

LEARNING MATERIAL

SEMESTER & BRANCH: 3RD SEMESTER ELECTRICAL ENGINEERING

THEORY SUBJECT: ENVIRONMENTAL STUDIES (TH-5)

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* Ecosystem - It is the basic functional logic unit. The ecosystem can be defined in a given area interacting with the physical environment around them.

* Ecology - It is the branch of science which deals with the relationship between the living organism & their environment. Thus it can be called as environmental biology.

* Ecological Succession:- It is a natural process of community change & this phenomenon involves an orderly & progressively replacement of communities by another, until a stable community is developed.

* Food chain:- Autotrophs produce food. So, transfer of food energy from the source to plants & to a series of organisms with respect eating and being eaten is called food chain.

* Food web:- The interlocking pattern of different food chain is called food web.

* Ecological Pyramid:- There is a correlation ship betⁿ no. of organisms, biomass and energy content of the primary producers, consumers of 1st order, 2nd order & so on, upto top carnivores in any ecosystem. This relationship may be represented in diagram & known as Ecological pyramid.

* Food chain:- The transfer of food energy from plant sources through a series of living organisms in an ecosystem is called food chain.

22/2/21

dB:- Ten times logarithm of the ratio of 2 sound intensity.

$$dB = 10 \log \frac{\text{Sound intensity measured}}{\text{Reference sound intensity}}$$

* Deforestation is the permanent destruction of forest and their replacement for other purposes.

* Desertification is a process in which the productivity potential of arid & semi-arid land fall by 10% or more and then turn into non-productive land.

→ Is the process by which a part of land becomes dry, fore growing trees on.

* Natural resources:- The gifts of nature found in making life comfortable & worth living are known as natural resources.

* Development:- The process by which people meet their needs & improve their living conditions & social development.

* Climate change:- The change in environmental conditions of an area over long period of time is called "climate change".

* Population:- A group of organisms of the same species living in a same area is known as population.

Unit 1 The Multidisciplinary nature of Environmental Studies

* Environment :-

- The term environment is derived from the French word "Environia" which means surrounding.
- It refers to both biotic and abiotic elements.
- Environmental studies deal with everything that affects an organism.
- It is a multi-disciplinary approach. Its components include biology, chemistry, physics, sociology, health, economics, anthropology, statistics etc.

* Scope :-

- As we look around at the area in which ^{we live} ~~believe~~, we see that part surrounding where originally a natural landscape such as forest, river, mountains are the combination of these elements.
- Most of us live in landscape that have been heavily modified by human being in villages, towns or cities.
 - Our daily lives are linked with our surroundings. We use water to drink and for day to day activities, we breathe air,

Environment consist of 4 components.

(i) Atmosphere

(ii) Hydrosphere

(iii) Lithosphere

(iv) Biosphere

(i) Atmosphere :-

→ Atmosphere comprise the protective blanket of gases surrounding the earth.

→ It absorb most of the cosmic rays from outer space and a major portion of electromagnetic radiation from the sun.

→ It transmit only Ultraviolet ray, visible infrared radiation and radio waves (0.14 to 40 mtr), while bittering out.

→ The tissue damaging Ultra-violet waves.

(ii) Hydrosphere :-

→ The hydrosphere consists of all types of water resources, ^{like} ocean, sea, lake, river, streams, ground water.

→ Nature - 97% of the earth water supply is in the ocean about 2% of water resources is locked in the polar icecaps. Only about 1% available as fresh surface water such as river, lake and ground water.

(iii) Lithosphere:-

- Lithosphere is the outer part of the solid earth.
- It consists of minerals occurring in the earth crusts and the soil.

(iv) Biosphere:-

- Biosphere is the relationship between ^{living} ~~living~~ organism and their interaction with environment.

* Importance:-

- Environment is not a single subject. It is an integration of several subjects that includes both science & social studies.
- To understand all the different aspects of our environment we need to understand biology, chemistry, physics, geography, resources management, economics and population issues.
- We live in a world in which natural resources are limited water, air, soil, the products are all a part of our life support system without them life is impossible as we keep increasing in no. and the quality of resources is also more used but in limited value. The earth can't be expected to sustain us.

→ We waste or pollute large amount of natural resources clean waters, we create more and more material like plastic.

→ Air pollution ^{leads} ~~leads~~ to respiratory diseases, water pollution causes several diseases, and many pollutants are known to cause cancer.

→ To improve this situation we should take some actions and we need to do it ourselves.

* Need for public Awareness: —

→ Since, our environment is being increasingly polluted by human activities. So, we have to do something.

→ We should all take part in the prevention of environment pollution as the part of our life. Just as per any diseases prevention is better than cure.

→ Individually also we can play a major role in environment improvement. We can reduce our natural resources.

→ We should take action against the source that leads to environment pollution.

→ It is made possible through mass public awareness. Mass media such as News

Unit 2: Natural Resources

24/06/2015

* Resources :-

Every substance which is required by human are known as resources.

- Some of them are natural occurring and some of them are artificially made.
- Naturally occurring resources are known as natural resources.

Our environment provide us with a variety of goods and services. which is necessary for our day to day life.

Naturally resources may be of two types - (i) Abiotic

(ii) Biotic

(i) Abiotic :- Abiotic natural resources is non-living part of the nature.

- It includes air, water, soil, mineral solar energy etc.

(ii) Biotic :-

- These are the living part of nature.
- It consists of plants, animals and micro-organisms. (eggs)

Natural resource may be renewable resource and non-renewable resource.

(i) Renewable resources:-

→ A renewable resource can be grown again and come back again after we use it.

→ It can be recycle.

For example:- soil, sun light, water etc.

(ii) Non renewable resources:-

→ It is a resource that does not grow and come back and or it takes very long time to come back.

→ It cannot be recycle.

Ex:- Coal, petrol, oil, minerals, etc.

Human population is growing day by day continuously. which causes an increasing demand for natural resources.

The over utilisation of natural resources creates many problems. So there is need for conservation of natural resources.

resources - can be used

are exploitation -

resources

estimate that India should
of its land under forest
day we have only about 12%.

we need not only to protect the
forest, but also to increase
forest cover.

tion of forest:-

where we are depend upon the existing
forest.

we home. furniture and paper are
made from wood and from forest.

We use medicines which are forest
products.

We depend upon taking oxygen that
plants give out.

→ forest reduces the rate of surface
run-off water.

→ Maintain carbon dioxide level for plant
growth.

→ Maintain climatic condition.

→ Maintain ^{soil} erosion control.

→ Maintain soil nutrients & structure.

Deforestation

- Deforestation is the removal of a forest into barren and barren use. Urban - 222

Reason for Deforestation

- conversion of forest land to agricultural land.
 → Trees are cut down to be used as fuel or timber in urban area, industry for the purpose of mining.
 → The high amount of grazing.
 → Dam build for irrigation project.

Effect of Deforestation

- Removal of trees without sufficient reforestation has resulted in damage to habitat (disappearing animal).
 → It causes soil erosion (crop).
 → It causes extinction of some species.
 → changes of climatic condition.
 → Deforestation causes global warming.

Timber extraction, mining, dams

- Timber extraction, mining & dams are the necessary part of the need of a developing country.
 → If timber is over harvested, the ecological generation of forest are lost.
 → Unfortunately forest are located in area where there are rich mineral resources. means it is suitable place for mining.
 → Forest also ideally suited to develop irrigation project like dam for hydro-electric power.

The agriculture spread the
barrenest when controlled mostly by tribal
people. These barrenest development
project are plant, can displace thousand
of tribal people who loose their home
when these plans are executed.

24/08/13

② Water Resources

→ water covers 70% of earth's surface but
only 2% of this is fresh water, 2% is
polluted & unusable and only 1% is usable
water in rivers, lakes and as ground water

→ The world depends on a limited quantity
of fresh water only a fraction of this
can be actually used.

→ At the global level, 70% of water is used
for agriculture, about 25% is used for
industry and only 5% of water is used for
domestic. However in India 90% is used
for agriculture, 7% is used for industry
and only 3% is used for domestic.

Use and overutilization of surface and
ground water.

→ We are using water far more than we need.
Generally the ground water is used for

Reverse flooding is most universally experienced natural hazards. Severe floods destroy human settlement and agriculture for land.

* Drought :- (करीब, सूखा)

→ Drought is also a serious natural hazard.

A drought is said to be occurring at a place where the place does not ^{get} as much water as ~~accepted~~ ^{accepted} or need over a significant period of time. As drought

usually originates from a deficiency of rainfall over an extended period of time, resulting in water shortage in some area.

→ All plants, animals and humans need water for their survival, besides the requirement for other human activities.

→ The impact of drought may be economic, environmental and social.

The economic impact of drought includes -

- (i) Loss of crops and money to farmers and reduce their business.
- (ii) Loss of business to those who deal in food processing activities.
- (iii) Loss of business to manufacturers who manufacture goods required in agriculture like tractor manufacture and fertiliser.

(iv) Loss of business who deals in fisheries and ^{freshwater} related product.

(v) Loss of trees and timber causing ~~loss~~ ^{loss} to timber industries.

The environmental losses of drought include —

(i) Loss or destruction of fish and wild life ^{habitate}.

(ii) Lack of food and drinking water for human and wild animals.

(iii) Increase in disease in human & wild animals because of reduced food & water supplies.

(iv) Loss of tree and other vegetation due to non-availability of water.

→ The social effect of drought includes —

(i) ^{Simple} Migration of people from drought affected area to urban area.

(ii) Loss of income, mental & physical stress.

(iii) Health and nutrition problem.

* Conflicts over water : —

01/09/2018

→ Water is the most important resource of a society, since no life is possible without water. A society can survive without other resources like minerals, fuels, forests etc. but cannot survive without water.

if water remains available to fulfill the present and future needs of society population, there shall occur no conflict among the population, but if the available water become deficient then naturally conflict will occur. there may be conflict between countries over the sharing of water. The upstream country may create scarcity condition for the downstream nation leading to conflict and water wars.

Signing such international agreement are absolutely necessary for reducing the possibility of water wars between different nations.

Dam's - benefits and problem :-

- In order to harness the precious water resources of a country, dam's are constructed across rivers.
- The construction of such a wall type construction across a river helps in storage of water, forming a reservoir.
- Construction of dam's become an absolute necessity in subtropical or tropical countries, where heavy rainfall occurs only during a few rainy months of an year.
- If no dam is constructed in such cases then eventually having floods will

→ After the expiry of ~~spring~~^{rainy} season the river will become dry and there will be no water to fulfill the various water demands of human, animals as well as plants and vegetation.

→ water can be stored -

(i) Under the ground, in the ground water, reservoir.

(ii) Artificial storage reservoir created by construction of dam across river.

(iii) The ground water one's stored again need to be lifted for utilization by the use of energy.

(iv) On the other hand, water stored behind a dam doesn't need to be lifted up, as it can be made to flow into rivers and channels by gravity. Hence no energy is reqd in utilization of water of a dam reservoir.

(v) Also water stored in the dam helps in the generation of hydropower on a large scale without consuming any other resource and without causing any kind of pollution.

Negative impact of dam -

→ Since dam convert flowing water to standing water there occurs a change in the water chemistry especially with

The change of food chain of aquatic animals.

→ Due to construction of dam across a river, the nearby area will attract lots of industries and human population which causes environmental or water pollution.

→ It is a obstructible for fisheries & hunting.

⑥ * Minerals Resources - The materials which contain metals and are found in the earth's crust contains several rocks, which are of great utility to humans, in their day to day use. These rocks are made of inorganic substances called minerals.

→ Minerals are naturally occurring inorganic substances having a definite chemical composition & physical properties.

→ Minerals are the most common solid material found on earth. All rocks found on earth surface all contain minerals.

People use minerals to make many products. Example graphite use for pencil leads, talcum powder from talc.

→ According to mineralogists, the minerals should have —

(i) A mineral has a definite chemical

composition at where ever it is

(ii) The atoms of minerals should arrange in a regular pattern and form solid unit.

(iii) A mineral is made of pure substances that are never alloying.

(iv) A mineral is found to occur in nature.

Classification of Minerals :-

Minerals can be classified into two types. These are :-

(i) Metallic minerals

(ii) Non-metallic minerals

(i) Metallic minerals :-

→ Metallic minerals are those minerals from which we get metals like Iron, copper, gold, aluminium, Zinc, Manganese, lead etc.

→ Different minerals (ores) contain different minerals and are used to extract different metals.

→ Chromite producing chromium metal, magnetite producing iron metal, bauxite producing aluminium metal, galena producing lead metal, Chalcopyrite producing copper.

(ii) Non-metallic minerals :-

→ Non-metallic minerals are those minerals which do not produce metals.

→ They include mineral like rock salt.

The change of land animals

→ Due to constant river, they lots of which

polluted

importance

sedimentation

land and form optical

one's, one need to be earth so that they process is known as

reaction is generally by the following

stages.

(i) Prospecting :- Searching for mineral.

(ii) Exploration :- Assessing or evaluating the size shape location of the minerals (deposit)

(iii) Development

→ Preparing access to the deposit so that the minerals can be extracted.

