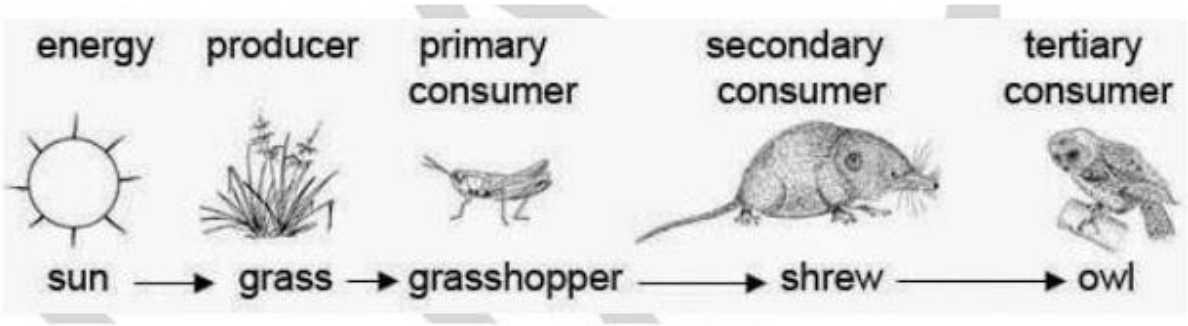
• Only About 1% of energy from the sun is used by green plants & rest remains unutilized.

• 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.

2.2.4 FOOD CHAIN

The chain of transformation and transfer of food energy in the ecosystem from one group of organism to another group through a series of steps or levels is called food chain.



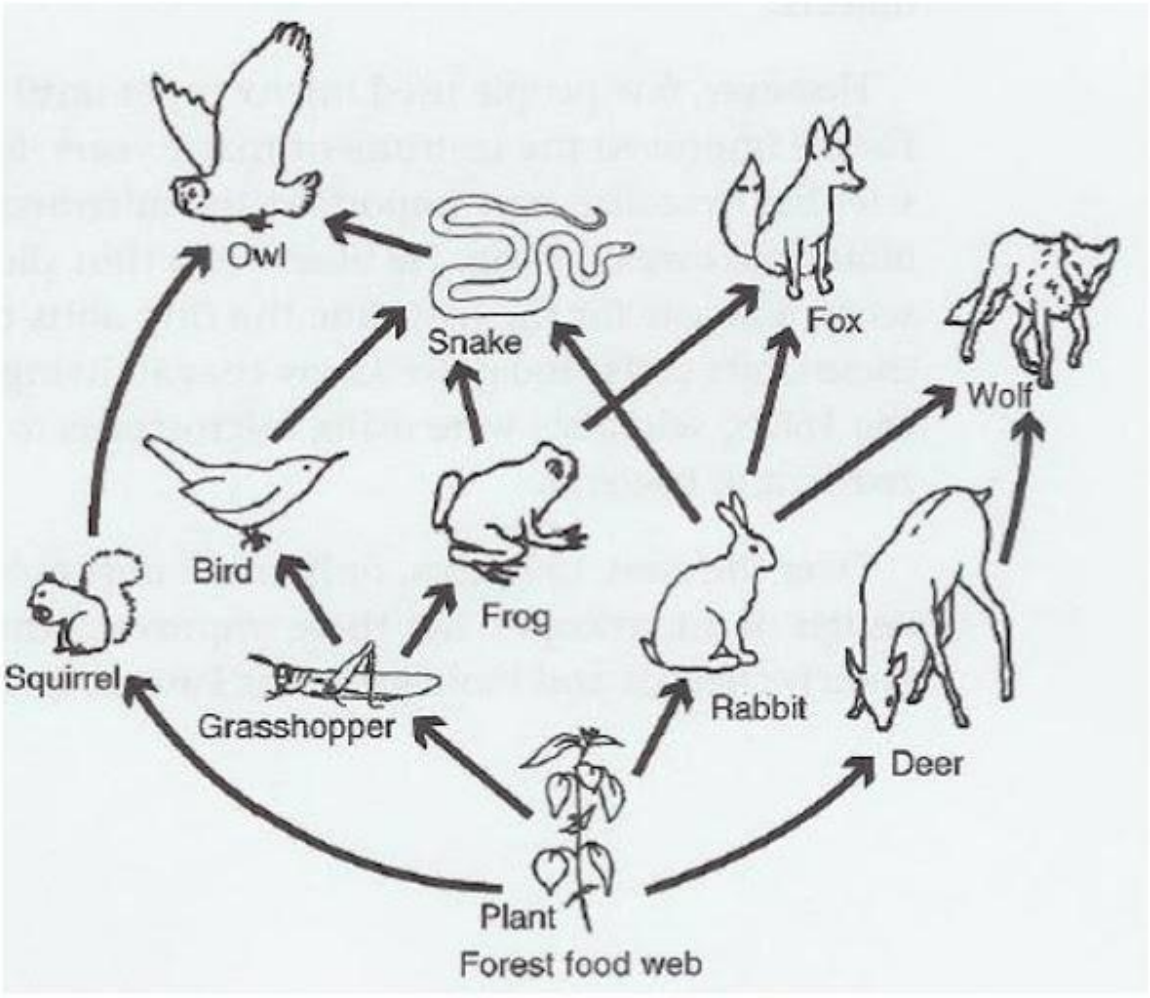
A Food Chain

Two types of food-chains are recognised:

2. Grazing food-chain: In a grazing food-chain, the first level starts with plants as producers and ends with carnivores as consumers at the last level, with the herbivores being at the intermediate level. There is a loss of energy at each level which may be through respiration, excretion or decomposition. The levels involved in a food chain range from three to five and energy is lost at each level. The phytoplanktons →zooplanktons →Fish sequence or the grasses →rabbit →Fox sequences are the examples, of grazing food chain.

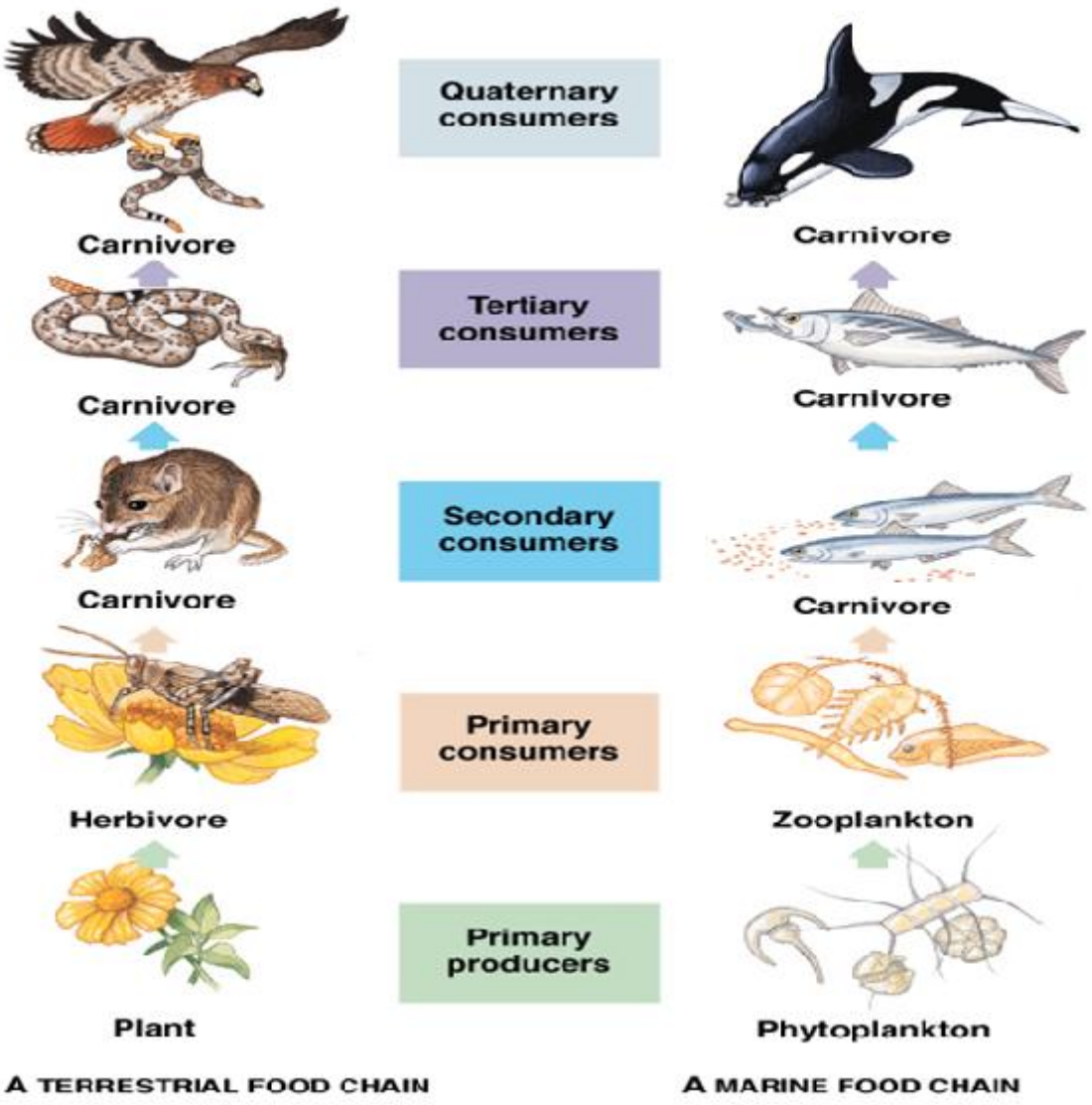
2. Detritus food chain: This type of food chain goes from dead organic matter into microorganisms and then to organisms feeding on detritus (detrivores) and their predators. Such ecosystems are thus less dependent on direct solar energy. These depend chiefly on the influx of organic matter produced in another system. For example, such type of food chain operates in the decomposing accumulated litter in a temperate forest.

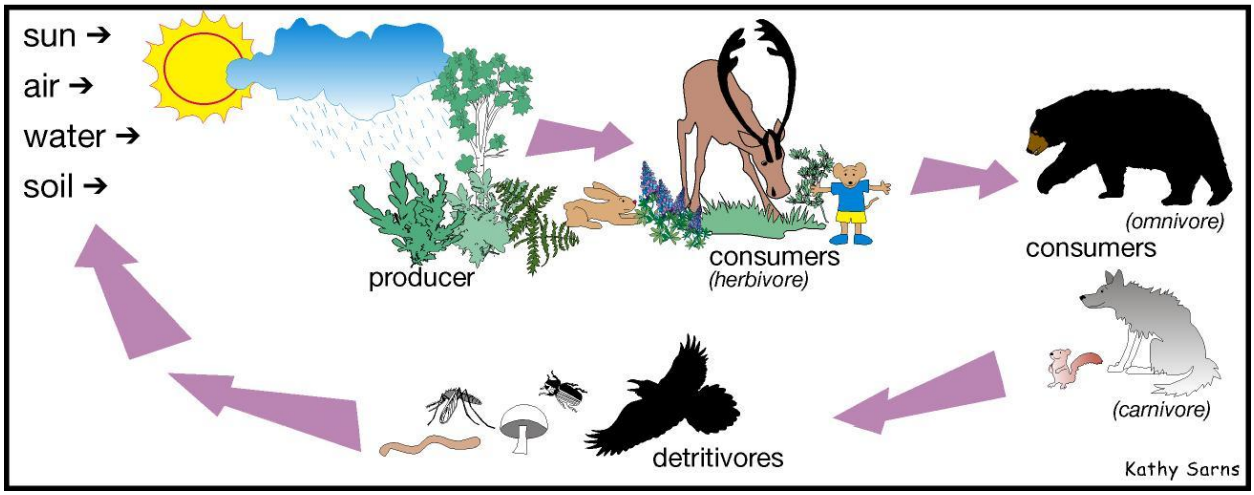
Food Web When the feeding relationship in a natural ecosystem become more complicated, the food chain does not remain simple and linear rather it is also complicated by several inter-connected overlapping food chains.This happens when greater number of species feed on many kinds of prey. Such complicated food chain is called **food web.**



A Food Web

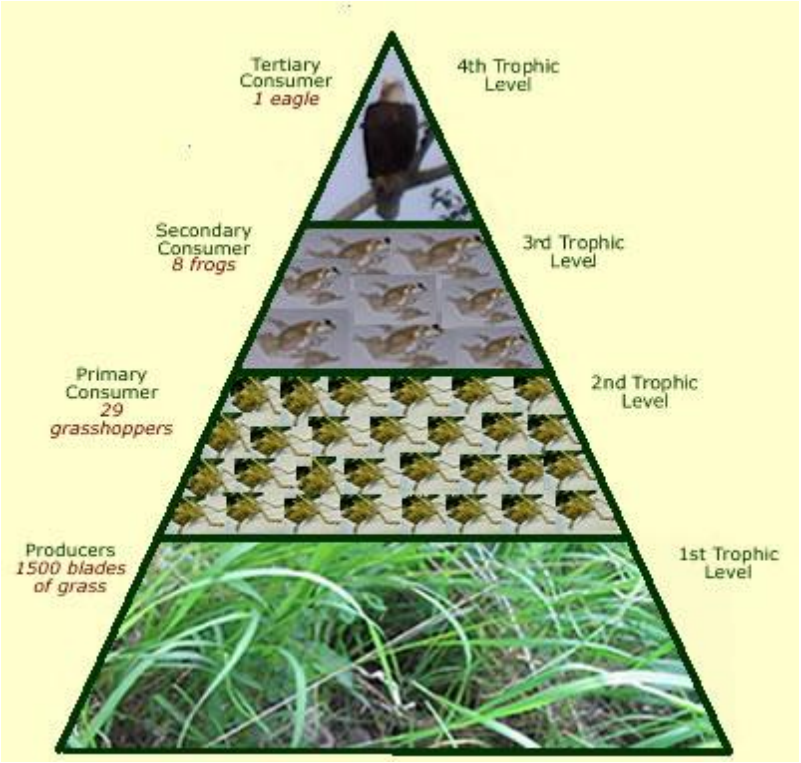
Thus, Energy is passed through the system in food chains and webs. The flow of energy in ecosystems is unidirectional.=> The important point to note is that the amount of energy decreases at successive trophic levels. The number of trophic levels in the grazing food chain is restricted as the transfer of energy follows 10 per cent law– only 10 per cent of the energy is transferred to each trophic level from the lower trophic level.=> Storage of energy in the system is shown by the amount of living material in both the plants and animals present. The amount of living material present is called the **standing crop.**=> This can be expressed in several ways but is usually shown as **biomass** (living material) per unit area, measured as dry weight, ash weight or **calorific value**.=> Usually the amount of standing crop in each trophic level decreases with each step on the food chain away from the plants. This can be shown diagrammatically by Ecological pyramids.


Quaternary consumers
Tertiary consumers
Secondary consumers
Primary consumers
Primary producers
Carnivore
Carnivore
Carnivore
Herbivore
Plant
A TERRESTRIAL FOOD CHAIN
Carnivore
Carnivore
Carnivore
Zooplankton
Phytoplankton
A MARINE FOOD CHAIN


sun →
air →
water →
soil →
producer
consumers
(herbivore)
(omnivore)
consumers
(carnivore)
detritivores
Kathy Sarns

2.2.6 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.

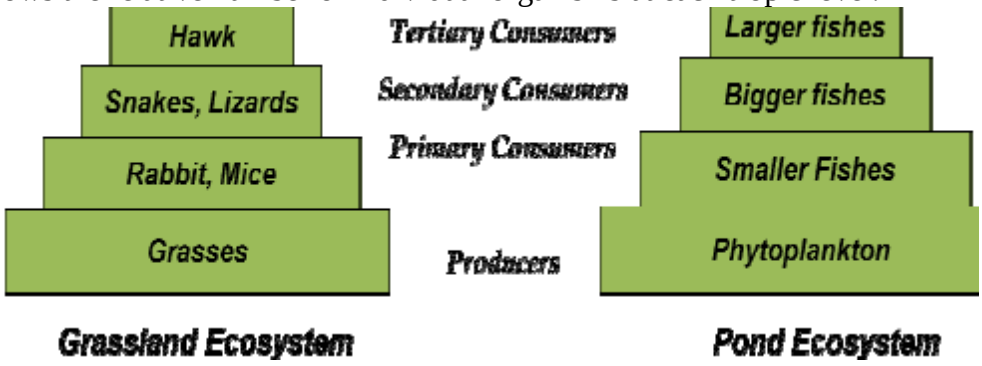


Ecological Pyramid

Types of Ecological Pyramids

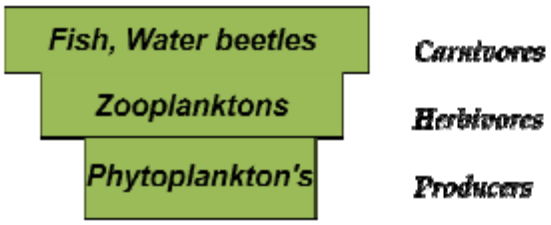
Pyramid of Numbers

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



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.area) of all the organisms in each tropic level at a particular time.



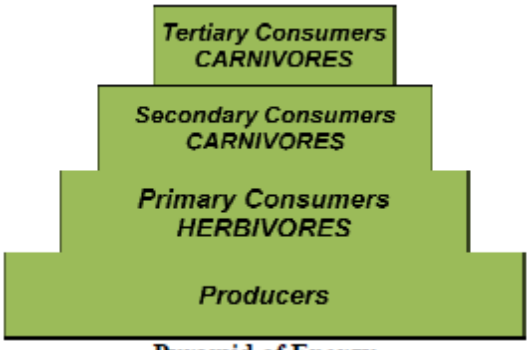
Pyramid of Biomass

Pyramid of Energy

Pyramid of Biomass

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.

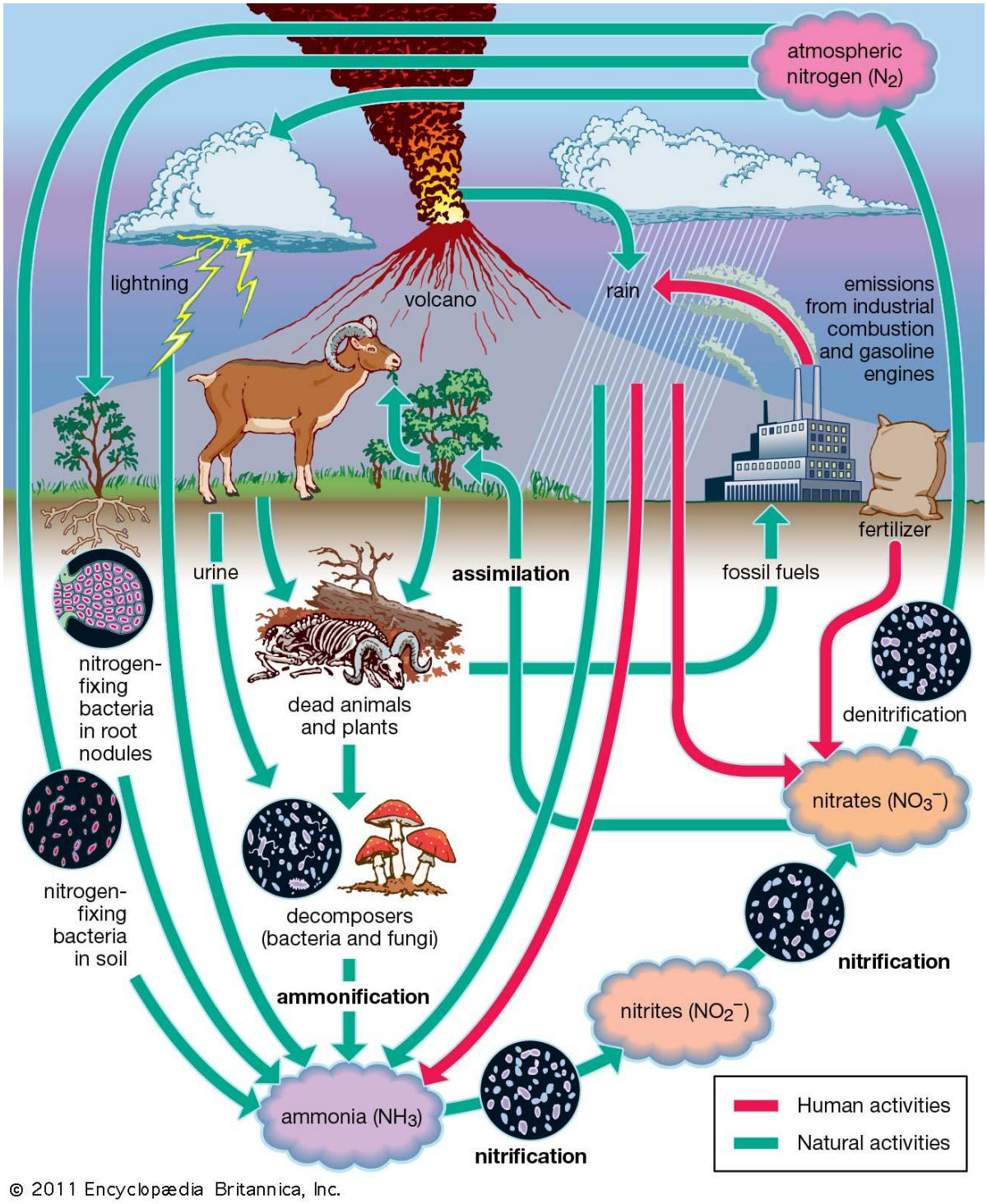


Pyramid of Energy

2.2.7 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

2.2.8 OXYGEN CYCLE

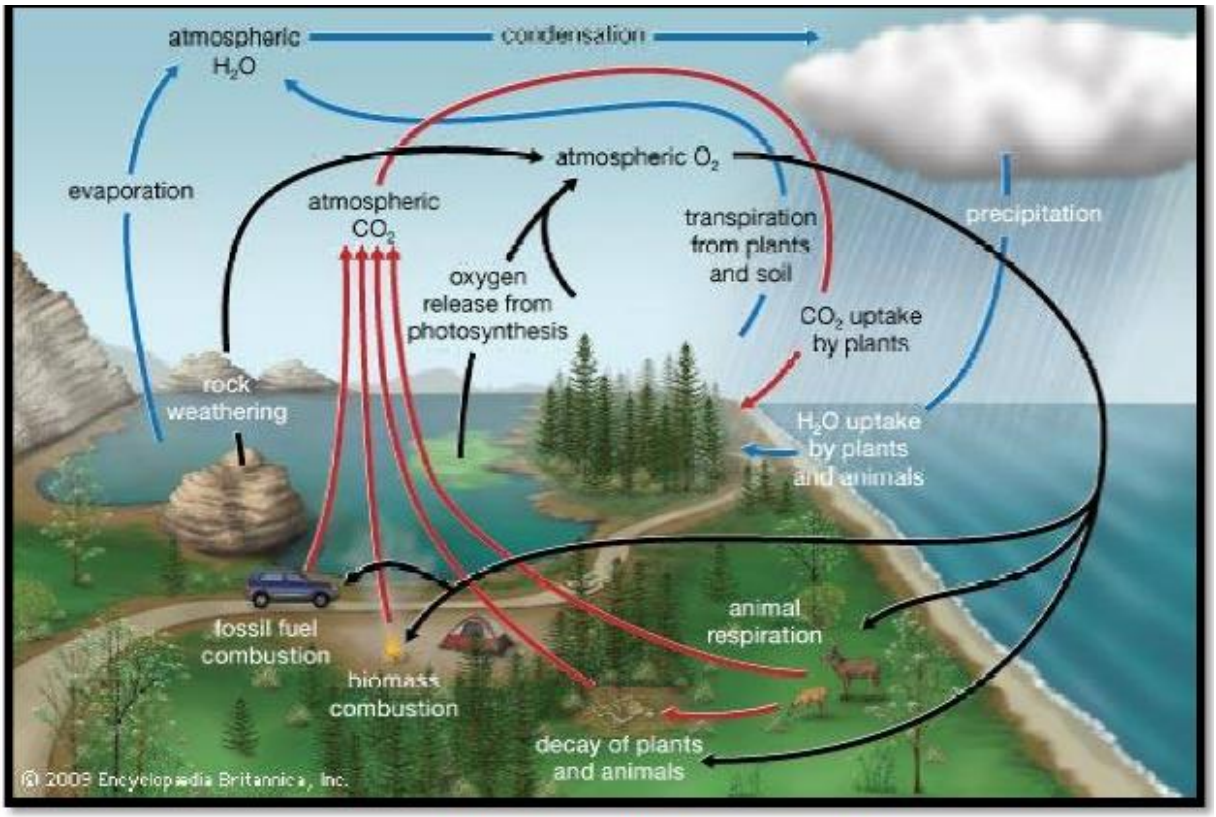
oxygen cycle is the circulation of oxygen in various forms through nature free in the air and dissolved in water.

Oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere.

Plants and animals use oxygen to respire and return it to the air and water as carbon dioxide (CO_2). CO_2 is then taken up by algae and terrestrial green plants and converted into carbohydrates during the process of photosynthesis, oxygen being a by-product.

The waters of the world are the main oxygen generators of the biosphere; their algae are estimated to replace about 90 percent of all oxygen used. example, over time, detritus from living organisms transfers oxygen-containing compounds
such as calcium carbonates into the lithosphere.

Despite the burning of fossil fuel and the reduction of natural vegetation (on land and in the sea), the level of atmospheric oxygen appears to be relatively stable because of the increase in plant productivity resulting from agricultural advances worldwide.



The generalized oxygen cycle

2.2.9 CARBON CYCLE

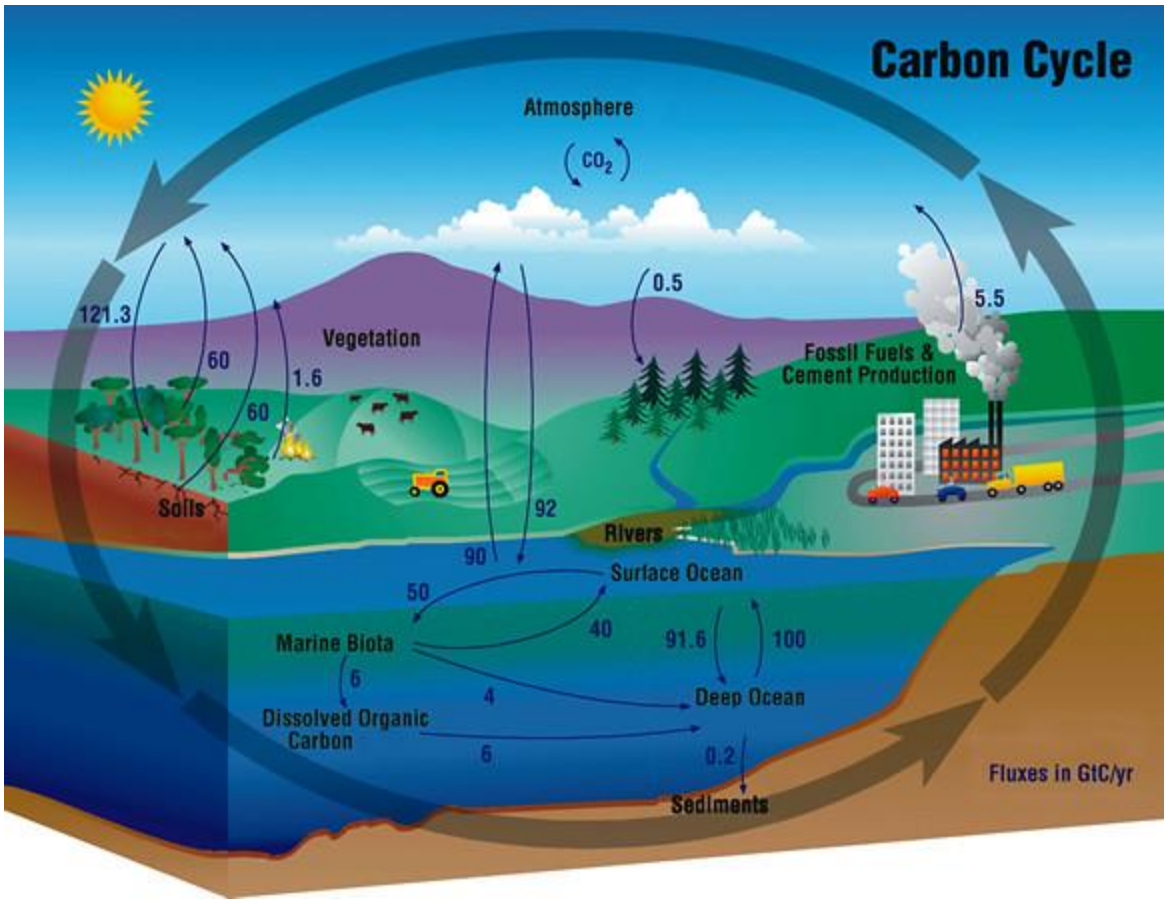
• Carbon enters plants, etc., as CO2

o Bacteria process carbon in a fashion that allows it to be recycled.

o 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.

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

2.2.10 PHOSPHOROUS CYCLE

• The only cycle that does not have a gaseous state.

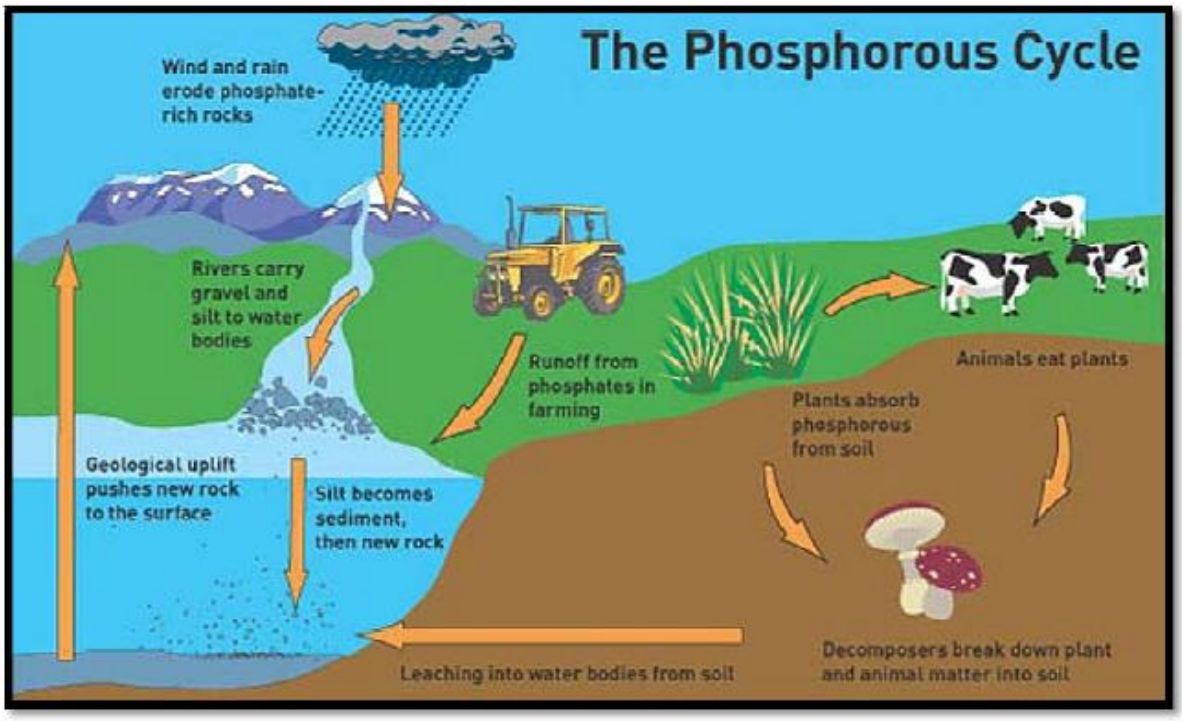
• Inorganic phosphate PO_4^{-3} is released from rocks and sediments through the action of erosion.

• 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.



Phosphorous Cycle

2.2.11 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:

☐ **Primary Succession:** Occurs where there is no soil, e.g. after a volcanic eruption or a glacial retreat.

☐ **Secondary Succession:** Community development in the areas that were previously occupied by another community. It occurs after a disturbance. E.g., loss of trees after disease, Fire or wind, deforestation etc.

Primary Succession Vs Secondary Succession

Primary Succession Vs Secondary Succession

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

2.2.12 FOREST ECOSYSTEM (TERRESTRIAL ECOSYSTEM)

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

Structure and Function of Forest Ecosystem

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 Consumer

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;

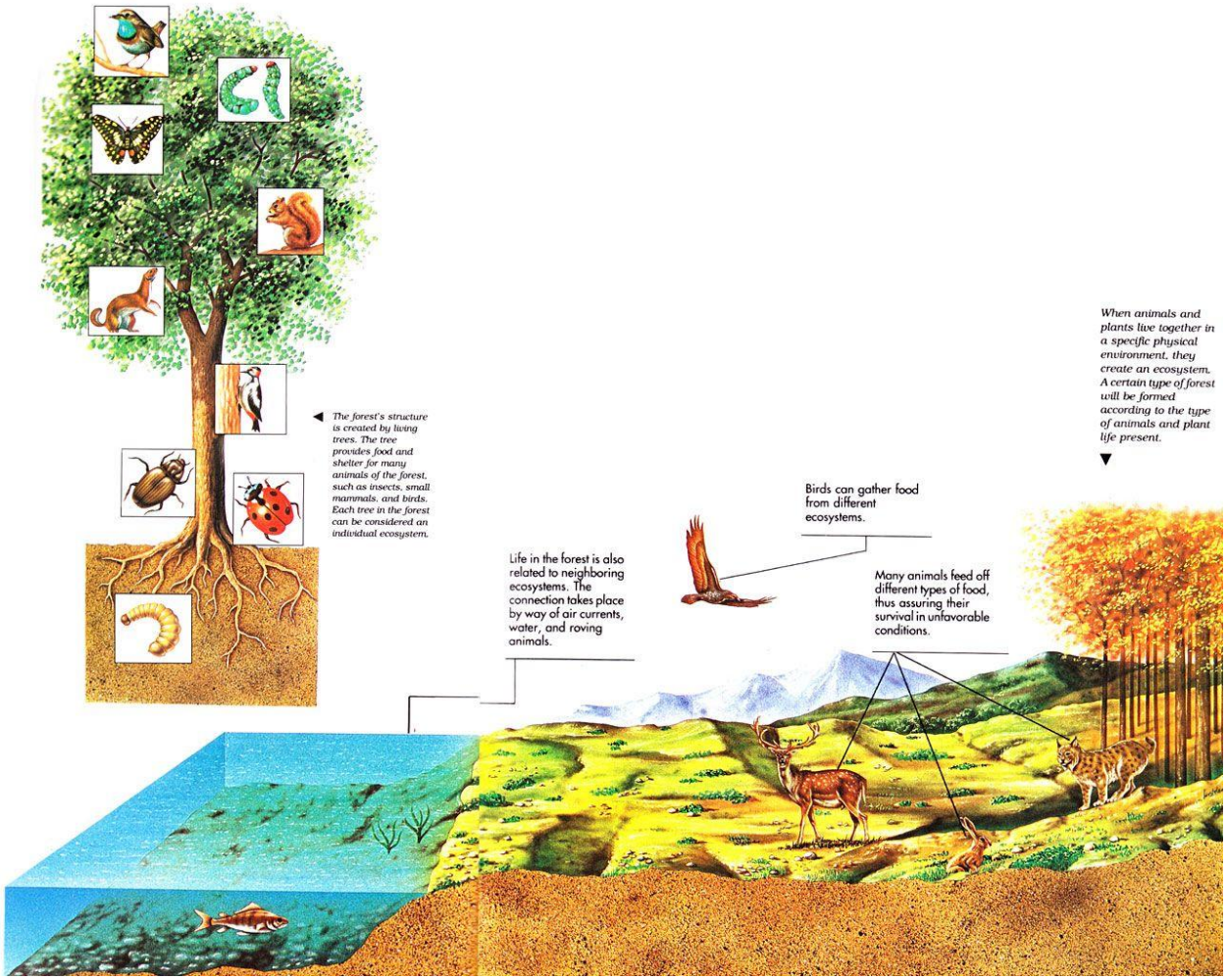
☐ Bacteria (Bacillus Sp., Clostridium sp., pseudomonas.

☐ 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.



Forest Ecosystem

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.

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.

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.