(iv) Exploitation :- Extraction the minerals from the Mine.

The method of Mining has to be determine depending on whether the minerals is near the surface or deep with in the earth. Mines are of two types -

(i) Surface Mines Open cast mines

(ii) Deep Mines or Undermines

In surface mines minerals deposits near the surface and in deep mines minerals are present within the earth.

Most minerals need to be processed before they become stable.

Mine's Safety :-

→ Mining is a hazardous occupation and safety of mine workers is an important environmental consideration of industry.

Surface mining is less hazardous than underground mining.

→ In all underground mine's rocks and roof falls, inadequate ventilation are the greatest hazard. Large ^{gas} explosions have occurred in coal mine's, killing many miners (mine workers). More miners have suffered from disaster due to the use of explosive in metal mine's.

Mining poses several long term occupational hazards to the miners. Dust produced during mining operation is injurious to health and causes ^{lung} disease known as black lung or pneumoconiosis.

dolomite, often
 * Mining : — mineral
 → Minerals — use and in deep
crust or processed

by incomplete digestion
 extremely poisonous.
 Mineral from coal is
 health of workers.
 radioactive metals like
 thorium is hazardous.

Use and exploitation :-

- The use of minerals varies between countries. The greatest use of minerals occurs in developed country.
- The use of minerals depend on it's properties. Ex - aluminium is light, but strong and durable. So it is used for aircraft, shipping and car industries.

Human wealth basically comes from agriculture, manufacturing and mineral resources. Our modern society is built around the use and exploitation of mineral resource. Since the future of humanity depends on mineral resources, we must understand that these resources are limited.

Environmental Problems :-

→ Mining operations are considered one of the main sources of environmental degradation. The extraction of all these products from the lithosphere has a variety of side effects.

(i) Mining causes water pollution, by discharging acid mine waters into surface water body like ponds, rivers etc. and mining adds toxic radioactive substance like selenium, nickel, fluorine etc. to the water body, thus by affecting the agriculture.

(ii) Mining causes air pollution by adding gaseous pollutant like sulphur dioxide, oxides of nitrogen, carbon monoxide to the air and it emits dust particulates to the atmosphere.

(iii) Due to the underground mining, the land surface subsides, which not only causes damage to the building & surface drains but also some times damages the highway, bridges etc.

(iv) Surface mining removes the top soil & creates pits.

(v) Mining causes large scale deforestation.

whole animals and birds leaving ~~loss~~ in the biosphere causing disturbance to the natural ecology of that area.

(v) Mining may cause large scale noise by mining operation. Malnutrition stages

(vi) Mining can also cause the health hazards.

Food Resources:

* World food problem: -

→ In recent years, world food supplies have been rising at an unprecedented rate & have grown faster than population in every continent.

→ Additional millions survive on a deficient diet suffering from stunted growth, mental retardation, & developmental disorders.

Among the essential dietary ingredients for good health are adequate calories, proteins, lipids, vitamins, and minerals.

Marasmus & kwashiorkor are protein deficiency diseases; anemia & goitre are caused by mineral deficiencies, & pellagra, scurvy, ~~beriberi~~, and rickets are vitamin deficiency diseases that affect millions of people worldwide.

→ The three major crops that are the main source of calories & nutrients for most of the world's people are rice,

→ About a dozen other types of seeds, grains, a few root crops, twenty or so fruits & vegetables, some mammals & their milk, a few domestic fowl, and a variety of seafoods comprise nearly all the food that humans eat.

→ Scientific improvement of existing crops and modernization of agriculture (irrigation, fertilization, better management) are potential sources of greater agricultural production.

→ World food-trade & international food aid help transfer food from areas of abundance to areas of shortage, but they also undercut local food supplies by encouraging the conversion of land from production of food for local consumption to production of cash crops for export.

→ Hunger, poverty, population growth, environmental degradation, and social problems form a complex interconnected web. Each is a cause as well as a consequence of the others.

Some problems & solutions

A. Raise the standard of living in developing countries

→ Lower birth rate will naturally follow (historically this has occurred).

→ First step, providing adequate nutrition and health care facilities.

Effects of Modern Agriculture:-

- During the evolution of human civilization the mode of resource use and pattern of energy flow in agricultural practice took various shapes.
- The transformation from traditional to modern mechanized agricultural practice took some years. The aim of such was to sustain a bigger population and to meet the ever increasing needs of man.
- Agriculture has evolved from being a less energy intensive to more energy intensive, and from less productive to more energy intensive, and from less productive to more productive.
- The changes that took place initially were more productive but soon it was forced to use of more fertilizers, intensive farming, use of high yielding variety of crops etc. took away a lot from the mother nature.
- Now we not have off when extensive use of pesticides and insecticides may be harming on man himself.

Fertilizer Problems:-

- For growth plants require certain minerals which are called soil nutrients. Sometimes the minerals are present in the soil production in the form of organic matter. The organic matter is acted upon by microorganisms

- Excessive removal of mineral causes nutrient depletion. To fulfill the loss chemical fertilizers are used as nutrients.
- These fertilizers contain macro nutrients, like nitrogen, phosphorus & potassium.
- Excessive use of such fertilizers induces plants to draw more nutrients from the soil, as a result the rate of growth of plants exceeds their normal growth.
- Soil can't replenish the supply of the micro-nutrients. The deficiency in the micronutrients leads to drop in the productivity of many crops.
- These chemicals, usually the nitrates find their way into ground water & some get mixed into ponds or river waters.
- Excess nitrates in water causes health problem. Washed away fertilizers into the ponds helps the aquatic plants to grow luxuriantly.
- Excess growth of plants leads to oxygen depletion in pond. Less dissolved oxygen affects the aquatic life in the pond, which is called Eutrophication.

Pesticide Problems:

- To protect plants from insects, mites & fungi, toxic chemicals like insecticides, fungicides, herbicides (weed killers) are generally used. These chemicals are collectively called biocides.
- These chemicals tend to remain active long after i.e. killing of pests (insects) fungi or weeds. It is this property which makes these chemicals dangerous.

→ A problem related to excessive utilization of plant protection chemicals is, that the target organisms (pest, weeds, rodents or fungi) are gradually becoming immune to the pesticides. These pests that have developed immunity are now resistant strains. These resistant strains are more dangerous and require new chemicals for their destruction. As a result more powerful & virulent biocides are being applied by the agriculturists.

→ The major problem of application of plant protection chemical is contamination of food items. Biocides are sprayed upon food grains, fruits and vegetables, and oil chemicals are present either taken directly or indirectly by human being. The chemicals enter human body via different food sources and accumulate in the tissues & lead to various types of diseases.

Water Logging —

To provide more water to agriculture fields, man has developed different methods. Canal irrigation, use of deep tube well for drawing water from deep zone of the earth are two common methods employed. In these two methods even water is employ available agricultural fields are irrigated excessively. Without proper drainage system, the soil liquid-air ratio is disturbed. The soil becomes drenched and remains soaked with water, this is called water logging. Water logging

They lack air which is essential for root respiration. Water soaked soil can't provide mechanical support to plant and the plant can't bear its weight. As a result the plants merge and merged in mud. This reduces the yielding of the plants.

Salt Accumulation / Salinity

→ Excessive irrigation in high temp. zones causes salt accumulation in soils. Due to high temp. water evaporates very fast, leaving behind traces of salt on the soil.

→ As more and more cycles of irrigation are repeated, the left over salt accumulates & forms a thick layer of gray or white efflorescence of salt on the upper layers of the soil increases. The salt affected soils of there become alkaline or saline.

→ In salt affected soil plants fail to absorb nutrients and have water stress. Water logging coupled with alkalinity destroys the fertility of the soil.

ENERGY RESOURCES

The amount of energy production and consumption is considered as an index of a country's economic development. The development is synonymous with energy use, the importance of energy production is increasing day by day.

On the basis of the nature of availability and sustainability, energy may be

(a) Exhaustible or Nonrenewable Energy:-

After use such type of energy is lost or exhausted and cannot be regained again e.g. coal, petroleum, natural gas etc.

(b) Non-exhaustible or Renewable Energy:-

This type of energy may be ubiquitous like solar energy and may be self-renewable type like flow of river water which produce hydel power.

* Growing energy needs:-

→ Since Industrial Revolution began in 1760, a clear trend was visible to use more energy from fossil fuel. The aim was to get more power within a short span of time with very little investment.

→ Gradually wood was replaced by coal & subsequently coal was replaced by petroleum and natural gas.

→ The frequent price hike of crude oil in the international market & limitations of coal to be used in sophisticated machinery were the prime reasons behind the search for an alternate source of energy. With all their limitations coal and petroleum still dominate the energy scene.

Renewable sources of energy:

Fossil fuels, nuclear energy are non eco-friendly & are responsible for different types of pollution. Pollution free energy are environment friendly & future development of the world lies in the use of renewable energy sources like solar, wind, hydro, geothermal and biomass.

① Solar Energy — Sun rays are tapped in photovoltaic cells which are then converted into energy. This energy known as solar energy. Considering the reducing cost & vast potential it is likely to grow steadily. In India it is now being more & more used in appliances like water heater, crop driers, cookers and lighting lamps in remote areas.

② Wind energy — Wind energy is pollutⁿ free, inexhaustible renewable source of energy. The mechanism of energy conversion from blowing wind is very simple & practical since medieval period in Holland. The kinetic energy of wind, through turbines, is converted into electrical energy.

③ Geothermal energy —

It is said or cracks develops in the crust and mantle, then the magma from the mantle comes out vigorously. This below the earth's crust temp. increases with

can successfully be tapped and can be converted to electric energy popularly called as "geothermal energy". This energy is now considered as one of the key energy sources.

④ Tidal Energy: Ocean currents are the source of infinite energy resource. Modern tidal energy project was first constructed in Canada at Bay of Fundy. Countries like France, UK and Russia are producing electrical energy from tidal energy.

⑤ Biomass Energy: It can be both animal & crop wastes. It is a potential source of energy conversion. Biomass energy can be converted into electrical, heat energy or gas for cooking. The waste recycling and power generating system is very simple. The gasified biomass can be converted to electric energy & then to other forms of energy.

* Non-renewable source of energy:

Coal is a sedimentary deposit formed by the slow action of heat & pressure on biomass buried under the earth's crust. Of all known sources of energy coal is the prime source. It is also a source for products like gases, tars, pitch.

Depending on the carbon content, coals are classified as Anthracite coal, Bituminous, Lignite & peat coal.

① Oil and Natural Gas:

* Petroleum: — Petroleum literally means rock oil. It is a liquid having a complex composition of carbon and hydrogen. Petroleum is a source of motor fuel & lubricants. Apart from being used as a fuel & lubricant, the hydrocarbon in the rock oil is now being used to produce different kinds of synthetic products known as petrochemicals.

* Natural gas: — ^{The} Natural gas, generally

found in association with the oil fields. Natural gas has tremendous heating power. It can be used both as a source of energy and also as an industrial raw material in petrochemical industry.

② Nuclear Energy: — The production of steam through use of nuclear energy utilises the nuclear process (fission of Uranium-235) whereby the nucleus of the atom is split into two lighter atomic nuclei, releasing in the process a substantial amount of energy. In this process, neutrons are also released to split other atoms and thereby produce a controllable chain reaction. This generates heat & steam and later can be con-

✓ Role of Individuals in Conservation of Natural Resources :-

Now, the time has come for man as an individual, to become a good conservator of natural resources. He must play a well-defined guardian role to preserve and promote natural resources.

- (a) Environmental awareness: Individuals must be aware of the importance of environment.
- (b) Afforestation: They must plant trees on the basis of the principle each one plant.
- (c) Make rational use of natural resources.
- (d) Recycle waste to generate wealth.
- (e) Minimise waste production.
- (f) Educate others to develop awareness about environment.
- (g) Use biofertilizers in place of inorganic fertilizers.
- (h) Take steps to conserve forests & wildlife.
- (i) Follow and respect environment protection laws.
- (j) Prevent & control all kinds of pollution.
- (k) Take care of land and soil.
- (l) Clean the surrounding near habitation.
- (m) Support Govt. policies and systems for protection of environment.
- (n) Adopt biogas technology.
- (o) Ensure safe disposal of domestic wastes.

It is true that self-help is the best help.

Vol. 3 SYSTEMS

Ecology: — It is a branch of science that deals with the relationship between the living organism and their environment, then it can be called environmental biology.

The term ecology is derived from the Greek word "Oikos" means "home" and "Logos" means "study". So, ecology is the study of the household of the planet earth. Ecology is broadly divided into two categories. There are —

(i) Autecology — Autecology deals with the life history, population, behaviour etc of a single species.

(ii) Synecology: — Synecology deals with ecological studies of communities.

Ecosystem: — It is the basic functional of a logical unit. Ecosystem is defined as a given interacting with the physical environment around them. It consists of two factors
(i) Abiotic factors

(i) Abiotic factors :— The abiotic factors may be classified as—

(a) Physical factors

(b) Chemical factors

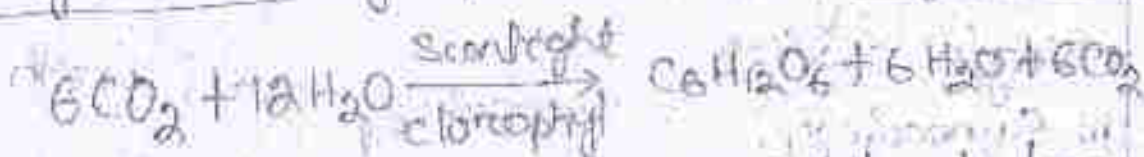
→ Physical factors includes, light, temperature, soil, water, air etc.

→ Chemical factors include pH & nutrients

(ii) Biotic factors :— Biotic factors includes all organisms, plants, animals and interaction among themselves.

* Producers :—

The ultimate source of energy for all living organisms in the ecosystem is sun. The solar energy is converted to chemical energy in the process of photosynthesis by producers. Ex- All green plants.



Producers can prepare food for all other organisms in an ecosystem, these are called as autotrophs.

* Consumers :— They can not prepare their own food and depend on producers. They may be classified into two types.

(i) Herbivores

(ii) Carnivores

(i) Herbivores :- These are the group of animal which feed directly on green plant.
Ex. Cow, goat, elephant, deer etc.

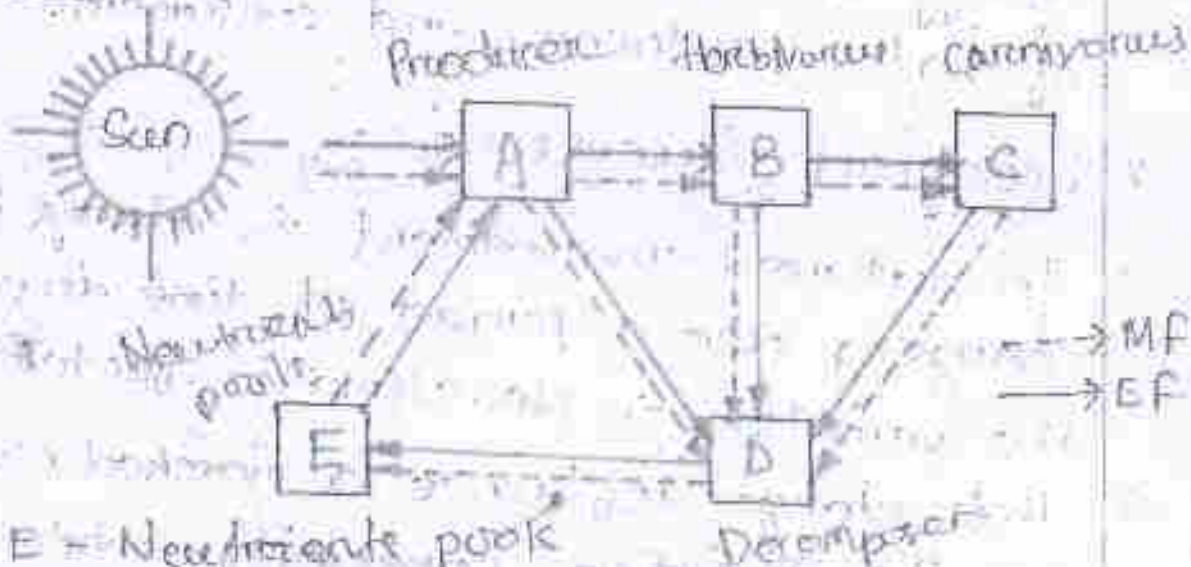
(ii) Carnivores :- These are the group of ^{omnivorous} animal which feed on other animal. Ex. People, Lion, tiger etc.

(iii) Decomposer :- They decompose dead plants and animal. Ex. Bacteria, fungi.
Consumer and decomposer are also called as heterotrophs.

* Energy flow in the eco-system :-

Flow of energy :- Transfer of energy from one trophic level to another in an eco-system is called flow of energy.

Flow of energy and nutrients :-



E - Nutrients pool

A - Producers

B - Herbivores

C - Carnivores

Characteristics :-

- Flow of energy in an ecosystem is always unidirectional in nature.
- There is reduction in energy at different trophic level.
- The magnitude of energy obtained at a trophic level depends upon its distance from energy source.

Factors on which the flow of energy in an ecosystem depends :-

- Efficiency of producers to trap and convert solar energy to chemical energy.
- Potential use of stored chemical energy in producers by consumers.
- Amount of energy utilised out of stored energy bore different metabolic activities of both producers and consumers.

* Ecological Succession :-

- In nature, environment is always keep changing over a period of time due to the variation in the climatic factors.
- This change influence a marked change in the existing community which may be replaced by another community at the same place.

→ This phenomenon is continuous and successive communities developed one after another over the same area till a final community becomes stable for a longer period of time.

So, ecological succession is a natural process of community change and this phenomenon involves an orderly and progressive replacement of communities by another until a stable community is developed.

→ During succession, a community comes to existence, grows, increases its boundary, matures, ~~manufactures~~ and finally disallowing other community to occupy the area.

→ This changing phenomenon with respect to environment & species community is called ecological succession. It is of two types.

These are - i) Primary succession

ii) Secondary succession

(i) Primary succession:- Succession ^{begins} ~~begin~~ for the first time in an area.

(ii) Secondary:- When community development ^{occurs} ~~occurs~~ which were previously occupied by other communities.

Function of Ecosystem:-

In order to understand the functioning of an eco-system we have to understand, as how plants and animals are related to each other through the food chain, and how energy passes from one organism to another and how the minerals circulate between biotic and abiotic component of the ecosystem.

* Food chain:-

Autotrophs produce food & transfer of food energy from the source to plants and to a series of organism with respect to eating and being eaten is known as food chain.

The transfer of energy from one trophic level to another in a sequence. The obtained sequence is known as food chain in an ecosystem.

Example:-

(i) Grass $\rightarrow$ goat $\rightarrow$ Man $\rightarrow$ Tiger

(ii) Grass $\rightarrow$ Insects $\rightarrow$ Frog $\rightarrow$ Snake $\rightarrow$ Hawk

(iii) Phytoplankton $\rightarrow$ Zooplankton $\rightarrow$ Small fish $\rightarrow$ big fish

The efficiency of food chain is depends on the number of trophic levels in a food chain. Shorter is the food chain, the more is the amount of energy available to the last trophic levels in a food-chain an ecosystem.

Longer is the food chain, less is the amount of energy obtained at final trophic level.

Food chain is unidirectional in nature. In food chain energy must be transferred through the intermediate trophic level in an eco-system.

Types of food chain :-

Depending upon the types of trophic level involve in the food chain, it is of two types. There are -

(i) Grazing food chain

(ii) Detritus food chain

Grazing food chain :- It starts

from living plants, proceeds through consumer of different order and then end at top carnivores. Example -

Plants $\rightarrow$ Herbivorous $\rightarrow$ 1st carnivorous $\rightarrow$ Top carnivorous
(1st consumer) (2nd consumer)

(iv) Detritus Food chain :-

Detritivores - Fungi, bacteria, algi -

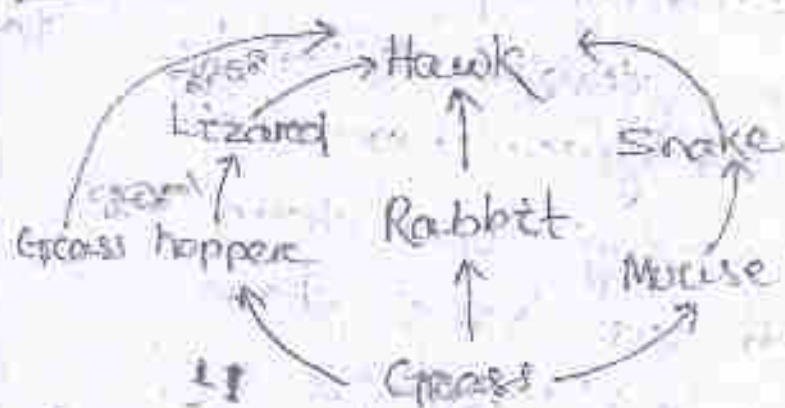
It starts from dead organic material goes to detritivores and then to the predators.

Ex- (i) Detritivores $\rightarrow$ Predators

(ii) Dead plants $\rightarrow$ soil moles $\rightarrow$ Insects $\rightarrow$ frog $\rightarrow$ snake $\rightarrow$ Hawk.

* Food webs -

There are several food chain in an eco system. In nature, normally food chains are not isolated sequence. They are interconnected with one another. The interlocking patterns of different food chain is called the Food webs.



(A food webs in a grassland ecosystem)

So, food webs can also be defined as the interaction between the different organism at different trophic level of food chain.

Significance of food chain.

- (i) It provides alternative path way for transfer of energy and nutrients through different food chain in an eco-system.
- (ii) It also maintains the stability in an eco-system.

Ecological Pyramids.

Charles elton in 1972 noted that the animals at the base of food chains are relatively abundant, while those at the end are relatively few in numbers.

There is some relationship between numbers, biomass and energy content of the primary producers, consumers of first order, second order and so on upto top carnivores in any ecosystem.

The relationship may be represented in diagram and known as Ecological pyramids.

Ecological pyramids are of 3 types:-

- (i) Pyramids of numbers
- (ii) Pyramids of biomass
- (iii) Pyramids of energy

Pyramids of numbers is based on number of organism at each level. Pyramids of

and pyramid of energy is based on the rate of energy flow.

- The pyramid of numbers and biomass may be upright or inverted depending upon the nature of food chain in the particular ecosystem, whereas pyramid of energy are always upright.

(i) Pyramid of number -

- This deals with the relationship between the number of producers, herbivores & carnivores at successive trophic level.



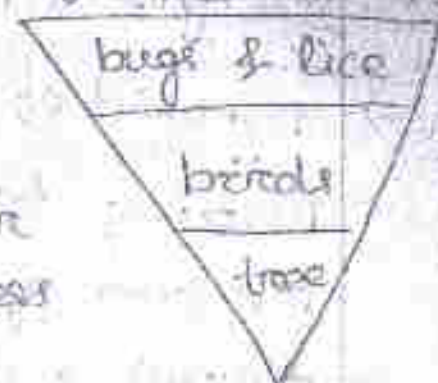
(Upright)

- At the base there is always number of primary producers and on the base there are consumers at successive levels.

In grassland ecosystem the producers which are mainly grasses are always many numbers. This number then show ~~are always~~ many decrease towards apex, as the primary consumers or herbivores like rabbit are less in number than grasses. So, secondary consumers are less in number than primary consumers. Finally the top consumers are least in number (upright).

Inverted Pyramid of No. (Frugivores)

In forest eco-system however the pyramid is inverted. Hence the number of producers (trees) is less than that of herbivores (birds depend upon the trees) the number of parasites like bug and lice are more than birds.



Pyramid of biomass - Here weight

forms the base of the pyramid.

The biomass of one tree is very high. The biomass of number of birds, feeding upon the tree is far less than that of the tree.



(Pyramid of biomass upright)

Similarly the biomass of large no. of parasites on the birds is less. Thus the pyramid of biomass become upright.

Inverted Biomass of phytoplankton is quite negligible as compared to small herbivores like fish that on them. The biomass of large carnivores



Inverted

(iii) Pyramid of energy:-

- Pyramid of energy is always upright.
Because, less energy is consumed and less energy is transferred from one trophic level to another trophic level.
- The quantity of energy trapped by green plant in an area over a period is highest as compare to that of organism of other trophic level. The energy contain by the consumer is less and the energy content of top consumer carnivores is least. Therefore the pyramid of biomass is upright.