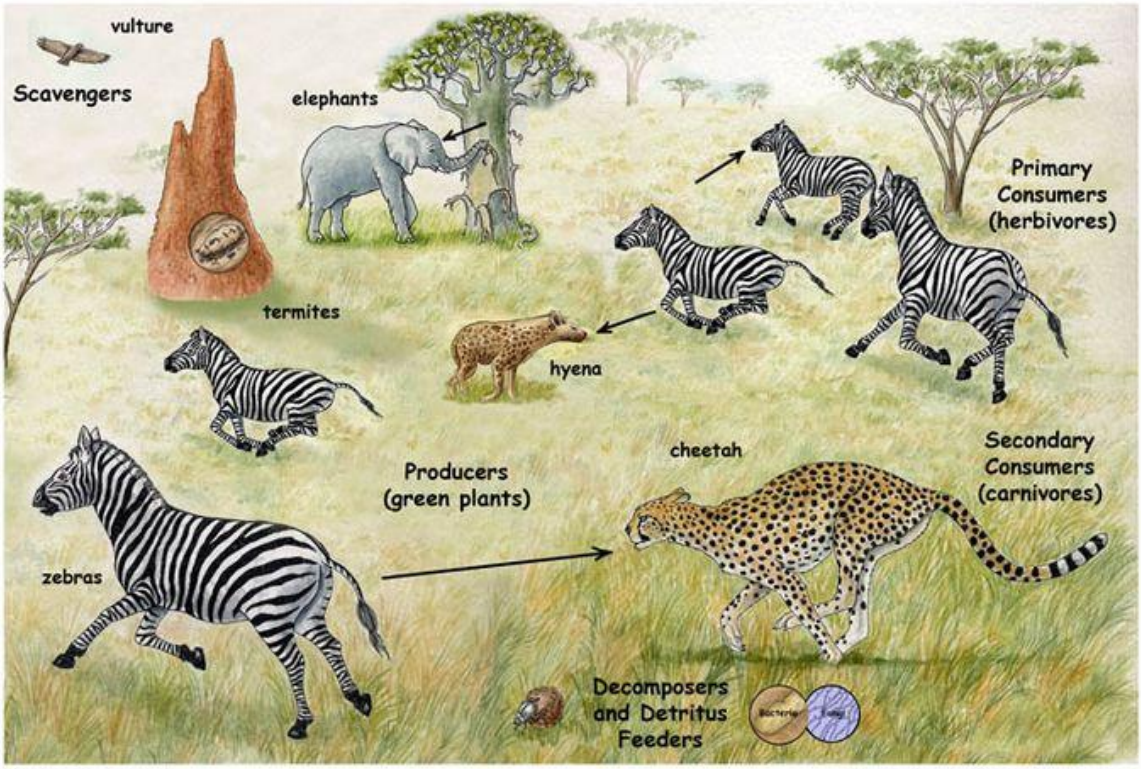
• Therefore, nutrients are released for reuse by producers.

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.

Grassland Food Web



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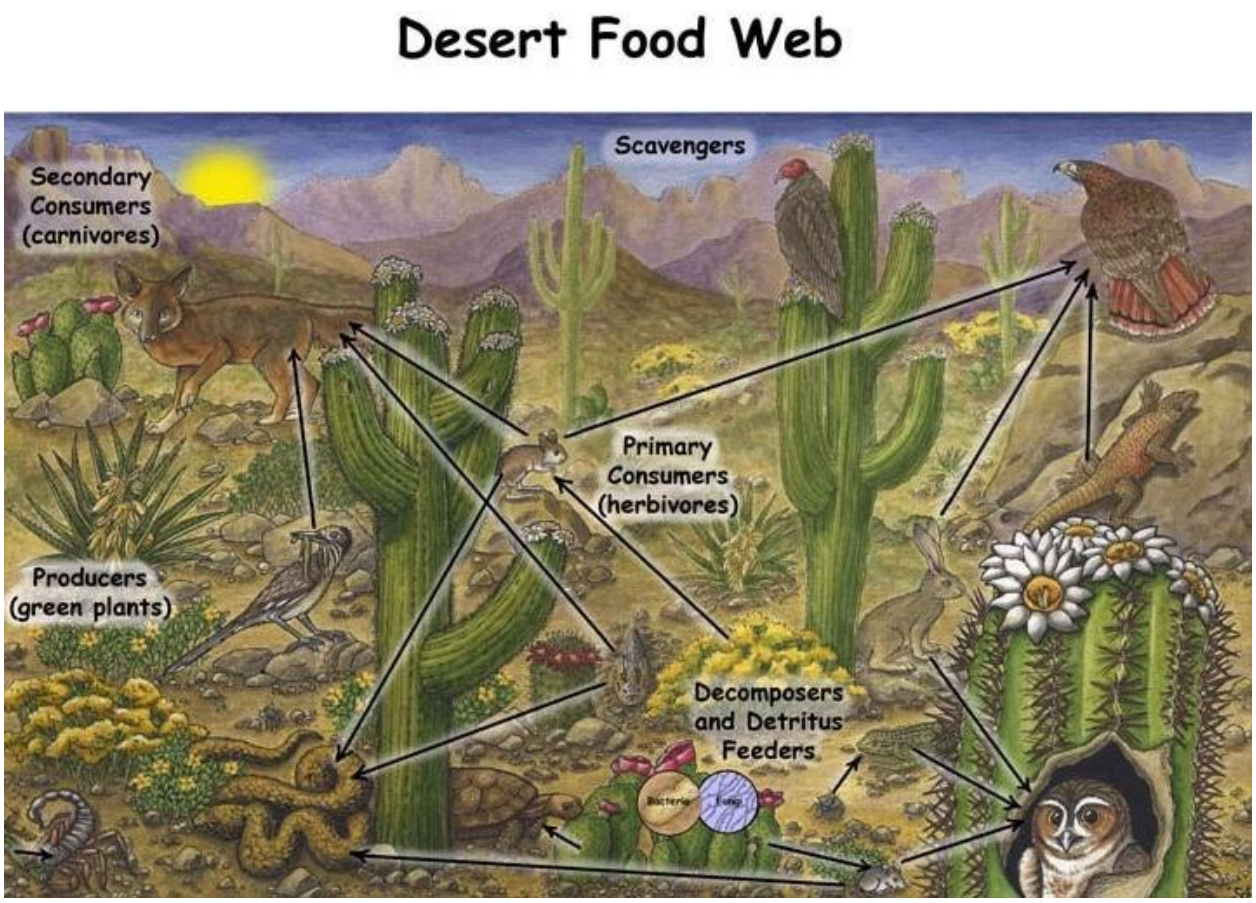


Introduction

• 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.

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.

2.2.15 AQUATIC ECOSYSTEMS

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.

Freshwater Ecosystem

• 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

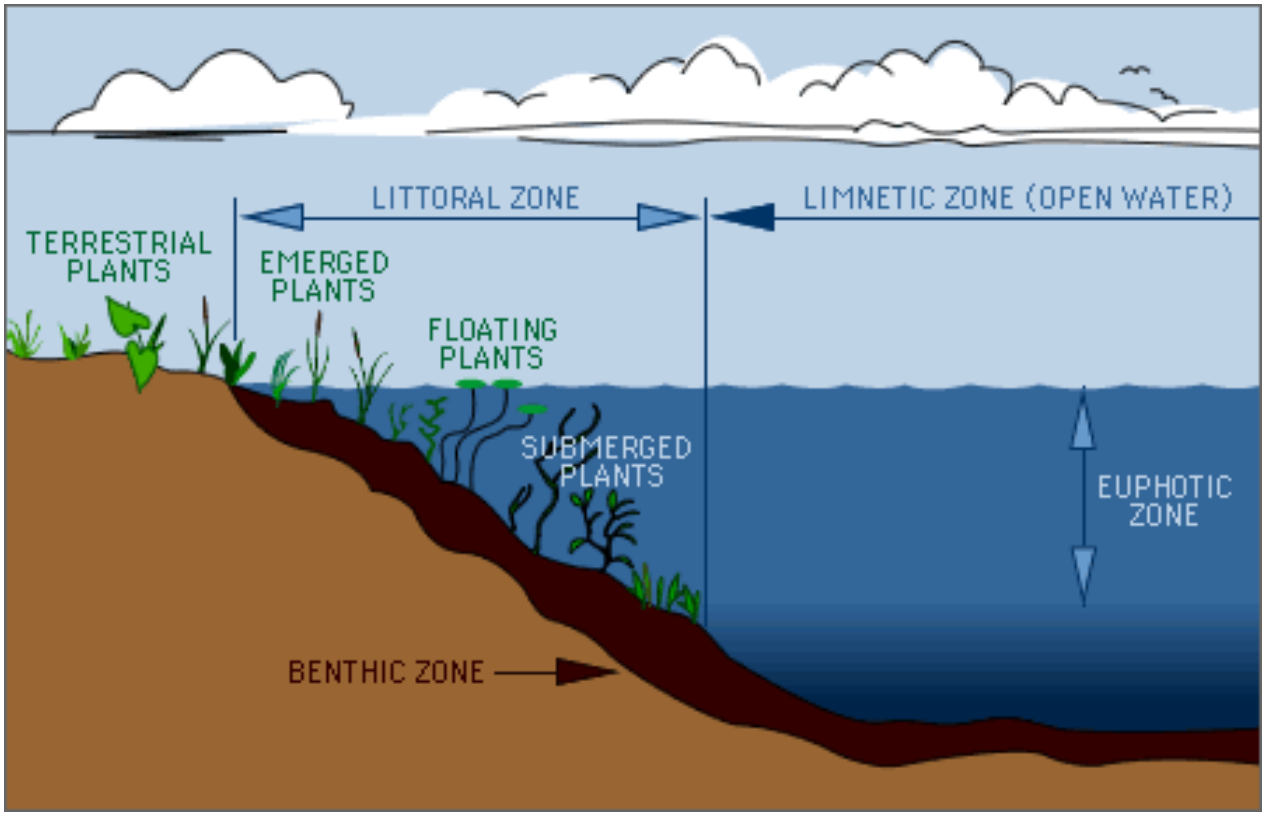
2.2.16 LAKES & POND ECOSYSTEM

• 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.



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.

2.2.17 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.)

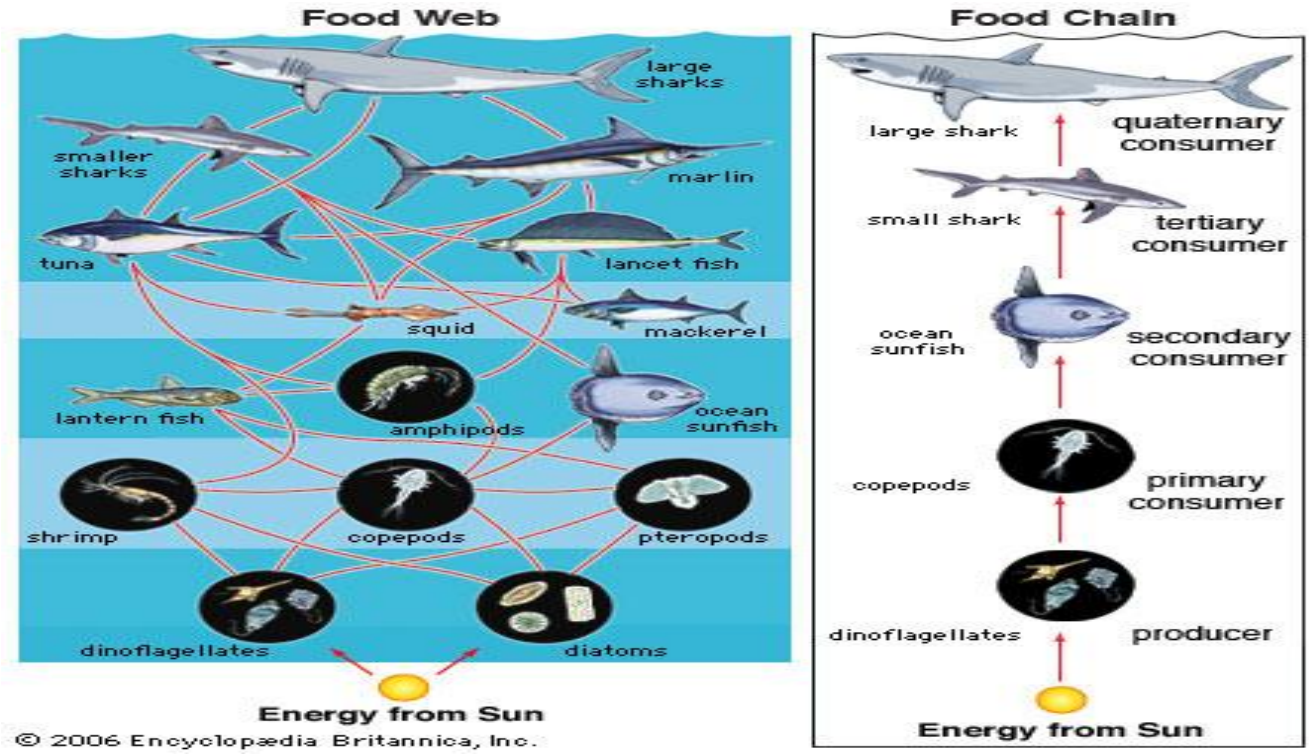
2) Consumers

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.