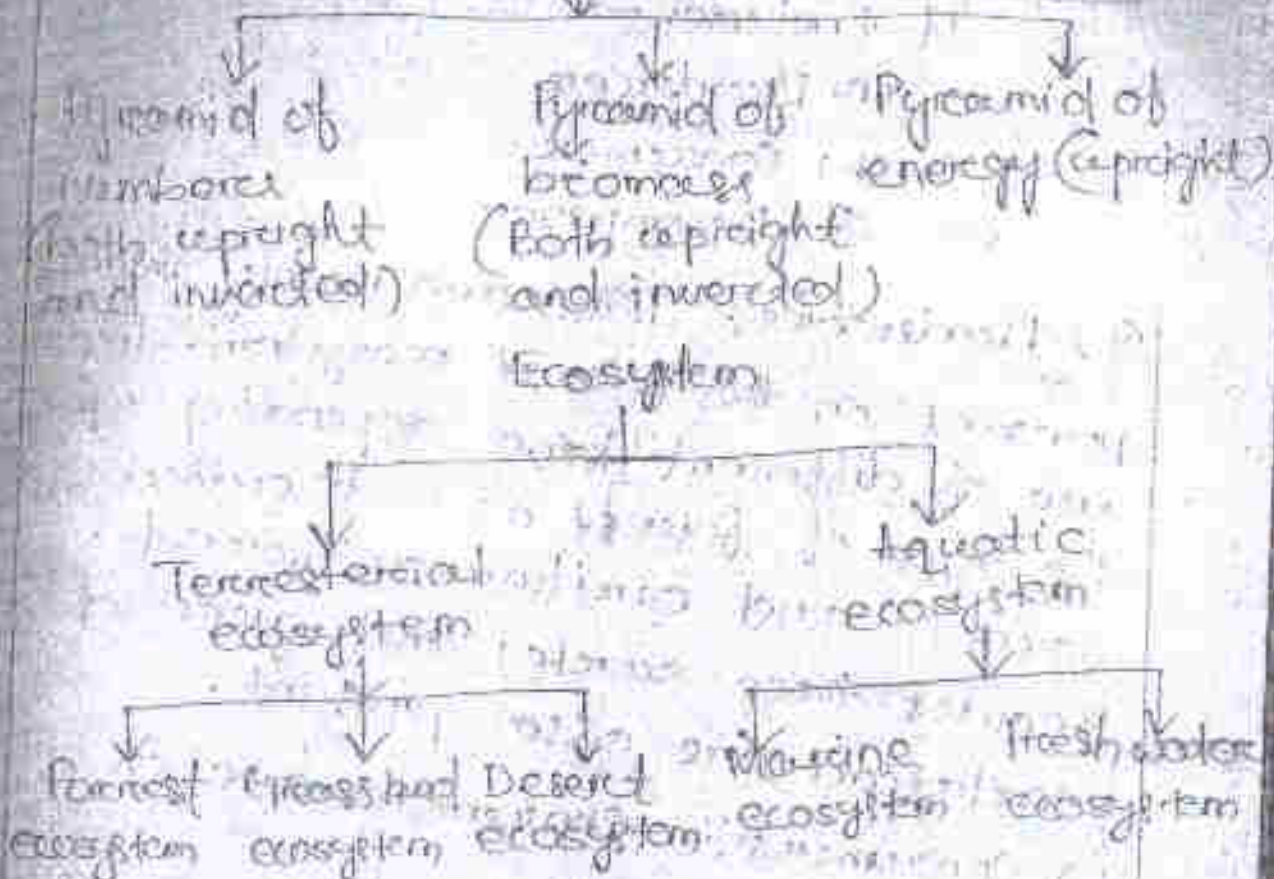
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(upright)

(Pyramid of energy in grassland ecosystem) (Pyramid of energy in aquatic ecosystem)

Ecological Pyramids



* Forest ecosystem :-

In India tropical rain forest are breeding evergreen ghats, Andaman and North-East Himalaya. The different components of ecosystem are :-

- (i) Abiotic component
- (ii) Biotic component

(i) Abiotic component :-

These are inorganic and organic substances present in the soil and atmosphere. Abiotic component also includes minerals present in the forest and dead remains of trees (tree-limb).

(ii) Biotic component

It includes -

- (a) Producers
- (b) Consumers
- (c) Decomposers

(a) Producers:- These are mainly trees present in the forest ecosystem. Trees are of different kind depending upon the type of forest as deciduous forest and coniferous forest. Besides tree species and ground vegetation are also present.

(b) Consumers:- Consumers are of following types -

- (i) Primary consumers
- (ii) Secondary consumers
- (iii) Tertiary consumers

(i) Primary consumers:- These are the herbivores that include animal feeding on the plants.

(ii) Secondary consumers:- These are the carnivores like snake, birds, lizards, hawk etc. feed on herbivores.

(iii) Tertiary consumers:- These are the top carnivores like lion, tiger etc. that eat carnivores of secondary.

Decomposers:- Decomposers are the wide variety of microorganisms like bacteria, fungi. Rate of decomposition in tropical and soft-tropical forest is more rapid.

Aquatic ecosystem

More than 70% of land is covered by water. Importance of ecosystems are -

i) Pond ecosystem:- Ponds are small bodies of water. Pond plays an important role in villages where most of the activities like washing, clothes, birthing, swimming, fishing, cattle birthing etc. takes place around pond. We may study pond as an ecosystem by making it's convenient division into some basic component. The component includes:-

1) Abiotic component

2) Biotic component

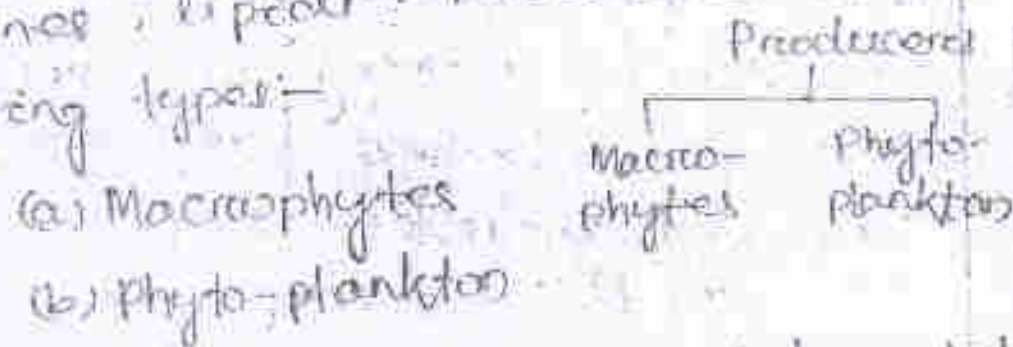
Abiotic component:- Apart from heat, light the basic inorganic and organic compounds elements are water, carbon dioxide, oxygen, calcium, nitrogen, phosphorus, amino acids etc.

→ Light intensity and turbidity (clarity of water) index of water at different

and sechrodise respectively. pH is determined by electrical pH meter. Dissolve oxygen (D.O), carbon dioxide (CO_2), phosphate, nitrogen, can also measured by appropriate method. Carbo-hydrate, proteins, lipids, are also can estimated.

② Biotic component - The biotic component ponds are -

(i) Producers - These are autotrophic and includes green plants. They ^{store} fix ^{some} inorganic energy and with the help of minerals and most form complex organic substances like carbo-hydrate, proteins, lipids. Producers are of following types:-



(a) Macrophytes - These are mainly rooted larger plants. Ex:- Treapa, Typha, chara, sagittaria, nymphaea, hydrilla, marsilea, a triceclaria, azolla, sylvia, temna, spiradella etc.

(b) Phyto-plankton - These are minute floating suspended lower plants, like eubacter, spiralgira, chloophora, lamina.

(i) Consumers : — Most of the consumers heterotrophic are known as primary, macro-consumers. Consumers are again following types —

Primary consumers



* Benthos : — Animal associated with living plants.

Ex : Fish, meter, molluscs, crustaceans.

* Zoo plankton : — Phytoplankton

Ex : Protozoa

* Secondary consumers : —

These are carnivorous like insects and fish which feed on primary consumers.

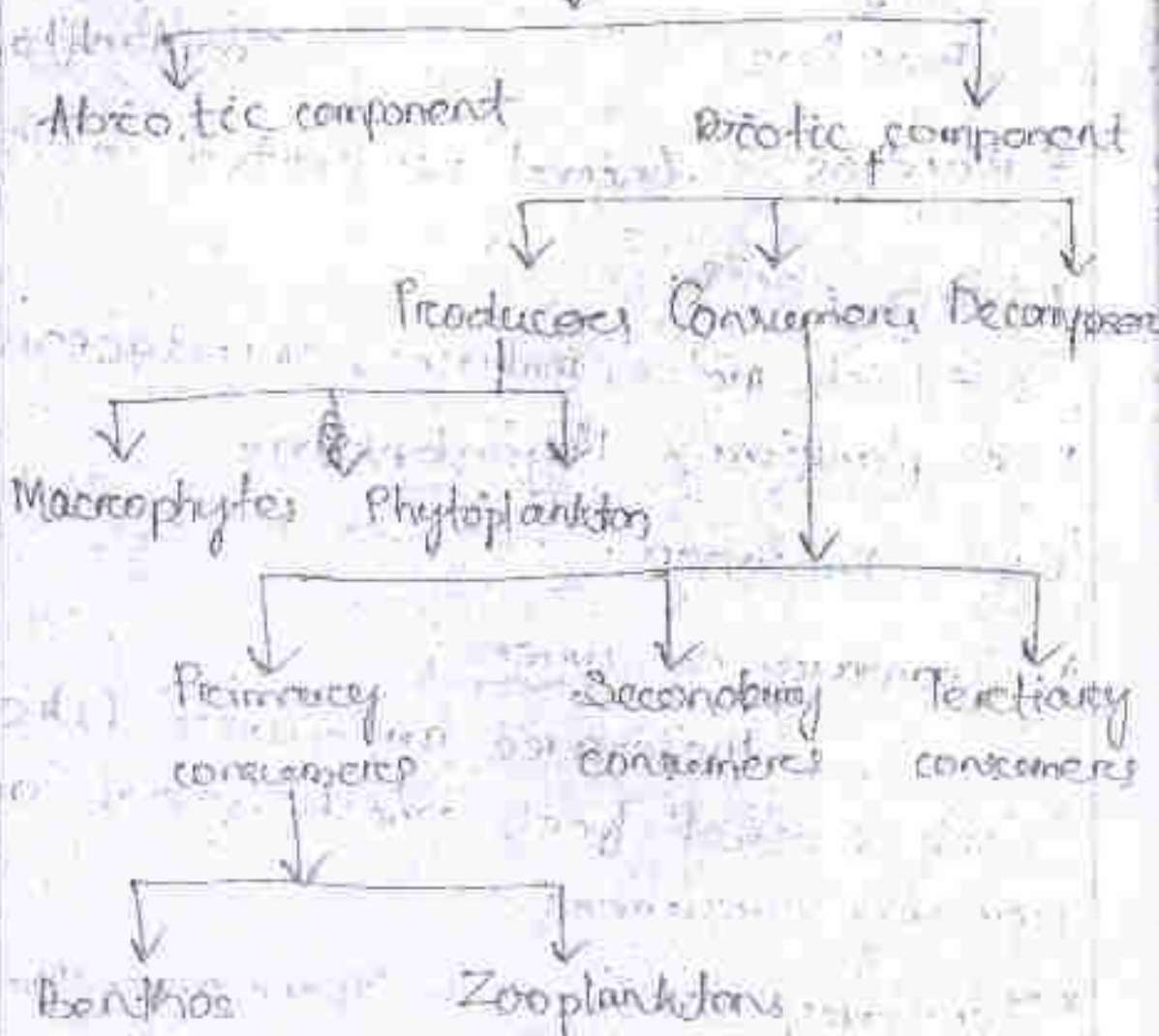
* Tertiary consumers : — There are some large fish may occupy more than one trophic level.

(ii) Decomposers : — These are the macro-micro-consumers which absorb only a fraction of the decomposed material.

They decompose organic matters of both

in simple terms. They play an important role in return of mineral element again to land. Ex - Fungi, bacteria.

Structure of pond eco system



* Marine ecosystem (Ocean):

The marine environment of seas and ocean is large occupying 70% of earth surface. Ocean plays an important role in regulating many hydrological and biochemical cycles, thereby regulating the earth climate.

It consists of two components. These are-

- (i) Biotic component
- (ii) Abiotic component

(i) Biotic component: -

The biotic component consists of -

(a) Producers: - These are autotrophic, which are mainly phytoplankton. They trap radiate energy from sun through their pigment. Ex: - Brown & Red algae.

(b) Consumers: - These are heterotrophic macro-consumers dependent for their nutrition on producers. These are -

(1) Herbivores: -

Like crustaceans, molluscs, fish etc which feed directly on producers are called primary consumers.

② Carnivores: - Like fishes feeding on herbivores are called secondary consumers or carnivorous.

Ex: - shark, herring

* Top carnivores: - Fishes feed on secondary consumers called as tertiary consumers or top carnivorous.

Ex: - Cod, haddock, halibut fish.

③ Decomposers: - These are the microbes who decay dead organic matter.

Ex: - Fungi, bacteria.

(ii) Abiotic Component: -

It includes high sodium, mg. to calcium and potassium salt concentration. also contains dissolve oxygen (D.O), light, temperature etc.

Environmental Succession

In nature, environment is always, keep changing over a period of time due to the variation in the climatic features.

This change influence a marked change in the existing community, which may be replaced by another community at the same places.

Depending upon the moisture content the primary & secondary succession may be of following types —

(i) Hydroch / Hydrosere

(ii) Mesarch / Mesosere

(iii) Xerarch / Xerosere

(i) Hydroch / Hydrosere — The succession

when start in aquatic environment.

(ii) Mesarch / Mesosere — The succession

begins in an intermediate type area.

(iii) Xerarch / Xerosere — when succession start in dry place having minimum amount of moisture.

Again they are divided into

(a) Lithosere :-

Succession initiating on rocks.

(b) Psammose :-

Succession initiating on sand.

(c) Halosere :-

Succession initiating on soil.

→ Some times succession may be of 2 types -

(i) Autotrophic Succession :- It is a
characterized by dominance of autotrophic
organisms like green plants.

(ii) Heterotrophic Succession :-

It is characterized by dominance
of heterotrophs such as animals,
bacteria, fungi, etc.

Ecology :- The term Ecology has been derived from two Greek words (Oikos = house and logos = study). Broadly speaking, ecology is the study of the household of the planet earth. The household consists of non-living (abiotic) matters such as, soil and water and living (biotic) organisms such as micro-organisms, plants and animals including man. Organisms depend upon each other for their survival and continuance. They also depend upon the non-living matter around them for their normal functioning.

Ecology deals with organisms, populations, communities, ecosystems and the biosphere.

Organisms include micro-organisms, plants and animals.

Population is defined as a group of individuals of any one kind of organism.

A community (biotic community) includes all the populations of a given area.

Ecosystem :- The community & the abiotic environment interact & function together as a system called ecological system or ecosystem.

Biosphere :- The part of the earth where different ecosystems operate is called the biosphere. In other words all the ecosystems of the earth collectively constitute the bio-

ENVIRONMENTAL POLLUTION

Environmental Pollution:-

Any undesired change of the physical, chemical and biological properties of our surrounding environment that may have harmful effects on the animals, human and plants, that is called environmental pollution.

~~Cultivation of pollution-resistant species is the best possibility of reducing pollution.~~

Air Pollution:-

Air pollution may be defined as the "presence of one or more pollutants or contaminants in the atmosphere which may tend to be injurious to human, plants or animal life."

→ The atmosphere is a dynamic system, which absorbs various pollutants, from natural as well as man made sources. Gas such as CO , CO_2 , H_2S , SO_2 and NO_x as well as particulate matter such as sand and dust are continuously releasing into the atmosphere through natural activities.

Man made pollutants, e.g., SO_2 , NO_x , SO_2 , CO_2 , hydrocarbon, particulates etc. are also released into the atmosphere.

→ The magnitude of the problem of air pollution has increased due to population explosion, industrialization, urbanization and automobiles etc.

Classification of air pollutants:-

The air pollutants may be classified in different ways.

(A) According to origin



① Primary Pollutants :- which are directly emitted into the atmosphere.

Ex:- CO , NO_2 , SO_2 and hydrocarbons.

② Secondary Pollutants :- These are the pollutants which are derived from the primary pollutants due to chemical and photochemical reaction in the atmosphere.

Ex:- Ozone, PAN (Peroxy-acetyl Nitrate), photochemical smog etc.

(1) According to chemical composition

(a) Organic pollutants

Hydrocarbons, aldehydes, ketones, amines and alcohols.

eg - Nitrogen compound (NO_x & NH_3)

→ Sulphur compounds (H_2S , SO_2 , SO_3 and H_2SO_4)

→ Halogen compounds (HF , HCl)

→ oxidising agent

→ Carbon compound (CO & carbonates)

→ Inorganic particles (fly ash, silica, dust)

(b) According to the state of matter

(1) Gaseous Pollutants

These get mixed with air.

ex: CO , NO_x & SO_2

(2) Particulate pollutants

These comprise of finely divided solids or liquids and often exist in colloidal state.

eg: smoke, fumes, dust, fog, smog, etc.

[1] Oxides of sulphur (SO_x):

SO_x comprises of SO_2 and SO_3

They are colorless, heavy water soluble with pungent odour. SO_x pollution is

due to volcanic activity, combustion of fuels, transportation, chemical plants, other natural and human activities.

In atmosphere,



Oxidation of SO_2 into SO_3 by photolytic and catalytic process gives rise to the formation of "photochemical smog", and in humid condition, SO_2 reacts with water vapours to produce droplets of H_2SO_4 aerosols, called "acid rain".

Biochemical effects:-

(i) React with cellular constituents, chemicals e.g. - enzymes.

(ii) The H_2SO_4 formed lowers pH , impairs enzymatic function and destroys various functional molecules.

[A] Oxides of Nitrogen (NO_x)

- Mostly comprises of NO , NO_2 and N_2O
- NO is colourless and it is slightly soluble in water.
- NO_2 is reddish brown gas, can react with water to form HNO_3 , which is a oxidising agent and react with most metals and many organic compounds.
- NO_2 is also involve in the destruction of ozone layer in the atmosphere.

Biochemical effects

- Forms bonds with haemoglobin & reduces the efficiency of oxygen transport.
- Disrupts some cellular enzyme systems.

[a] Carbon monoxide (CO)

- Colourless, odorless, toxic gas, slightly water soluble, but still it is dangerous because it has a greater affinity for haemoglobin than that of O_2 .

Biochemical Effects

- It reduces the oxygen carrying capacity of blood.

[4] Ozone (O_3) and PAN

- Ozone is pale blue gas, fairly water soluble, very reactive, oxidising agent.
- PAN are harmful to plants, animals & humans. (PAN is a component of photochemical smog, a mixture of air pollutants + gases + particulates).

Biochemical effects

- Ozone & the cellular constituents.
- PAN and ozone toxicity is produced through the generation of free radicals.
- O_3 causes irritation to eyes and respiratory tract.

[5] Hydrocarbons

- These are very reactive, volatile hydrocarbons and other organic compounds participate in atmospheric reactions generating ozone.

Biochemical effects

Some of these compounds can react with the constituents of the cell. Carcinogenic hydrocarbon like benzo[a]pyrene can react with DNA causing mutations and cancer.

(i) Particulate Matter:—

Solid particles or liquid droplets including brime, smoke, dust.

Biological effects:—

Carbon particle and other particles can cause a lung disease known as pneumoconiosis.

Particulates may accelerate corrosion of metals and cause damage to paints and sculptures.

Effects of Air pollutants on Man and its Environment:—

(i) Damage to Material:—

The material may be affected by air pollutants. The types of possible damage to these material by air pollutants includes corrosion, abrasion, deposition, direct or indirect chemical attack.

(ii) Damage to Vegetation:—

Air pollutants, such as sulphur dioxide, HF, particulate fluorides, smog, oxidants like ozone, NO_x, chlorine, herbicides etc exert toxic effect on vegetation. Retardation of plant growth may also occurs in some cases.

The extent of damage to a

and concentration of the pollutant, time of exposure, soil & plant condition etc.

[3] Damage to farm animals

- Arsenic, lead, fluorides are the main pollutants which cause damage to livestock.
- Arsenic occurs as an impurity to coal and many ores. It is also used as insecticides. Livestock suffers smelting and other industrial operation suffer arsenic poisoning like salivation, thirst, inflammation of digestion of central nervous system.
- Lead poisoning occurs in horses and other animals with the symptoms like depression, paralysis.
- Cattle and sheep are particularly susceptible to fluorine toxicity which may causes fluorosis of teeth and bones.

[4] Darkening of sky & reduced visibility

- Sky darkening may be caused by heavy smoke and fog.
- The reduced visibility may be due to smoke, fog and industrial fumes.

(5) Effect of human health and human activities.

Air pollution may affect the health of workers in industrial area.

Apart from the effects on industrial workers, air pollution also affects general population.

Chronic bronchitis, bronchial asthma, lung cancer may occur due to air pollution.

It causes sickness, which may result in the decrease in efficiency of human activities.

* Measures to check air pollution:

It is not easy to control or check air pollution but we can check it or prevent by careful planning like industries, better design, operation of equipments & general awareness to do this. The following are the general method of air pollution control —

(i) Controlling the air pollution at source.

(ii) Site selection/zoning.

(iii) Controlling air pollution by devices/equipment process modification.

(iv) Air pollution control by growing vegetation.

(v) Air pollution control by fuel selection.

(i) Controlling air pollution at source:

It is best to check Air pollutant at source. This can be achieved by -

(a) Modifying the process in such a way that pollutants don't form at all, beyond the permissible limit.

(b) Before release the pollutants, they should be reduced to tolerable levels by method equipments to destroy, alter, or trap it.

(ii) Site selection / zoning:

To control the air pollution site selection / zoning plays an important role.

→ For improvement of the people's health, zoning should be done properly.

→ Industries running on electrical power causing no nuisance may be either near residential area, but opposite to this may be located far away from residential area.

(iii) Controlling of air pollution by devices / equipment / process modification:

It may be -

(a) Method / equipments used to control

Method/Equipment used to control particulate emission.

Method/equipment used to control gaseous pollutants.

For gaseous pollutants, following methods are generally used. Those are

- (i) Absorption
- (ii) Adsorption
- (iii) Combustion
- (iv) Cold trapping or condensers
- (v) Others

→ Absorption, adsorption and combustion are in common use.

→ In absorption, they have suitable liquid as absorbent to remove one or more pollutants, present. This technique is used to remove NO_x , H_2S , SO_2 , SO_3 , HCl , HBr etc.

→ In Adsorption, gaseous pollutants are passed through porous solid adsorbent taken in suitable container. The efficiency of adsorption depends upon the surface area per unit weight of the absorbent. e.g. - SO_x is removed from the boiler, by CaO (limestone).

Emission of SO_x is prevented, because CaO forms CaSO_3 and

→ Combustion:— The combustion of organic gaseous pollutants convert them into H_2O and CO_2 .

[Q] Method / Equipment used to control particulate emission:—

The various methods are:

(i) Filtration

(ii) Mechanical

(iii) Precipitators

(iv) Scrubbers

(i) Filtration:— Different types of filters are generally used, i.e. fibrous, deep bed, cloth bag filters. The particulate matter passed through filters, particles are trapped and collected in fibre.

(ii) Mechanical:— It includes 2 Mechanics:

(a) Gravity settling in which the velocity of horizontal carrier gas is reduced so that particles settle by gravitational force.

(b) Sudden change of direction of the gas flow causes the particles to separate.

(iii) Precipitators:— It works on the

principle that when particulates move through a region of high electric strength, they become charged and

then they are attracted to an opposite charge area, where they are collected and removed.

(iii) Scrubber: — In this device the particles are washed out of the gas flow by a water spray.

(iv) Controlling of Air pollution by growing vegetation: —

Planting tree is very helpful in reducing air pollution. Tree should be planted all around the source in order to reduce the spreading of air pollution from pollutant coming out of industry.

Cultivation of pollution resistant species is the best possibility of reducing pollution.

* Water Pollution :-

Water is essential for the survival of any form of life. Human consumes about 2 litre of water everyday. Water accounts for about 70% of the weight of a human body.

An analysis conducted in 1982 revealed that about 70% of all the available water in our country is polluted. Municipal water is mainly used for drinking purpose and for cleaning, washing and other domestic purpose. The water that is fit for drinking purpose is called portable water.

Characteristics of Portable water :-

- It should be colourless, odourless and tasteless.
- It should be free from germ, bacteria and other ^{or virus} pathogenic organism.
- It shouldn't contain toxic dissolved impurities, such as heavy metals, pesticides etc.
- It should have p^H in the range 7-8.5.

Water pollutants and their Sources :-

Various types of water pollutants are

(1) (a) Oxygen demanding wastes :-

This include domestic and animal ^{waste} sewage, bio-degradable organic compound and industrial wastes from food processing and ^{textile} mills etc.

All these are degraded and decompose by bacteria but in the presence of D.O. This results in rapid depletion of D.O. from water, which is harmful to aquatic organisms.
[1] Disease causing water:—

These include ^{pathogenic} micro-organisms which may enter the water along with sewage and may cause tremendous damage to public health.

[2] Synthetic organic compounds:—

These are the man made materials such as synthetic pesticides, detergent, insecticides, paints, plasticizers, plastics and other industrial chemical. Most of these chemicals are toxic to plants, animals and human.

[3] Inorganic pollutants:—

Inorganic pollutants includes mineral acids, inorganic salts, cyanide, sulphates, nitrate and metals. The heavy metals such as Hg, Cd and lead metalloids such as As, Sb, Se are most toxic.

[4] Suspended solids:—

Suspended solids in water mainly comprise of sand and minerals from soil.

[5] Radioactive Materials :

- (a) Mining and processing of ores - Uranium.
(b) Increase use of radioactive isotopes in research, agricultural, industrial and medical application - $^{131}_{53}\text{I}$, $^{32}_{15}\text{P}$, $^{60}_{27}\text{Co}$, $^{45}_{20}\text{Ca}$, $^{35}_{16}\text{S}$, $^{14}_{6}\text{C}$, $^{86}_{37}\text{Rb}$.

- (c) Radioactive material from nuclear power plant and nuclear reactor - $^{90}_{38}\text{Sr}$, $^{137}_{55}\text{Cs}$, $^{238}_{92}\text{Pu}$, $^{241}_{94}\text{Am}$.

- (d) Radioactive material from testing and use of nuclear weaponry - $^{90}_{38}\text{Sr}$, $^{137}_{55}\text{Cs}$.

The radioactive isotopes found in water include $^{90}_{38}\text{Sr}$, $^{131}_{53}\text{I}$, $^{137}_{55}\text{Cs}$, $^{144}_{54}\text{Ce}$, $^{60}_{27}\text{Co}$, $^{54}_{25}\text{Mn}$, $^{55}_{26}\text{Fe}$, $^{239}_{94}\text{Pu}$, $^{140}_{54}\text{Ba}$, $^{40}_{19}\text{K}$, $^{226}_{88}\text{Ra}$.

[6] Heat :

Water is used as coolant in thermal power plant, the nuclear power based electricity generating plants. Then the whole hot water is returned to the original water bodies. Hence the temperature of the water body increases. The rise in temperature decreases the D.O content of water.