Food Web
large sharks
smaller sharks
marlin
tuna
lancet fish
squid
mackerel
lantern fish
amphipods
ocean sunfish
shrimp
copepods
pteropods
dinoflagellates
diatoms
Energy from Sun
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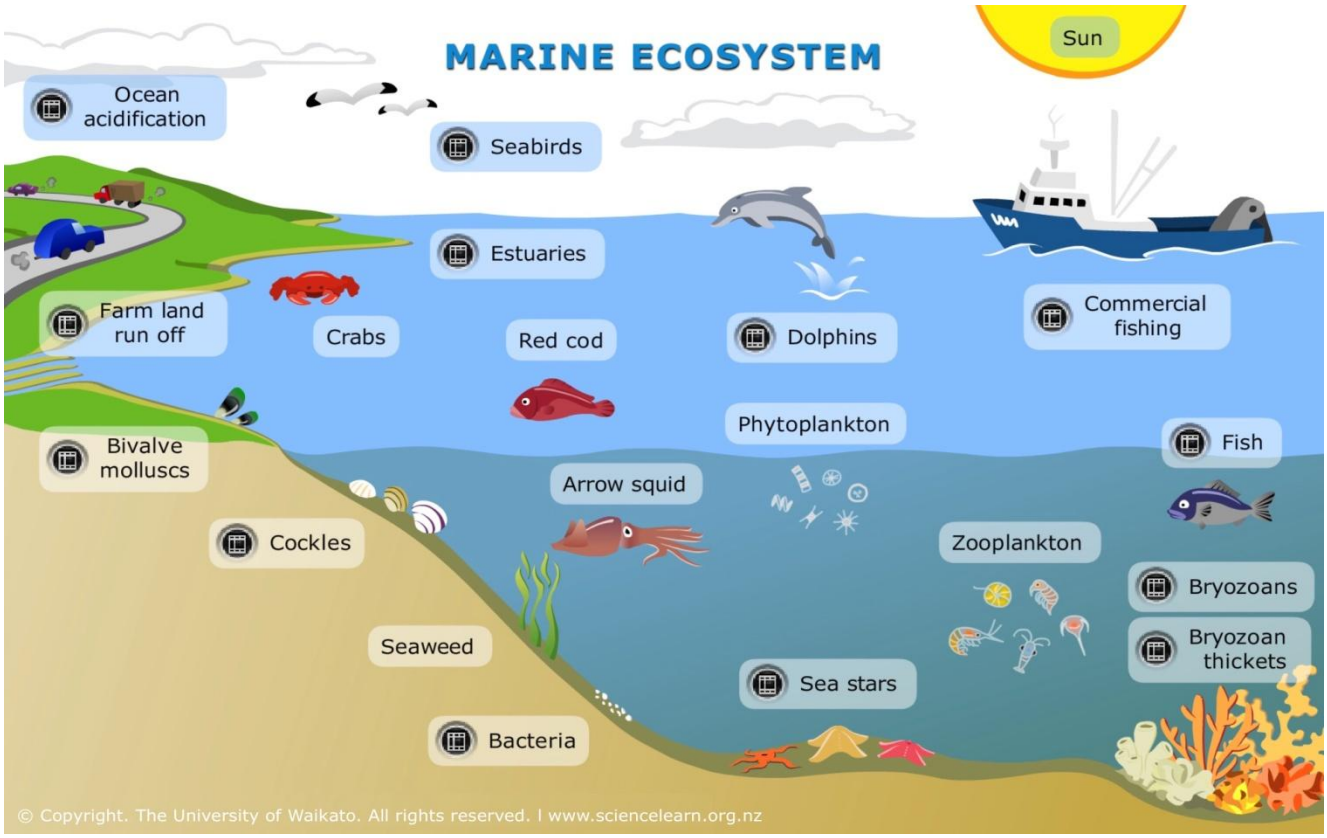
Food Chain
large shark
quaternary consumer
small shark
tertiary consumer
ocean sunfish
secondary consumer
copepods
primary consumer
dinoflagellates
producer
Energy from Sun


MARINE ECOSYSTEM
Sun
Ocean acidification
Seabirds
Estuaries
Farm land run off
Crabs
Red cod
Dolphins
Commercial fishing
Phytoplankton
Fish
Bivalve molluscs
Arrow squid
Cockles
Zooplankton
Bryozoans
Seaweed
Bryozoan thickets
Sea stars
Bacteria
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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.

2.2.18 SIGNIFICANCE OF ECOSYSTEMS

• The food relationship among the different organisms in an ecosystem

• The food chains are the living components of the biosphere

• These are the vehicles of transfer of energy from one level to another

• Through the food chains, transfer of materials and nutrients also takes place

• The movement of some toxic substances (like DDT) in the ecosystem, sprayed to kill the pests and insects, through the various trophic levels, their accumulation at the highest trophic level, etc. can be studied.

2.3 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.

2.3.1 PREREQUISITE DISCUSSIONS

Biologists most often define "biological diversity" or "biodiversity" as the "totality of genes, species, and ecosystems of a region".

It is virtually synonymous with “Life on earth”.

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.

2.3.2 CONCEPTS : LEVELS OF BIODIVERSITY

2. Genetic diversity: It is a level of biodiversity that refers to the total number of genetic characteristics in the genetic makeup of a species.

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.

3. Ecosystem diversity: It refers to the diversity of a place at the level of ecosystems.

2.3.3 BIOGEOGRAPHIC CLASSIFICATION OF INDIA

Our country can be divided into ten major regions based on the geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibians, insects and other invertebrates that live in them.

Each of these regions contain a variety of ecosystems such as forests, grass lands, lakes, rivers, mountains and hills which have specific plant and animals species.

India’s Biogeographic Zones:

2. The cold mountainous snow covered Trans-Himalayan region of ladakh

2. The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttatkhand, Assam and other North-eastern States.

3. The Terrain, the low land where the Himalayan rivers flow into the plains

4. The Gangetic and Brahmaputra plains.

5. The Thar Desert of Rajastan

6. The semi- arid grassland region of the Deccan plateau, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamilnadu

7. The North eastern States of India
8. The Western Ghats in Maharastra, Karnataka and Kerala
9. The Andaman and Nicobar Islands
10. The long western and eastern coastal belt with sandy beaches, forests and mangroves.

2.3.4 VALUES OF BIODIVERSITY

2. Consumptive use:

Drugs: Many plants are used in primary health care. 70% of modern medicines are derived from plant and plant extracts.

Penicillin – fungus is the source – Antibiotic
Quinine – Chincona bark - Malaria treatment
Morphine – Poppy bark – Analgesic

Fuels: Fire woods are directly consumed by villagers.

Food: A large number of wild plants and wild animals are consumed by human beings as food.

2.Productive use:

Biodiversity products have commercial value. These products are marketed and sold. These are derived from animals and plants.

Animal products: Silk from silk worm, Wool from sheep, Musk from musk deer, Leather from animals

Plant Products: Wood for paper and Plywood, Cotton for textile industry, Pearl for pearl industry

3.Social value:

It refers to the manner in which the bio-resources are used in the society. These are associated with the social life, religion and spiritual aspects of the people.

e.g., Holy plants : Tulsi, Lotus, Neem trees
Holy animals : Cow, snake, bull, peacock

4.Ethical value:

It means that a species may or may not be used but its existence in nature gives us pleasure.

e.g., Holy river : River Ganga
Holy tree : Tulsi, Vengai

5.Aesthetic value:

The beautiful nature of plants and animals insists us to protect the biodiversity. Ex) eco-tourism, colour of butterfly, flowers etc.

6.Optional value:

The optional value of biodiversity suggests that any species may be proved to be a valuable species after someday.

2.3.5 BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVELS

Global Level:

Conservative estimates of the existing biodiversity is ten million species, but if estimates for insects are correct then it could be around 30 million species, we have till now enlisted about 2.4 million species.

It includes among others about 98% birds, 95% reptiles and amphibians, 90% fish and about 85% higher plants known to exist on this Earth.

National and Local Level:

India has over 108,276 species of bacteria, fungi, plants and animals already identified and described. Out of these, 84 percent species constitute fungi (22.2 percent), flowering plants (13.9 percent), and insect (49.3 percent). In terms of the number of species, the insecta alone constitute nearly half of the biodiversity in India.

These species occur on land, fresh and marine waters, or occur as symbionts in mutualistic or parasitic state with other organisms. In the world as a whole, 16, 04,000 species of Monera, Protista, Fungi, Plantae and Animalia have been described so far. However, it is estimated that at least 179, 80,000 species exist in the world, but as a working figure 122, 50,000 species are considered to be near reality. Percentage of Different Biota in India.

INDIA

India is the seventh largest country in the world and has the second largest population. There is much diversity in the geographical features: the towering Himalayas and the extensive river plains in the north, the Thar desert in the west, the Deccan Plateau in the centre and the south, the coastal plains to the east and west and the numerous islands. The country has 26 states and 6 union territories.

The rising population has forced the rural poor to borrow against the future by depleting the natural resources. It was reported that the population reached one billion people in 2000, comprising about 16% of the world's population. The problem is further compounded by the high cattle population, estimated to be 450 million; most of these animals have a very low productivity but are allowed to graze freely in forest areas, causing the degradation of forests. It was estimated that the cattle population was 18% of the cattle population in the world. This has led to severe erosion, loss of soil, and floods in the lower plains, in addition to the destruction caused by shifting cultivation. As a result, the demographic and economic landscape of the country is plagued with poverty and underemployment.

Agricultural productivity is only 1 ton per ha against the actual capability of 4 ton per ha. How to achieve the optimum land use, including soil and moisture conservation measures, are the main challenges confronting the policy and decision-makers. To reverse the process of degradation and for the sustainable development of forests, the Government has prepared the National Forestry Action Programme (NFAP). Sixty percent of the forests are located in ecologically sensitive zones. These forests need to be managed in a way to ensure that they are ecologically protected and maintained, as well as sustained at the highest productivity level to meet the growing population's burgeoning demands for fuel, food, fodder, and timber.

India is one of the 17 mega diversity countries, commanding 7% of the world's biodiversity and supporting 16% of the major forest types, varying from alpine pastures in the Himalayas to temperate, sub-tropical, tropical forests, and mangroves in the coastal areas. But nearly half of the country's area is degraded, affected by the problems of soil degradation and erosion. The most common forms of degradation are wind and water erosion, and salinity. About 146 million ha are affected by wind and water erosion, and 7 million ha have become degraded due to excessive salts. About 8.5 million ha are under water logging and about 10 million ha are affected by shifting cultivation.

According to the Government statistics, nearly 22%, or 65 million ha, of the country's land have been recorded as forests, but only 19.5% have forest or tree cover, which is much less than the goal of 33% set by the National Forest Policy, 1988.

India currently has 80 National Parks. These National Parks in turn houses largest number of tigers found in the world, largest number of one-horned rhinos found in the world, now almost extinct Asiatic Lions, and a large percent of elephants. These wildlife animals are but only a part of more than 500 species of mammals that have made India their natural home. Apart from the mammals, India is also blessed with over 2000 species of birds, over 500 species of reptiles and amphibians and around 30000 species of insects including colorful butterflies.

2.3.7 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.

Criteria for determining hot-spots

• Number 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.

2.3.8 THREATS TO BIODIVERSITY

Habitat loss is mainly due to human population growth, industrialization and changes

in the land use patterns, poaching of wild life and man wildlife conflicts.
Poaching: Specific threats to certain animals are related to large economic benefits.
Man wild life conflicts: Conflicting situations with wild life starts causing immense damage and danger to man.