Effects :

Some important effects of various

water pollutants are -

Unwanted solids present in water may cause bad odour and taste and also may provide the conditions favourable for growth of pathogenic bacteria.

Radioactive isotopes like ^{90}Sr to life-forms which releases from testing of nuclear weapons, accumulate in bones and teeth and cause serious disorders in human beings.

The presence of lime, flesh, CaCO_3 etc. may interfere with the photosynthetic activities of aquatic plant.

(ii) High amount of bleaching is present in phosphate fertilizer. The bleaching present in the water causes dental and skeletal fluorosis to human.

(iii) The presence of excess salt and Cr in the waste water may decrease the quality of ground water.

(iv) The dissolved chromium present is toxic to fish and aquatic life.

(v) The acidic or alkaline pollutant present in water are corrosive to metal pipes.

(vi) Suspended solids such as silt and coal may injure the gills of the fish.

(vii) Excess of NO_2 in water is also causes

Control of water pollution

Control of water pollution is difficult, but we may try for its prevention and minimization. Some of these are —

- (1) Scientific techniques are necessary to be adopted for the environmental control of rivers, lakes, ponds or streams.
- (2) Industrial plants should be based on recycling process.
- (3) Instead of throwing waste into water, the recycling should be done for better use.
- (4) Minimum, appropriate quantity and concentration of fertilizers, pesticides and insecticides should be used, because excess will cause pollution.
- (5) Water resources should be discouraged use in the best possible economic way.
- (6) Destruction of forest should be discouraged.
- (7) Our goal should be conservation of forest and plant more trees.
- (8) There should be proper agenda for water pollution control on radio, TV, Newspaper etc because public awareness is must.
- (9) Techniques like adsorption, electrolysis, ion exchange and reverse osmosis etc for removal of water.

Local authorities, industrialists, govt. and public participation should be encouraged to find ways to control water pollution.

Soil Pollution

Soil is a very important constituent of the lithosphere. The word soil is derived from the Latin word "solum" which means "earthy material in which growth of plant takes place".

Soil is a complex physio-biological system containing water, mineral salts, nutrients and dissolved oxygen.

The study of soil science is called "pedology" or "edaphology".

Importance of soil to the Biosphere

- (i) Soil provides mechanical support to the plants.
- (ii) Due to the porosity and water holding capacity of soil, it serves as a reservoir of water and supplies water to the plants through the roots even when the land surface is dry.
- (iii) Soil has ion exchange capacity. Thus it supply micro & macro nutrients for the growth of plants, animals and microbes.

- (iv) Soil contains organotrophic bacteria, nitrifying bacteria, nitrogen-fixing bacteria, fungi, protozoa and other microbes which help in decomposition and mineralization of organic matter and regeneration of nutrients.

Sources of soil pollution:

- The source of soil pollution includes mining, fertilizers, pesticides etc.
- Indiscriminate dumping of industrial wastes and municipal wastes leads to soil pollution.
- Direct pollution of soil by dangerous pathogenic organisms.
- Commercial and domestic urban wastes which include garbage and rubbish material such as plastics, waste paper, fibres, rubber also contribute to soil pollution.
- Human and animal excreta, farm waste, radioactive waste etc. also causes soil pollution.

Effects of soil pollutants:

(a) Effects of modern agriculture practice:

Synthetic Fertilizers:

Synthetic fertilizers increase the soil fertility and crop productivity. However excessive use of fertilizers may result in following effects.

Excessive use of nitrogenous fertilizers leads to accumulation of nitrate in the soil, which can enter into the human body & may cause Stomach Cancer.

Excessive use of chemical fertilizers may reduce the ability of plant to fix nitrogen.

Excessive use of potassium fertilizers in soil may reduce the quantities of vitamins (carotenic acids).

Pesticides:-

Some Arsonic pesticides may cause some soil permanently infertile.

Pesticides such as endrin, dieldrin, DDT may seep (flow or leak) through the soil & then to contaminated ground water and surface waters.

DDT can enter the food chain and accumulate in human fats and may leads to disorders.

(b) Effects of Industrial effluents:-

Industries such as paper, iron, steel, fertilizers, dyes, automobiles, pesticides, coal-based thermal power plants etc contain a variety of pollutants such as toxic heavy metals, solvents, detergents, plastics, suspended particles and non-biodegradable chemicals. If they are not properly treated at source, they gives rise to soil pollution.

[C] Effects of 'Urban wastes' :-

Million tones of urban waste are produced every year from critically polluted cities. The untreated sewage sludge not only creates serious health hazards but also pollute the soil and decreases it's fertility and productivity. Other waste materials such as rubbish, used plastic bags, garbage, sludge, dead animals, waste medicines, hospital wastes, skins, tyres, shoes, coils etc also cause soil pollution.

* Control of soil pollution :-

The major sources of soil pollution are domestic wastes, industrial wastes and agricultural wastes. The various approach to control soil pollution are —

- Banning the use of highly toxic & synthetic chemical pesticides.
- Encouraging the use of bio-pesticides in place of toxic chemical pesticides.
- Conservation of soil to prevent the loss of top soil from erosion and to maintain in a fertile state for agriculture purposes.
- Recycling, reuse of material should be done whenever possible.
- Avoiding excessive use of chemical fertilizers and pesticides.

Marine pollution:

Sea are the unlimited source of water for man and are also the main source of food and earning for persons living in coastal areas. When the marine water is polluted it will affect the animals present in the sea.

* Sources of Marine pollution:

The main source of marine pollution are—

- (1) Rivers are the main source of marine pollution. They carry wastes and join sea. Rivers carry the wastes like industrial pollutants or chemicals, detergents, plastics etc.
- (2) Ship which carry toxic substance, oils, paints, fuels, automotive material & other chemicals from one place to another, some times by accident or by leakage pollute the marine water.
- (3) Testing of automatic weapons, space air-crafts, missiles and other radioactive wastes when dumped in sea, causes heavy loss to aquatic organism.
- (4) Harmful pollutants from nuclear power stations or from other scientific organisations, chemical industries, fertilizers, pesticides and insecticides industries when mixed with marine water causes harmful effect to

(5) Marine pollution also caused by oil drilling in seas, tourism activities and heat released.

Effects of Marine pollution:

The major effects of marine pollution are-

(i) Oil is most dangerous pollutant (when mixed in sea) to marine life.

(ii) Oil affects phytoplankton, zooplankton & other aquatic organisms.

(iii) Plastics and plastic material when dumped into sea by commercial ship or from drainage, animal take it through their food in stomach. It reduces hunger.

(iv) Marine pollution affects the food chain in seas. E.g. - serious diseases like cancer are caused when affected animals are taken by man from ocean.

(v) Detergents are also responsible for pollution of marine life.

(vi) Heavy metals (like lead and Mercury), factory minerals, mineral oils, acids causes serious effect to marine life.

Control of Marine Pollution:

The control of marine pollution can be studied in following steps

(i) Steps already in operation

(ii) Suggesting steps to control marine

Steps already in operation:

- (i) Land authorities are alert and introducing antipollutants.
- (ii) Various research organizations, institutions are working in this field to check marine pollution.
- (iii) Monitoring and survey operations are there to control the marine pollution.
- (iv) Authorities are take care to check the oil leakage from ship and tankers.
- (v) Urban and coastline operations are trying to check the dumping wastes from human activities and municipal etc and helping to recycle and reuse.

Suggesting steps to control marine pollution

- (i) Dumping of oil, hazardous and toxic substances, gases from radioactive labs into sea should be banned or should be properly treated before dumping.
- (ii) Drainage, industries pollutants should not be discharge into river which joins sea.
- (iii) Development activities on coastal area should be minimized.
- (iv) Ship and ports should have certain facilities for reducing pollution.
- (v) Biological methods should be allowed to maintain ecological balance in the water body to prevent pollution.
- (vi) Nuclear explosions & other nuclear activities should be minimized.

7. We should develop awareness in people to reduce the amount of waste in their daily life.

(E) Noise Pollution :-

Sound is a special kind of wave action which is usually transmitted through air in the form of animals transformed into electrical impulses in the ear and carried to brain which enables us to hear.

The term "noise" may be defined as an "unwanted sound" at a wrong time and a wrong place.

- Prolonged and loud sound is generally considered as noise which is mostly caused by industries, vehicles, aeroplanes.

Frequency :- Rate at which the wave arrives at a fixed point.

- Hz (Hertz) or cycles/sec measures the sound frequency.
→ Human being can hear only 20 Hz - 20 kHz.
→ Greater than 20 kHz - Ultra sound.
→ < 20 Hz - Infrasonic.

Sound intensity :-

- Sound power / unit area
- measured in watt/m^2 .

The response of ear to sound is proportional to the logarithm of intensity or pressure.

Loudness of two sound is judged by ear by the ratio of their intensities.

Unit - Decibel

Deci - latin word - means ten

bel - is the logarithm ratio of 2 intensities.

Decibel (dB) - Ten times logarithm of the ratio of 2 sound intensities.

$$dB = 10 \log \frac{\text{sound intensity measured}}{\text{Reference sound intensity}}$$

Effects :-

Physiological effects :-

The effect caused by noise depend upon the frequency and pressure.

At 150 dB - immediate permanent hearing impairment may be caused.

At sound level 120-150 dB $\rightarrow$ Effect of loss of physical control, other physical changes resulting from stress, nausea and vomiting may be caused.

(ii) Psychological effects :-

$\rightarrow$ Nervous illness caused by noise.

$\rightarrow$ Reduces concentration and even mental disorientation at high noise level.

$\rightarrow$ Continuous loud noise reduces the working

→ Interrupts sleep. As sleep is important to emotional stability, noise cause emotional disturbance.

[3] Hearing loss —

Prolonged exposures to loud noise can cause temporary or permanent loss to hearing.

[4] It may cause headache
Other health effect of noise pollution

→ It may cause headache, irritability.
→ Our optical system is also affected by noise pollution.

→ Impairment of night vision, decrease in colour perception ability.

→ Noise affects cardiovascular system.

* Prevention & control of noise pollution

Loud noise is the form of pollution.

Steps to control noise pollution are —

[1] Reduction of noise at the source of its origin —

→ This can be achieved by replacement of noisy devices or machines with quieter ones.

→ Proper oiling and greasing to ensure smooth running and using effective silencers etc.

(2) Application of sound proofing techniques to reduce loud noise.

→ Sound barriers should be used around the source of origin of loud noise.

(3) Keeping residential localities free of noisy industries, busy high ways, aero-dromes etc.

→ Residential localities should be established away from noisy industries, busy highways, aerodromes or these noisy establishment should be developed away from residential.

(4) Noise control method in industrial plant:-

Excessive noise is produced from various types of machines; petrol & diesel engines, pump & pumping system etc.

→ It is always economical and effective to identify the noise source or problems in the design stage and do the necessary noise control measures.

(5) Strict rules and regulation:-

→ legal framework against noise pollution has been developed. Effective measures to enforce these rules and regulations.

(F) Thermal Pollution

Thermal pollution :- It can be defined as

(i) Addition of excess undesirable heat to water that makes it harmful to man, animal, plant and aquatic life.

(ii) Heated effluents which contaminated with water supplies, may be harmful to life because of their toxicity, reduction in dissolved oxygen (D.O).

(iii) It is a byproduct of rapid & unplanned industrial progress and over population.

* Sources of thermal pollution :-

(i) Nuclear power plant :-

Nuclear power plant discharge its heat to the nearby water bodies. Heat discharge is about 10°C higher than the coolant reception & affects aquatic life.

(ii) Coal fired power plant :-

Some thermal power plants discharge heat having temp. 15°C higher than the water bodies. The heated effluents decreases dissolved oxygen (D.O).

(iii) Industries :-

Industries like textiles, paper, as well as sugar releases heat in water.

1) Hydro electric power plant:—

The generation of hydroelectric power plant, results in negative loading on water system.

2) Domestic sewage system:—

The municipal sewage normally has a higher temp. than receiving water.

Effect of thermal pollution:—

Reduction in Dissolved oxygen (D.O):—

Concentration of dissolved oxygen decreases with increase in temperature.

Change in water properties:—

The change in temp. also changes the physical and chemical properties of water. Vapour pressure increases sharply, density decreases.

Increase in toxicity:—

A rise in temp. increases the toxicity present in water. A 10°C rise in temp. doubles the toxic effect of potassium cyanide.

Interferes with biological activity:—

Temp. is considered to be vital importance to physiology, metabolism and biochemical process in controlling respiratory rates, digestion & overall development of aquatic organism. The change in temp. totally disrupts the

[5] Effect of Marine Life

Some marine organisms cannot tolerate wide changes of temp. so they die at higher temp.