2.3.9 ENDANGERED AND ENDEMIC SPECIES OF INDIA

• 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. About62% 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.

2.3.10 CONSERVATION OF BIODIVERSITY

In general biodiversity is generally disturbed by human activities. To solve the problems, it is essential to protect our bio diversity by two ways.
2. In-situ or on-site conversion
2. Ex-situ conservation
In-situ conservation:

• Conservation of species in its natural habitat, in place where the species normally occurs

• The strategy involves establishing small or large protected areas, called protected areas

• Today in world, there are 9800 protected areas and 1500 national parks

Methods:
2. Nature or biosphere reserves (Eg) Nilgiri Bio reserve
2. National parks and sanctuaries (Eg) Mudumalai, vedanthangal
3. On farm and home garden conservation for plants, vegetables and fruits to maintain traditional crop varieties.
Ex- situ conservation:

• It involves maintenance and breeding of endangered plant and animal species under

partially or wholly controlled conditions in zoos, gardens and laboratories

• The crucial issue for conservation is to identify those species which are more at risk of extinction.

Methods:

2. Long term captive breeding
2. Shortage term propagation and release
3. Animal translocation and re introductions

4. Seed bank
5. Reproductive technology

i. Embryo transfer technology
ii. Cloning

2.3.11 SIGNIFICANCE OF BIODIVERSITY

Biosphere is a life supporting system to the human race. Each species in the biosphere has its own significance.

It is the combination of different organisms that enables the biosphere to sustain human race. Biodiversity is vital for a healthy biosphere.

Biodiversity is must for the stability and proper functioning of the biosphere.

Besides these biodiversity is so important due to having consumptive use values, productive use values, social values, ethical values, aesthetic values and option values.

GLOSSARY

Abiotic: A non-living component of the environment

Biodivetsity: The variety and variability of different living organisms

Biotic: Of or relating to life

Conservation: Not wasting and renewing when possible

Consumers: Organisms which consume protoplasm produced from photosynthesis directly or indirectly

Decomposers: Organisms which utilize energy from wastes or dead organisms and complete the cycle by returning the nutrients to the soil or water and CO2 to air

Ecological Succession: The sequential replacement of one vegetative community by another through a series of stages

Ecosystem: A community of living things interacting with one another and with their physical environment

Endangered Species: A species threatened with extinction

Endemic: Peculiar to a certain region or country; native to a restricted area; not introduced

Producers: Autotrophic organisms which produce protoplasm using inorganic carbon and energy from sun

Species: A group of organisms capable of interbreeding with members of other species.

ENVIRONMENTAL POLLUTION

3.1 ENVIRONMENTAL POLLUTION

Any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil) which can cause harmful effects on various forms of life or property.

3.1.1 PREREQUISITE DISCUSSIONS

Pollution is derived from Latin word 'polluere' which means 'to contaminate' any feature of environment.

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.

This occurs only when short term economic gains are made at the cost of long term ecological benefits of humanity.

Soil is a natural resource for which there is no substitute. Environmental historian Donald Worster reminds us that fertilizers are not a substitute for fertile soil.

Soil cannot be manufactured with a tank of chemicals. Soil is formed from the parent material by physical and chemical weathering of rocks. Climate and time are also important in the development of soils.

Extremely dry or cold climates develop soils very slowly while humid and warm climates develop them more rapidly. It is a thin covering over the land consisting of a mixture of minerals, organic material, living organisms, air and water that together support the growth of plant life.

The organic portion, which is derived from the decayed remains of plants and animals, is concentrated in the dark uppermost "top soil".

The inorganic portion, which is made up of rock fragments, is formed over thousands of years by physical and chemical weathering of bedrock. We may enhance the soil by helping its processes along, but we can never recreate what we destroy.

Pollution may be local, regional, trans-boundary or global. The agent which causes pollution is called pollutant.

3.1.2 CONCEPTS

Pollutants can be classified as:

1. Degradable or non persistent pollutants: These can be rapidly broken by natural processes. Eg. Domestic sewage, discarded vegetables etc.

3. Slowly degradable or persistent pollutants: These remain in the environment for many years in an unchanged condition and take decades or longer to degrade. Eg:DDT

3. Non degradable pollutants: These cannot be degraded by natural processes. Eg:Toxic elements like lead or mercury and nuclear wastes

Types of environmental pollution:-

1. Air pollution
3. Water pollution
3. Soil pollution
4. Marine pollution
5. Noise pollution
6. Thermal pollution
7. Nuclear hazards

3.2 AIR POLLUTION

Air pollution occurs due to the presence of undesirable solid or gaseous particles in the air in quantities that are harmful to human health and environment.

It can be defined as presence of foreign matter either gaseous or particulate or combination of both in the air which is detrimental to the health and welfare of human beings.

Pollutants that are emitted directly from identifiable sources are produced by natural events can be in the form of particulate matter or gaseous form. These are called primary pollutants Ex: Dust storms and volcanic eruptions and through human activities like emission from vehicles, industries etc.

There are five primary pollutants that contribute to 90% of global air pollution. These are carbon oxides (CO & CO2), N oxides, sulphur oxides, volatile organic compounds and suspended particulate matter.

The pollutants that are produced in the atmosphere, when certain chemical reactions take place among the primary pollutants and with others in the atmosphere are called secondary air pollutants. Eg: Sulphuric acid nitric acid, carbonic acid and acid rain.

Particulates are small pieces of solid material.

Particulate matter can be

1) Natural such as dust, seeds, spores, pollen grains, algae fungi, bacteria and viruses
2) Anthropogenic such as mineral dust, cement, asbestos dust, fibres, metal dust, fly ash smoke particles form fires etc.

3.3.1 Causes of Air pollution

☐ Air pollution may originate from one or more variety of sources. The natural pollution includes sources such as oceanic aerosol, volcanic emissions, biogenic sources, windblown terrestrial dust and lightening.

☐ The artificial pollution generates from human activities and includes sources such as fuel burning, refuge burning, transportation, construction of buildings, chemical factories, metallurgical factories and, vehicles.

☐ The third category includes solvent usage and sources include spray painting and solvent extraction. Automobiles are the first rate of polluters. Industries occupy second position.

3.3.2 Effects of Air Pollution

• Effects on human health: Particulates cause carcinogenic effects, accumulate in lungs and interfere with ability of lungs to exchange gases. Prolongeal exposure causes lung cancer and asthma.

• Effects on plants: Gaseous pollutants enter the leaf pores and damage the leaves of crop plants, interfere with photosynthesis and plants growth and reduces nutrient uptake and causes the leaves to turn yellow, brown or drop off altogether.

• On materials: Air pollutants break down the exterior paint on cars and houses.

• Effect on stratosphere: The upper stratosphere consists of considerable amounts of ozone, which works as an effective screen for UV light. Presence of certain pollutants can accelerate the breakdown of ozone. Depletion of ozone effects human health, food productivity and climate

3.3.3 Control measures

Two approaches

1. Preventive technique
3. Effective control

includes devices for removal of pollutants form fuel gases through scrubbers, closed fuel collection recovery systems.

Using unleaded petrol for vehicles is another way of control. Industries should be carefully located so as to minimize the effect of pollution after considering topography and wind directions.

Mechanical devices such as scrubbers, cyclone separator, bag houses & electro-static precipitators, reducing particulate pollutants.

3.3.4 MECHANISM OF PEROXYACYL NITRATES(PAN) GENERATION

In the atmosphere peroxyacyl nitrates are not generated as they are; they are generated in situ by photochemical reactions having NO_x and VOC as precursors.

Depending on organic radical, peroxyacyl nitrates can be: peroxy acetyl nitrates (PAN): $CH_3C(O)OONO_2$; peroxy propionyl nitrates (PPN): $CH_3CH_2C(O)OONO_2$; peroxy nbutyryl nitrates (PnBN): $CH_3CH_2CH_2C(O)OONO_2$ etc. Among these, PAN plays an important in atmospheric chemistry.

The reactions of PAN formation are based on generation of acetyl radicals by radiation of some VOC (hydrocarbons, alcohols, aldehides).

In addition to the reaction with NO_2, peracetyl radical can also react with NO generating NO_2 and CH_3 radicals. These species generate formaldehyde by oxidation.

PAN decomposition occurs only in the presence of NO. The rate of PAN decomposition increases fast with the temperature. In the atmosphere PAN concentration depends on temperature, NO_2/NO ratio (competition between reaction 3 and 4 and VOC availability and reactivity VOC can generate acetyl radicals). Therefore, the relationship between PAN in the air and the emission of its precursors (VOC and NOx) is not linear and, in the same time dependent on O_3, VOC and NOx concentrations.

Acyl radicals having a higher number of carbon atoms (propionyl-, n-buthyryl-) generates PPN or PnBN, and not PAN. Ethanol as direct precursor can be oxidized to acetaldehyde.

PPN/PAN ratio can be an index of the impact of using ethanol as an additive for vehicles fuels compared to using gasoline. Both PPN day variation and ratio PPN/O3 are similar to those for PAN.

3.3.5 FORMATION OF SMOG

Smog is a yellowish fog caused by a mixture of atmospheric pollutants and it consists mainly of fine particles and ozone. The latter is the product of complex photochemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOC), which are called “precursors”. The main sources of these pollutants are motor vehicles, industrial processes and the heating of buildings.

Fine particles are released directly into the air by motor vehicles, industrial processes and heating, especially wood burning, or are created in the atmosphere following the

chemical reactions of precursor pollutants such as sulfur dioxide (SO2) and nitrogen oxides (NOx) in the air.

Smoggy day in Québec, February 02, 2005

Smog-creating pollutants can originate on the other side of the border or locally. The winds bring the precursor pollutants and ozone from southern Ontario and the central US. These then combine with the contribution from urban areas in Québec.

3.3.6 FORMATION OF OXYGEN

Free oxygen gas was almost nonexistent in Earth's atmosphere before photosynthetic archaea and bacteria evolved, probably about 3.5 billion years ago. Free oxygen first appeared in significant quantities during the Paleoproterozoic eon (between 3.0 and 3.3 billion years ago). For the first billion years, any free oxygen produced by these organisms combined with dissolved iron in the oceans to form banded iron formations. When such oxygen sinks became saturated, free oxygen began to outgas from the oceans 3–3.7 billion years ago, reaching 10% of its present level around 1.7 billion years ago.

The presence of large amounts of dissolved and free oxygen in the oceans and atmosphere may have driven most of the anaerobic organisms then living to extinction during the Great Oxygenation Event (oxygen catastrophe) about 3.4 billion years ago. However, cellular respiration using O_2 enables aerobic organisms to produce much more ATP than anaerobic organisms, helping the former to dominate Earth's biosphere. Cellular respiration of O_2 occurs in all eukaryotes, including all complex multicellular organisms such as plants and animals.

Since the beginning of the Cambrian period 540 million years ago, O_2 levels have fluctuated between 15% and 30% by volume. Towards the end of the Carboniferous period (about 300 million years ago) atmospheric O_2 levels reached a maximum of 35% by volume, which may have contributed to the large size of insects and amphibians at this time. Human activities, including the burning of 7 billion tonnes of fossil fuels each year have had very little effect on the amount of free oxygen in the atmosphere. At the current rate of photosynthesis it would take about 2,000 years to regenerate the entire O_2 in the present atmosphere.

3.3.7 CONTROL OF PARTICULATE AND GASEOUS EMISSION

Gaseous effluents, such as flue gases and off-gases, must be monitored carefully in order to control: Plant operation Emission of pollutants, and sometimes both. Either oxygen or carbon dioxide is monitored, in order to verify the excess of combustion air. This factor determines the thermal efficiency of the boiler plant. The quality of combustion (addressed in detail in *Pollution Control through Efficient Combustion Technology*) can be derived from few parameters, such as CO, TOC or sooting (Ringelmann or Baccharach value).

Pollutants proportion may be measured on the basis of a wide range of general emission parameters. Frequently covered are the values for dust, heavy metals, CO, SO_2, NO_x, C_xH_y, TOC, and HCl (for incinerators). Rarely measured are SO_3, Cl_2 and N_2O. Specific compounds are either process or raw materials related, e.g. fluorides from enamels, phosphoric acid or aluminum production.

The nature and limit values of the parameters to be monitored and the method and frequency of their determination are given in general codes and also in specific conditions, stipulated in operating permits. Detailed procedures vary from country to country, although

E.U.-Directives and Federal Codes may decide on minimum requirements and also on measures to be taken (notification, even halting plant operation) in case limit values are being exceeded for a specified time period.

Emissions Control of NOx, SO_2

NOx Control: SCR, and SNCR *Selective Catalytic Reduction (SCR).* The SCR process consists of injecting ammonia upstream of a catalyst bed. It is critical to the design of the SCR to produce efficient and complete mixing prior to the ammonia making contact with the catalyst surface. NOx combines with the ammonia embedded on the catalyst surface, and is reduced to molecular nitrogen through the activation energy of the catalyst. SCR is capable of over 95 percent NOx *reduction (reference Peerless Mfg. Co. Dallas, Tx.*)

Titanium Oxide in a homogenous extruded substrate is the SCR catalyst material most commonly used, though vanadium pentoxide, noble metals, or zeolites are also used, depending on the type of fuel and operating temperature of the exhaust gas. The ideal operating temperature for a conventional SCR catalyst is 400 to 750 °F. New catalyst formulations have been developed which extent these temperature ranges. However, with these new catalyst formulations are associated deeper catalyst beds which increase pressure drop, shorter catalyst life, and higher capital cost, etc.

Typically, the catalyst reactor is mounted on a spool piece, located within the exhaust stack or in the discharge duct before the stack section, at a location where the gas temperature of a boiler is typically in the ideal range of 450 to 750 "F. High temperature zeolite SCR catalysts for applications have been developed that permit continuous SCR operation at temperatures as high as 1050 F. High temperature SCR catalysts must be used with applications where exhaust temperature ranges from 850 to 1000 F range.

A certain amount of ammonia slip occurs when using SCR. Ammonia slip is usually limited by permit conditions to 5 or 20 ppm, corrected to 3 percent 03. Ammonia is classified as an air toxic compound in California. Ammonia passing through the SCR and emitted to atmosphere can combine with nitrate (NOx) or sulfate (S04) in the ambient air to form a secondary particulate, either ammonium nitrate or ammonium sulfate. Based on 1995 District data, ambient NOx and S04 concentrations are greater than ambient ammonia concentrations.

SO2 Control SO2 control is briefly discussed for completeness, however not considered applicable in a natural gas only environment.

The wet venturi scrubbing technique is a wet system capable of removing both SO2 and particulate in flue gas from oil fired and coal-fired boilers burning medium- to high

sulfur fuels. In the basic process, the centrifugal scrubber imparts a spinning motion on the gas passing through, resulting from a tangential entry of the gas stream. The particulate are impacted into the wet scrubbing droplets injected before the venturi. The flue gas passes through a venturi scrubber located downstream of the boiler exhaust; the particulate emissions are embedded and grown in size through the collision mechanism. The cyclonic action then serves to remove the particulate from the gas stream. SO2 is then reacted with the caustic solution (NaOH), which is injected into the spray mechanisms. Cleaned flue gas then passes into the atmosphere through the stack. The process is expected to achieve SO2 reductions of 90%.

The basic process chemistry associated with the SO2 removal, consist of injecting potassium, ammonium, or sodium salt solution into the gas stream. As described above, this

application uses Sodium Hydroxide (NaOH) solution. The pH of the entrainment fluid is then controlled, and the resulting salt formations are removed through a blowdown mechanism. The solution is considered wastewater, is not available for further SO2 removal, and is therefore not considered a regenerative process.

3.3.8 MITIGATION PROCEDURES

1) Pre- disaster mitigation can help in ensuring foster recovery from the impacts of disasters.
2) Mitigation measures must ensure protection of the natural and cultural assests of the community
3) Hazard reduction methods must take into account the various hazards faced by the affected community & their desires and priorities
4) Any mitigation programme must also ensure an effective partnership between the Govt, Scientific, private sector, NGOs and the community

The main elements of a mitigation strategy

1) Risk assessment and Vulnerability analysis: This involves the identification of hotspot areas of prime concern, collection of information on past natural hazards, information on the population and infrastructure.
2) Applied research and technology transfer: There is a need to establish or upgrade observation equipment and networks, monitor the hazardous properly, improve the quality of forecasting and warning.
3) Public awareness and training: Training to be given to officials & staff of various Departments involved in state & district level.
4) Institutional mechanisms: There is need to emphasize on proactive and predisaster measures rather than post-disaster response. It is thus essential to have a permanent administrative structure which can monitor the developmental activities across departments and provides suggestions for necessary mitigation measures. The national disaster management centre (NDMC) can perform such a task. Professional like architects, struc tural engineers, doctors and chemical engineers who are involved with management of hazardous chemicals, can be asked to form groups that can design specific mitigation measures.
5) Incentives and resources for mitigation: Provide stable source of funding for all mitigation programs.
6) Land use planning and regulations .
7) Hazard resistant design and construction.
8) Structural and Constructional reinforcement of existing buildings: This can be done by the insertion of walls, specially on chored frames, construction of new frame systems, designing residential electrical equipment above flood level, designing water storage tanks to be able to withstand cyclonic winds, earthquakes & floods.

3.3 WATER POLLUTION

When the quality or composition of water changes directly or indirectly as a result of man’s activities such that it becomes unfit for any useful purpose is said to be polluted.

3.3.1 Two types of pollutions:

Point source of pollution: This source of pollution can be readily identified because it has a definite source and place, where it enters the water. Eg: Municipal industrial discharges pipes.

Non point source of pollution: When a source of pollution cannot be readily identified such as agricultural runoff, acid rain etc, it is called as non point source of pollution.

3.3.2 Causes of Water Pollution

Disease causing agents

☐ Oxygen depleting wastes

☐ Inorganic plant nutrients

☐ Excess pesticides

☐ Water soluble organic chemicals

☐ Variety of organic chemicals

☐ The sediments of suspended matter

☐ Water soluble radioactive isotopes

☐ Hot water released by power plants & industries

☐ Acid drainage into rivers.

3.3.3 Effects of Water pollution

☐ Large amount of human waste in water increase the number of bacteria which cause gastro intestinal diseases, Water borne diseases diarrhea, typhoid etc.

☐ If more organic matter is added to water the O_2 is used up. This causes fish and other forms of O_2 dependent aquatic life dies.

☐ High levels of organic chemicals (acids, salts& toxic metals) can make the water unfit to drink, harm fish and other aquatic life, reduce crop yields.

☐ Variety of organic chemicals / oil gasoline, plastics & detergents are harmful to aquatic life and human life.

☐ Radioisotopes cause birth defects, cancer and genetic damage.

☐ Hot water because of thermal pollution not only decrease the solubility of O_2 but also changes the breeding cycles of various aquatic organisms.

☐ Accidental oil spills cause environmental damage.

☐ NO_3 contamination causes Blue baby disease (Methaemoglobinaceae) and PO_4 contamination causes bone marrow disease.

3.3.4 Control measures of water pollution

☐ Setting up of effluent treatment plants to treat waste water can reduce the pollution load in the recipient water. The treated effluent can be reused either for gardening or cooling purposes or wherever possible.

☐ Root zone process has been developed by Thermax by running contaminated water through the root zone of specially designed reed beds. These have the capacity to

absorb from the surrounding air through their stomata openings. It creates O2 rich conditions where bacteria and fungi oxidize the wastes.

☐ Providing sanitation and waste water treatment facility.

☐ Integrated nutrient management (INM) and integrated pest management (IPM) practices will reduce the effects caused due to excess pesticides.

3.3.5 PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE MARINE WATER

Water is essential to the maintenance of all life. It constitutes 80 per cent or more by weight of active protoplasm. It is the most efficient of all solvents and carries in solution the necessary gases, oxygen and carbon dioxide, as well as the mineral substances necessary to the growth of plants and animals, and it is itself one of the essential raw materials in the manufacture of foods by plants.

Organisms living in the terrestrial environment have devised means, such as impervious integuments, to conserve water, and the land plants have roots and special vascular systems for transport of water to all growing parts. In the marine environment there is freedom from dessication, except at high-tide levels, and therefore no highly specialized means are provided for conservation of water or for its transport in plants.

Also of biological importance are the high heat capacity of water and its high latent heat of evaporation, both of which obviate the danger that might result from rapid change of temperature in the environmental medium. Owing to the high degree of transparency of water it is possible for the sea to sustain plant life throughout a relatively deep layer, and in animals the development of organs of vision and of orientation has progressed to a marked degree.

Sea water is a buffered solution; that is, changes from acid to alkaline condition, or vice versa, are resisted (p. 195). This property is of vital importance to the marine organisms, mainly for two reasons: (1) an abundant supply of carbon can be available in the form of carbon dioxide for the use of plants in the synthesis of carbohydrates without disturbance to the animal life that may be sensitive to small changes in pH, and (2) in the slightly alkaline habitat the many organisms that construct shells of calcium carbonate (or other calcium salts) can carry on this function much more efficiently than in a neutral solution.

The support offered to the bodies of marine organisms by the specific gravity of the surrounding medium obviates the need of special supporting skeletal structure in many forms. Striking examples of these are the jelly fishes, unarmored molluscs, unarmored dinoflagellates, and even the large marine mammals with their heavy skeletons, which could not survive in their present bulky state except in an aquatic habitat. The hard shells of crabs, clams, snails, and so on, doubtless serve as support, especially in some burrowing and intertidal forms, but these hard parts may be looked upon also as protective and as a framework for attachment of muscles used in digging, creeping, or swimming.

3.3.6 PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE TERRESTRIAL WATER

Aquatic organisms and the physical and chemical components of their environment are inseparably inter-related and interact with other. Flow and water chemistry are the primary factors governing life in riverine habitats, and both are closely related to seasonal

variations. This is especially true for monsoon rivers such as the Mekong.The key physical and chemical characteristics of aquatic ecosystems are:

Oxygen: dissolved oxygen is a basic requirement for a healthy aquatic ecosystem. The amount of oxygen available for aquatic life depends on the factors that effect how it dissolves in water. Mixing of water allows exchanges of oxygen with the air. In the absence of adequate mixing oxygen levels in deep systems such as a reservoir can become reduced including the formation of layers of differing oxygen concentrations. Discharges of wastes or excessive plant growth caused by nutrient enrichment, followed by death and decomposition of vegetative material. This can use large amounts of oxygen and hence reduce oxygen concentrations in the water. These sources include discharges from forest harvesting, pulp mills, agriculture, effluent from sewage treatment and industrial plants.

Temperature: affects the solubility of many chemical compounds and can therefore influence the effect of pollutants on aquatic life. Increased temperatures increase the amount of oxygen organisms require. Human sources of pollutants that can impact water temperature include industrial effluents, agriculture, forest harvesting, urban developments, and mining.

Alkalinity and acidity: are important characteristics of water that affect its suitability for biota and influence chemical reactions. The ability to withstand changes in acidity or alkalinity, a buffering agent, is a related factor. Many biological processes, such as reproduction, cannot function in water with the incorrect acidic or alkaline properties.

Light: is necessary for photosynthesis, and is often a defining feature when describing habitat. The largest influence that light has on aquatic ecosystems is its influence on plant growth. Shade is also important in determining the nature of habitats.

Substratum: is the organic and inorganic material that makes up the bed of a river, stream or lake etc.. The impact of substrate on aquatic biota depends on substrate particle size, organic content and interaction with other environmental factors. Biodiversity and abundance of organisms tend to increase with substrate stability. Variations in substrate promote biodiversity.

Water velocity: represents perhaps a major environmental factor affecting the biota of running waters.

The physical factors discussed above can vary greatly according to the seasons.

The actual chemical composition of stream and river water depends on the interplay of several variables that are unique to each river catchment and even to tributary subcatchments. These include:

- climate, the amount, distribution and initial chemical composition of precipitation, and its nearness coastal regions and to industry.
- the nature of the surrounding catchment and movement of water from the catchment to the river related to topography, geology, soils and vegetation and to the contribution of groundwater;
- the distance from headwaters and the season or even time of day and timing of the last rainfall; and
- the influence of human activity and land use in the catchment, such as agriculture, forestry and urbanization..