* Control of thermal pollution

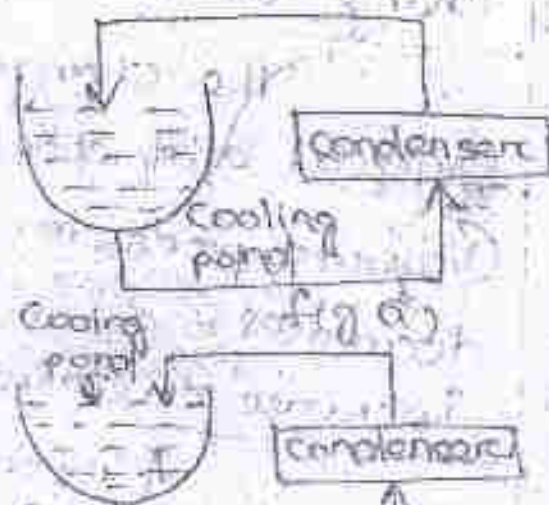
Heat must be removed from the condenser cooling waters prior to their disposal into water bodies.

The following methods can be adopted to control high temp. caused by thermal discharges.

(1) Cooling ponds

The cooling ponds are beneficially used in the dissipation of heat.

The water from the condenser is stored in the earth like ponds, where natural evaporation brings down the temp. The water is recirculated again. Another method is in fig. (b).



(2) Spray Ponds



In spray pond, the water is forced upwards in the cooling pond with the help of spray nozzle and provides more surface area to facilitate heat transfer to atmosphere.

Cooling towers —

In wet cooling towers, the hot water is brought in direct contact with continuously flowing air. The evaporation brings down the temperature.

(C) Nuclear Hazards —

Hazard means dangerous to human being. Radiations originate from instability of the nuclei of an atom, which loses sub-nuclear particles and energy to acquire a stable state. A number of atoms possess the ability to radiations and thereby cause radioactive pollution.

Radiation is the emission of rays and particles or release of energy from the source.

Sources of Radioactive pollution :-

2 main sources

Natural
Sources

Man made
sources

① Natural Sources :-

- The natural sources of radioactivity are considered mainly of cosmic rays (radiation) received from space.
- The most abundant naturally occurring radioactive nuclei on the earth are Uranium, Thorium and potassium.

② Manmade Source :-

(i) Nuclear weapons :-

Testing of nuclear weapons consist of

(i) The use of U₂₃₅ and Plutonium 239

for fission.

(ii) Hydrogen and lithium as fusion material.

(ii) Atomic reactor and nuclear fuel :-

The most common fuel used for fission in the nuclear power plants are uranium, thorium and plutonium.

→ Uranium undergoes several process from mining to reactor.

* Radioactive Isotopes :-

- Radioactive isotopes such as ^{125}I , ^{14}C , ^{32}P and their compound uses in scientific research.
- Radioactive iodine and phosphorus also enter the food chain through water.

* Other sources: —

During different medical treatment, varying concentration of radiations enter the human body.

* Hazard associated with radioactive pollutant

(Effects): —

- Damages enzymes, DNA, RNA etc & DNA, RNA absorb these radiations, which causes carcinogenic mutagenic effects.
- Damages to cell membranes, chromosomes, mitochondria etc.
- Inhibition of cell division.
- Damages to tissues and organs.
- Disruption of central nervous system.
- Human being exposure of radiation results in effects like reddening of skin, pigmentation of skin, burning sensation all over the body.
- Most of the radiation have high penetrating power. They can easily penetrate to organs and cause cancer.

* Control of Radioactive pollution: —

- Wastes generating radiation should not be disposed freely in the environment.
- It should be contained and stored out of reach of human's environment.

* Solid Waste Management

Any material that is thrown away or discarded as useless and unwanted by human or from animal activities is known as solid waste.

The activities involved with the management of solid wastes from the point of generation to final disposal have been grouped into 6 functional elements: —



Sources of solid wastes

1. Residential
2. Commercial
3. Municipal
4. Industrial
5. Agriculture
6. Hazardous waste
- construction waste.

Causes of solid wastes: —

Food wastes are the animal, fruit and vegetable residues resulting from handling, preparation, cooking and eating of food. This is known as garbage. This causes solid wastes.

- Material remaining from the burning of wood, coal and other combustible wastes.
- Wastes generated from buildings and construction sites.
- Agricultural wastes.
- Chemical, biological, flammable, explosives or radioactive material can generate solid wastes.

Effect of solid wastes: —

- Air pollution, water pollution and soil pollution are caused due to accumulation of different types of solid wastes.
- Various types of germs develop in the waste. They reach us through air, water and food & causes disease like cholera, diarrhoea etc.
- Accumulation of heavy metal particles cause serious health hazards. Mercury can cause Minamata disease.
- Industrial solid wastes are the source of toxic metal and hazardous waste, which affect soil and water.
- Wastes like cans, pesticides, plastic, batteries, medicine bottles, razor etc can

* Management of solid waste

① Methods of solid waste disposal

(a) Physical removal → It is generally done by manual activities like collection of wastes and sorting out of them. Then disposal becomes easy. dustbins should be used in homes.

(b) Dumping:- Transfer of solid waste from place of collection to the site of disposal is called dumping. Municipality collect and dump the solid waste in some suitable and safe site, located far away from human habitation.

(c) Compaction and Baling:- The solid wastes are often spread on a plane & pressed by bulldozers. This is called compaction. These compacted layers are rolled and piled. This is called baling. Now such compacted and baled solid wastes are dumped.

② 3R or Reduce, Reuse and Recycle of solid waste

* Reduce:- We should measure the household waste by using maximum part of the goods.

Before throwing outside, we

should think the waste has been

When we purchase the things, we should avoid polythene. Waste can be controlled by the reduction at the source.

* Reuse :— After selecting the waste (which can be reused), we should use it after proper treatment.

Furniture, clothes and other repairable articles should be reused after repair instead of throwing.

* Recycle :— The recycling of solid wastes is a major ecological goal. This can be done by:

(i) Sewage treatment

(ii) Palverisation - volume reduce by grinding.

(iii) Composting - The process of making decomposable waste with the help of micro-biological activity is called composting.

③ Sanitary landfilling :— Solid wastes are scientifically buried into low land. As this can not be recycled or burnt.

(iv) Thermal process :—

Burning of solid waste under controlling condition.

* Role of an individual in prevention of population —

- One should start from the field of environment awareness to protect the population.
- Give the message for save environment through papers, magazines, T.V & radio.
- Promote plantation & conservation of forest.
- To organise seminars, on subject related to pollution.
- Awareness is very effective in childhood, hence we should go to school, organise rallies to teach the lesson of environment.
- World forest day, world environmental day and other such action, should be organised for general awareness.
- Population growth should be reduced.
- Discourage the use of more fertilizers, insecticides and pesticides but should encourage the use of biofertilizers.

© Social issues & the Environment

From Unsustainable to sustainable Development:—

Unsustainable development

means the development of a few nations both in science and technology.

To be sustainable, development must process both economical & ecological sustainability. The Brundtland (1984) has defined that sustainable development is development that meet the need of the the present without compromising the ability of the future generation to meet their own needs. In order to achieve sustainable development, the development process and environment protection must go on.

Freedom & sustainable development are mutually exclusive ideas.

There are two aspects of sustainable development:—

① Inter-generational equity:—

This emphasizes that we should stop over exploitation of resources. Reduce waste discharge and emission and maintaining an ecological balance.

② Intra-generational equity

This emphasizes that technological development should support economic growth.

* Measures for sustainable development:-

① To promote environmental education & awareness

From childhood, we should develop a feeling of belongingness to earth. This can be possible by introducing environment as a subject in education from primary stage.

② 3R approach:- Three 'R' means - Reduce, Reuse and Recycle. We should reduce the excessive use of natural resources, but use them again & again instead of throwing. Recycle the material to reduce the wastes.

③ Appropriate technology:- The technology should use less resources and produce minimum waste.

④ To utilize resources as per carrying capacity of the environment.

* Urban problem related to energy:-

Energy is required in every place like industry, transport, defence, agriculture, education, domestic etc.

Cities are the main centers of

important aspect here. The requirements of urban population are much higher than that of rural ones. Energy problem day by day becoming serious. People are facing 'power cut'. Energy demand is higher than production.

Main cause of energy problems: —

- (i) Increase use of energy for domestic & commercial purpose (due to increased population & industrialization).
- (ii) Non renewable resources of energy like coal, petroleum and natural gas are decreasing.
- (iii) Decreasing production of hydro-electricity due to insufficient rains.
- (iv) Increasing of transport mail.
- (v) Transmission loss due to defective power distribution system.

Steps to solve the energy related problems: —

- (i) To control urbanization.
- (ii) To develop renewable resources of energy like solar radiation, wind power, tidal power and biomass.
- (iii) Effective measures for transmission loss and energy left.
- (iv) Welcoming the awareness, public programs to save energy.

* Water conservation

Water is needed in almost every human activity, without water life is not possible. No other liquid can replace it.

Water is required for direct consumption or indirectly by washing, cleaning, cooling etc. Importance sectors of human activity which require water

1. Irrigation

2. Industries

3. Live stock management

4. Thermal power generation

5. Domestic requirement

6. Hydro-electric generation

Water requirement have greatly increased due to rapid population growth, industrialization and agriculture. Therefore conservation of water is an absolute necessity of today.

* Steps for conservation of water

① Water economy, Reuse and Recycle

The consumption of water in domestic live stock management and industries should be reduced.

Water used once may be used again for another purposes.

Efficient distribution system

Water resources are not distributed evenly. Some localities have plenty of water and others have little. Many rivers have plenty of water which flows down as unused to sea. Schemes of one river can be used to make up the deficit at another.

Enhancement of surface storage capacity:-

A large amount of fresh water which flows down to oceans through streams & rivers are of no use of mankind. We can store this water for mankind in tanks, reservoirs, dams for the use in dried.

Reduce evaporation loss:-

Water losses through evaporation from the reservoir and distribution system. It should be reduced.

Improvement of underground storage capacity

Fresh water is stored in underground deposit. This deposit regularly feed streams and rivers during dried periods.

Desalination of sea water:- A huge store of water exists in our oceans. If salt content of the sea water removed.

Reforestation and Afforestation check the loss of water.

Artificial rain making and precaution of

* Rainwater Harvesting :-

Rainwater harvesting is collection/ utilization of rain water.

It is categorised into domestic rainwater harvesting and rain water for agriculture, erosion control, flood control.

Domestic rain water harvesting, also known as roof water harvesting or roof-top rain water harvesting, is the technique through which rain water is collected & stored in tanks.

The main objective of rainwater harvesting are

- To store excess water for use.
- To improve physical and chemical quality of ground water.
- Reduce soil erosion.
- To control flood.

Advantages of rainwater Harvesting :-

- Rise in ground water levels in wells.
- Prevent decline in water level.
- Reduction in flood hazards & soil erosion.
- Improvement in water quality.
- Prevent the water to get salinated.
- It just upgrade the social and environmental status.

Rainwater harvesting essentially means collection of rain water on the roof of building and storing it in underground bore later use.

Not only rain water harvesting increases water availability, it also checks the declining water table.

Every drop of water has to be saved and this will ensure that water isn't wasted.

Rainwater harvesting is not only simple but economical too.

The process of rainwater harvesting is environmental friendly, helps improve ground water quality, help to meet increasing demand for water, particularly in urban area and prevent flooding.

Watershed Management -

Watershed is the area of land that separates water flowing to different rivers, or seas. A watershed is a natural topographic unit, a part of the earth's surface moulded by weathering, particularly by the action of running water. A watershed includes all the land & water area which contributes run off to a certain point. It is marked by an elevated line that forms a division between two areas drained by separate streams. Since watersheds are natural units, they are ideal for planning & management of natural resources.

* Resettlement and Rehabilitation of people It's problems and concerns

Sometimes for the development of project, like construction of dams, mining, creation of parks etc and during natural calamities, like Earthquake, Landslides, volcanic, floods, Droughts, cyclones the problems of resettlement and rehabilitation arise. This disturbed socio-economic and ecological base of local community.

Various types of project result in the displacement of native people are:-

1. Displacement due to Dams:-

Water without energy is not irreplaceable. The most easily accessible and ecofriendly form of renewable energy is hydropower. For the generation of hydropower potential, the various project dams are those which displaced more than 25 million people.

2. Displacement due to mining:-

Mining is also important and it covers large area. Due to this development activity, thousands of people are displaced.

3. Displacement due to National park

To conserve natural resources

national resources. Some times
the forest area is covered under
national parks and sanctuary.

Therefore, efforts should be made
to provide proper rehabilitation and
employment to the affected people.

Rehabilitation:-

The United Nations Universal
Declaration on Human Right has declared
that "Right to housing is basic human
right". This suggest better rehabilitation.
National Rehabilitation policy is needed
to honour the human rights of displaced
people.

There is need of public awareness
also in resettlement and rehabilitation
of people.

Environmental Ethics:-

Issues and possible solutions:-

The issues relating to human inter-
action with their environment are called
"environmental Ethics" or "earth ethics".

Human beings are over exploiting
the natural resources and polluting the
environment. These human acts are very
dangerous and may lead to environmental

In relation to environmental protection
or in relation to environmental ethics
there are two world views.

① Eco-centric world view—

This states that earth resources are limited, and they are not for human beings alone but for all species. So we have to draw our requirement from environment, but not to that extent. A healthy economy depends the healthy environment. Therefore success of mankind depend upon how we cooperate with nature.