Increased nutrient concentrations are a serious and well-known consequence of a greater human presence and changing land uses within a watershed. Agriculture increases nutrient levels due to fertilizers and animal wastes, and also by increasing soil erosion. Municipal wastes and fertilizers are significant nutrient sources from urban areas.
Large amounts of organic and inorganic materials can be washed into rivers and transported long distances. Inorganic suspended solids originate from terrestrial sources through soil disturbance followed by heavy rainfall and subsequent bank erosion. The significance of suspended solids relates largely to the effects on light penetration into the water and to the nature of the substrate. The nature of suspended and dissolved materials conveys optical properties that can be used to classify water as:

• Blackwater: is poor in dissolved inorganic and suspended solids, but dissolved organic matter produces a reddish-brown colour. These are typically acidic.

• Whitewater: has high levels of suspended solids with a muddy/silty appearance, as well as high levels of dissolved inorganic solids, tending to be alkaline.

• Clearwater: varies in acidity and has little suspended material..

Pollution can be defined as the release of harmful materials, typically generated through human activity including industry, domestic and agricultural waste, into the receiving environment. Point-source pollution is discharged in the system through a single source. Diffuse-source pollution is mainly the result of agricultural and forestry activities, although it can also occur where there is small-scale mining over a large area.
Aquatic ecosystems undergo constant change and adaptation, and can withstand stress based on their unique physical, chemical and biological properties. Ecosystems may become unbalanced because of man-made factors.
Each species of animal and plant has an optimal range for physical and chemical requirements. Outside this range organisms face increasing stress and eventually die. Even when all physical and chemical characteristics of the environment fall within tolerable limits, production of species can be influenced by various combinations of factors. These different combinations explain the ecological variety that makes each stream unique. The interpretation of these factors requires an integrated approach and an understanding of the interdependent nature of biological systems over time and space.

3.3.7 WATER QUALITY PARAMETERS – PHYSICAL, CHEMICAL AND BIOLOGICAL

It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

Standards

In the setting of standards, agencies make political and technical/scientific decisions about how the water will be used. In the case of natural water bodies, they also make some reasonable estimate of pristine conditions. Different uses raise different concerns and therefore different standards are considered. Natural water bodies will vary in response to environmental conditions. Environmental scientists work to understand how these systems function, which in turn helps to identify the sources and fates of contaminants. Environmental lawyers and policymakers work to define legislation with the intention that water is

maintained at an appropriate quality for its identified use.
The vast majority of surface water on the planet is neither potable nor toxic. This remains true when seawater in the oceans (which is too salty to drink) is not counted. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. In fact, water quality is a complex subject, in part because water is a complex medium intrinsically tied to the ecology of the Earth. Industrial and commercial activities (e.g. manufacturing, mining, construction, transport) are a major cause of water pollution as are runoff from agricultural areas, urban runoff and discharge of treated and untreated sewage.

3.3.8 WATER TREATMENT

Water treatment is, collectively, the industrial-scale processes that makes water more acceptable for an end-use, which may be drinking, industry, or medicine. Water treatment is unlike small-scale water sterilization that campers and other people in wilderness areas practice. Water treatment should remove existing water contaminants or so reduce their concentration that their water becomes fit for its desired end-use, which may be safely returning used water to the environment.
The processes involved in treating water for drinking purpose may be solids separation using physical processes such as settling and filtration, and chemical processes such as disinfection and coagulation.
Biological processes are employed in the treatment of wastewater and these processes may include, for example, aerated lagoons, activated sludge or slow sand filters.

3.4 SOIL POLLUTION

Soil pollution is the introduction of substances, biological organisms, or energy into the soil, resulting in a change of the soil quality, which is likely to affect the normal use of the soil or endangering public health and the living environment.

3.4.1 Causes of Soil Pollution

- Soil erosion
- Soil contaminants
- Fertilizers and pesticides
- Excess use of irrigation water

3.4.2 Effects of Soil Pollution

☐ Food shortage

☐ Desertification

☐ Decrease in the extent of agricultural land

☐ Top soil erossion

☐ Excess use of irrigation leads to waterlogging and soil salinisation.

☐ Fertilizer run off leads to the eutrophication of waterways.

3.4.3 Control measures

☐ Proper soil conservation measures to minimize the loss of top soil

☐ INM, IPM, using bio pesticides and integrated environment friendly agriculture to

reduce pesticides or fertilizers.

☐ Appropriate water management practices in agriculture

☐ Keeping the soil surface covered with crop residues or crop cover

☐ Planting trees as a part of afforestation/ shelter belts/wind breakers

☐ Cleaning up of polluted soil

3.5 SOLID WASTE MANAGEMENT

• The combined effects of population explosion and changing modern living standards have had a cumulative effect in the generation of a large amount of various types of wastes.

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

• Any material that is thrown away or discarded as unwanted is considered as solid waste.

3.5.1 Types

1. Garbage or food waste
3. Rubbish
3. Agricultural waste
4. Industrial waste
5. Hazardous waste

3.5.2 Cause

☐ Over population

☐ Affluence

☐ Technology

3.5.5 Effects

☐ Health hazard

☐ Environmental impact

3.5.6 Control measures

Solid waste management include

☐ The waste generation

☐ Collection of solid waste

☐ Disposal of solid waste

☐ Land fill- Disposal of municipal waste in the upper layers of the earth‟s mantle.

☐ Incineration- Burn highly combustible wastes at very high temperature

☐ Composting or Bio degradation- Decompose the organic components of the municipal solid wastes.

☐ Waste utilization

a) Reuse

b) Recycling
c) Reclamation

3.5.7 SIGNIFICANCE OF SOLID WASTE MANAGEMENT

In communities where appropriate sites are available, sanitary landfills usually provide the most economical option for disposal of nonrecyclable refuse. However, it is becoming increasingly difficult to find sites that offer adequate capacity, accessibility, and environmental conditions.

Landfills will always play a key role in solid-waste management. It is not possible to recycle all components of solid waste, and there will always be residues from incineration and other treatment processes that will eventually require disposal underground.

Landfills can actually improve poor-quality land. In some communities properly completed landfills are converted into recreational parks, playgrounds, or golf courses.

3.6 MARINE POLLUTION

Marine pollution is defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as hazardous to human health, obstruction of marine activities and lowering the quality of sea water

3.6.1 Sources

☐ Municipal waste & sewage from residences and hotels in coastal towns

☐ Pesticides and fertilizers from agriculture

☐ Petroleum & oil washed off from roads enter sewage system & finally into seas

☐ Ship accidents & accidental spillage at

☐ Off shore oil exploration also pollute the sea water to a large extent

☐ Dry docking

☐ Pollution due to organic wastes

☐ Pollution due to oil

☐ Tanker accidents

☐ Volcanic eruptions in the sea.

☐ Deep sea mining

3.6.2 Effects of marine pollution

• A large amount of organic wastes can also result in the development of ‘red tides’. These are phytoplankton blooms because of which the whole area is discolored.

• Commercially important marine species are also killed due to clogging of gills and other structures.

• For salt marshy plants oil slick can affect the flowering, fruiting and germination.

• The coral reefs are the productive ecosystems offer many benefits to people. These coral reefs are threatened by a) the sediments from deforestation carried by the runoffs.

• Drill cuttings dumped on the seabed result in the production of toxic sulphides in the

bottom sediment thus eliminating the benthic fauna.

3.6.3 Control measures of marine pollution

☐ Introduction of sewage treatment plants to reduce BOD of final product before discharging into sea.

☐ Cleaning oil from surface waters and contaminated beaches can be accelerated through the use of chemical dispersants which can be sprayed on the oil.

☐ Load on top system reduces oil pollution cleaned with high pressures jets of water.

☐ Crude oil washing: The clingage is removed by jets of crude oil while the cargo is being unloaded.

ROLE OF AN INDIVIDUAL IN PREVENTION OF POLLUTION

• Use stairs instead of elevators

• Use public transportation walk or ride a bicycle

• Plant trees around building

• Turn off lights, television sets and computer when not in use.

• Pay immediate attention to leaks in pipes.

• Install waste saving equipments.

• Recycle glass metal and paper.

• Compost garden waste

• Segregate waste and recycle

• Buy locally made long losing material

• Buy environmentally degradable products.

• Take some bag from home to market to purchase.

Solid Waste Management

What is a solid waste?

· Trash/garbage that is solid in nature (and not liquid or gas)

· Discarded solid material from industrial, municipal and agricultural activities

· Household material consisting of everyday garbage, food and yard waste

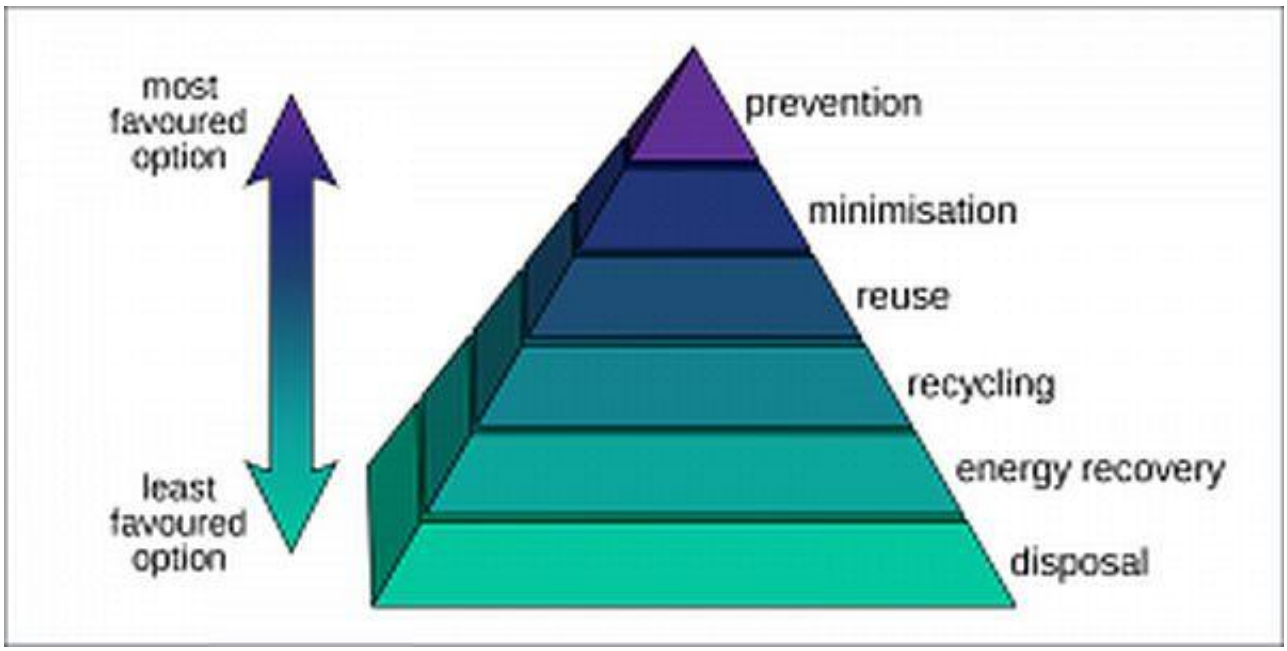
· Includes construction waste, biomedical waste, electronic waste (or e-waste) or even sewage sludge as part of different industries.

What is solid waste management?

Waste management is the entire process from collection of waste from source till its disposal. This includes all processes like transportation, analysis, legal procedures,

along with monitoring and enforcing regulations. There are a number principles related to waste management, but a generally accepted concept is one of the 'Hierarchy of Waste Management'.

The image above shows waste management strategies according to their maximum effect on waste minimisation. The flowchart below illustrates the functional elements of waste management in a simple way.



Waste handling and disposal practices vary in different demographics. In India, the practices vary depending on the type of solid waste which has been classified as
- Municipal Solid Waste.
- Hazardous Solid Waste.

Municipal solid waste is again classified into different types like biodegradable substances (rotten or waste foodstuffs and general kitchen waste), recyclable materials and domestic hazardous waste (light bulbs, batteries, etc). Hazardous solid waste is industry generated which need special disposal techniques.

Solid waste management is an integral part of the environmental domain of any region. Inefficient waste disposal systems lead to environmental pollution along with presenting severe health hazards. As shown in the diagram above, solid waste management generally includes a collection of waste, transporting waste, processing and recycling it, and finally disposal of waste.

Today, the most general method of waste disposal is by using landfills. Olden landfills are being covered and the present day sanitary landfills are not just dumped sites. They are designed and customized pertaining to the region, type of waste and other environmental factors. The primary purpose of this is to dispose of waste effectively without causing health risks or contributing to environmental pollution.

[Source:https://byjus.com/biology/solid-waste-management/]