② Anthropocentric World view—

It states that man is the most important species of nature. Earth has an unlimited supply of resources. So success and healthy economy of mankind depend upon how nicely man derives benefits from nature.

To check environmental problems, we must follow the certain environmental ethics for better future:—

- ① One should love and honour the earth.
- ② Don't waste or exploit the natural resources.
- ③ We should respect to plants and

(1) We should conserve the ecosystem & promote appropriate sustainable development.

We shouldn't do anything at the cost of nature.

To bring about awareness regarding conservation of life support system.

We should concentrate on general awareness regarding environmental ethics from primary education.

A healthy environment depends on healthy economy.

5th - June - 1989 (The world environment day)

Environmentalist Dr. T. N. Khosho gave the concept of "Drama of ecology".

Climate change:-

Climate change is the environmental factors of an area, which includes quantity of light, temp., humidity, wind, gases, water etc. Thus the changes in environmental conditions of an area over long period of time is called Climate change.

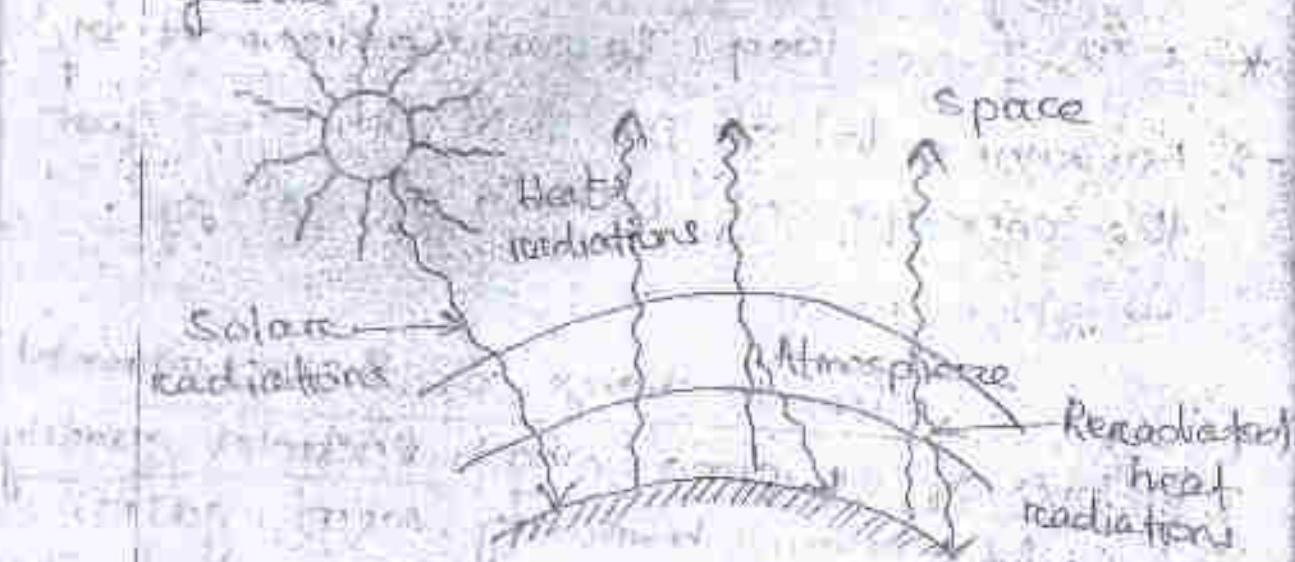
These changes affect the agriculture, migration of animals, hydrological cycle, distribution of rainfall etc.

Manmade (Anthropogenic) activities are responsible for it. This includes excessive use of fossil fuel, desertification, loss of natural industrial

→ Change in the atmospheric condition or climate change resulting into serious problems like green house effect, depletion of ozone layer and rise of world temp.

* Global Warming —

Global warming is the heating up the atmosphere, as a result of the depletion of the ozone layer surrounding the earth atmosphere. The ozone layer is depleted due to presence of green house gases.



Green house gases —

The green house gases present in the troposphere and resulting in an increase in the temp. of air and earth.

The green house gases are →

① Carbon dioxide (CO_2) —

CO_2 is considered as the most dominant factor responsible for green house effect.

The concentration of CO_2 is increasing

due to fossil fuel. Clearance of forest is another factor for the increase of CO_2 .
② Chloro Fluoro Carbon (CFC) : —

The main source of CFCs include leaking air conditioners and refrigerators, evaporation of industrial solvent etc. The concentration of CFCs is rising nearly 5% per year.

③ Methane (CH_4) : —

It is produced from decomposition of organic matter, incomplete combustion of vegetation, natural gas, pipeline leaks, use of oil and ~~natural gas~~ and petroleum, oil etc.

④ Nitrous oxide (N_2O) : —

It is released from burning of fuels (specially coal), from breakdown of fertilizers in soil, livestock wastes and nitrated contaminated ground water, nylon product etc.

Impact of global warming : —

① Climate change : —

(Increase in global temp.)

Increase the level of greenhouse gases causes the global warming have affected the global climate and climate change also affects rainfalls, plant reproduction cycle.

(ii) Effect on sea levels:-

Rise in temperature will cause glaciers to melt and polar ice caps to shrink. As a result sea level may rise by $0.2-1.5\text{m}$ over next 50-100 years. It may rise by is proved that sea level have already risen by 10-25 cm. If it continues, many low lying area may be submerged in near future and it is possible to destroy 20-80% of coastal wet land.

(iii) Reduction of Biodiversity:-

Increased temp. may caused reduction in biodiversity in aquatic & terrestrial ecosystem.

(iv) Effect on Agriculture:-

There are different views regarding the effect of global warming on agriculture. It may be positive or negative.

Negative effect:- With rise in temperature soil moisture will decrease & evaporation also increase. This will affect certain crops.

Positive effects:- With increase in temp, CO_2 also increases, increased nitrogen fixation in root nodules which may increase the growth of plant by 50%.

Effect on human health :-

(15)

Higher temp. and humidity will increase respiratory and skin diseases.

Warmer temp. favour the breeding of mosquitoes and some insects, which causes diseases like malaria, filariasis, elephantiasis etc.

Measures to check Global warming :-

To check the global warming following steps are necessary :-

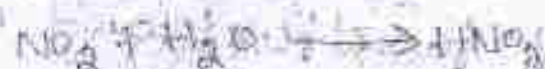
- (i) Plant more trees.
- (ii) Control population growth.
- (iii) Use energy more efficiently.
- (iv) Less use of fossil fuel and CFCs.
- (v) Use photosynthetic algae to remove atmospheric CO_2 .
- (vi) Adopt sustainable agriculture.

Acid Rain :-

Normal rain water is always acidic because CO_2 is present in the atmosphere get dissolved in it forming carbonic (H_2CO_3) acid.

Because of the presence of SO_2 (sulphur dioxide) and NO_2 (nitrogen dioxide) gases as pollutants in the atmosphere, the pH of rainwater further lowered (as low as 2.4). This is known as "Acid rain".

- So, acid rain means presence of acids in rain water.
- Acid rain is a mixture of acid mainly H_2SO_4 and HNO_3 .
- H_2SO_4 (60-70%), HNO_3 (30-40%), HCl and others.
- Most acids come from human activities like cars, houses, factories, power stations etc.
- The acidity is due to oxides of sulphur and nitrogen. These oxides are produced by combustion of fossil fuels, power plants, automobiles, domestic fires etc.
- Acid rain problem has drastically increased due to industrialization.



Effect of acid rain:

Acid rain causes both direct and indirect effects on the organisms and materials. It comes in contact with

Some of the effects may be —

1. A significant reduction in fish population.
2. Many bacteria and blue green algae are killed due to acidification.
3. Acid rain destroys crop and forest, reducing agricultural productivity.
4. Acid rain has retarded the growth of pea, radish, potato, carrot etc.
5. Modern researches show that acid rain

the essential elements from the top soil.
Acid lakes have low level of phytoplankton.
Acid causes extensive damage to building
structural material of marble, lime
stone etc. lime stone attack as -



The attack on marble is termed as stone
leprosy.

X. Ozone layer:-

Troposphere is the part of atmosphere
where human fire and other life processes
also occur. The stratosphere is the region
of space between approximately 15-50 km
above the earth surface.

Ozone is a naturally occurring gas.
It found from 15-50 km above the earth.
This region is known as ozone layer.

Both atmosphere and earth surface are
subjected to radiation from sun. These
radiations are absorbed by atmospheric
gases leading to ionization or dissociation
of gases. In lower mesosphere, atmospheric
oxygen get dissociated & subsequently
combines with molecular oxygen forming
ozone in stratosphere.

Formation of ozone:-



The presence of ozone layer in stratosphere is highly significant, because the harmful solar radiation such as UV rays, which are harmful to life on the earth are not allowed to reach atmosphere by ozone layer.

→ Thus the ozone layer strongly absorbs or blocks the UV rays & protect the life on earth.

→ Thickness of ozone layer is measured in Dobson Unit (D.U.).

→ where $1 \text{ D.U.} = 0.01 \text{ mm}$

→ Avg. thickness of ozone layer in stratosphere has been estimated to be about 220 D.U.

→ Ozone layer is known as earth protective umbrella.

Ozone layer depletion:-

Ozone layer depletion simply means the reduction of amount of ozone.

Mechanism of ozone depletion:-

There are two processes -

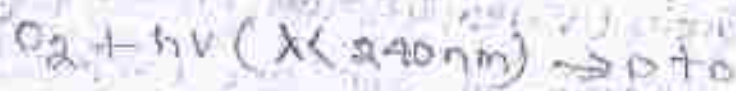
(i) Natural process

(ii) Anthropogenic process

(i) Natural process:-

A dynamic equilibrium existing between the production & decomposition of ozone molecules. The least amount

temperature



Decomposition: $O_3 + h\nu (\lambda = 230 - 320\text{nm}) \rightarrow O + O_2$



Ozone is highly oxidizing agent.

Anthropogenic process:-

Most human activities are responsible for increase in the trace radicals like HOx , NOx and $ClOx$ in the atmosphere. These radicals has capable of destroying the ozone layer.



Effects of ozone layer depletion:-

With the ozone layer depletion, there is danger of the U.V. rays entering to the earth's atmosphere. They are harmful for human life.

UV radiation causes patches of skin, skin cancer.

UV radiations cause sun burning, leukemia and breast cancer.

UV radiations absorbed by cornea and lens in the eye leading to photo-degeneration and cataracts.

→ Intense UV radiation causes greater evaporation of surface water through stomata of the leaves & decrease soil moisture content.

→ Many micro-phytoplankton's would die because of their exposure to UV solar radiation.

* Public Awareness -

Environmental pollution, environmental degradation, environmental deterioration, environmental crisis etc are now words which becoming day by day a subject of concern in every walk of life.

This is all due to industrialization, rapid population growth, Urbanisation etc.

It is necessary to make people aware about laws & legislations and to save environment. It is "of the people, by the people and for the people"

Thus public awareness means making the people conscious about the physical, social and aesthetic aspects of environment.

Methods:-

It is necessary to find the permanent solution of environmental & ecological problem. It can be done by holistic means.

Through Mass Media:-

There are various means of mass communication to educate and give information, instruction to people through radio, T.V, news papers and magazines etc.

Through education:-

Students are the ^{organ} backbone of a country. If environmental education is started from the childhood stage, it will give good results.

Through rallies, orientations & training programmes:-

To promote environmental awareness, environmental rallies with posters, programmes may be organised on certain occasions like "5th June" as "World environmental day", and "1st week" of October as "Wild life week".

(iv) Through voluntary organisations and NGOs:- Some voluntary organisations & Non-government organisation (NGOs) play an important role in the direction of environmental awareness in people by organising competitions etc. Some voluntary organisation working in this field are-

- (i) Bombay Natural history society (BNHS)
- (ii) Wild life preservation societies

3. World wide bound for Noise - India
(comb - India)

A. Centre for science and environment (CSE)

X. Air (Prevention & control of Pollution) Act

The Air (Prevention and control of pollution) Act was passed in 1981 to regulate and control the hazardous emissions from the automobiles and industrial units. The Central Board for Prevention & Control of Water pollution is authorized to implement and enforce that act. The Central Board is also empowered to coordinate the activities of the State Boards present in every state of India. The state governments can declare any area within the state as "air pollution control area" and prohibit setting of industry causing air pollution. The Central Pollution Board has laid down standards for the quality of emission air mentioned below:—

(i) Emission Standard from Industries:—

Various emission standards have been prescribed for different industries. Dusts come from cement plants, thermal plants, iron plants etc. The max^m permissible level of dust in the form of suspended particulate matter (SPM) is $150 \mu\text{g}/\text{Nm}^3$ (microgram per normal cubic metre).

Some synthetic fibres plants are
large acid mist consisting droplets of dis-
solved gases suspended in air. The total
permissible level of acid mist from the
factory exhaust should be less than
 50 mg/Nm^3 .

(i) Vehicular Emission Standards: —

In metropolitan cities of world,
automobile emissions alone contribute 60%
of the total air pollutants. The automobile
exhaust contains carbon monoxide, solid
particles, lead compounds, oxides of
nitrogen & unburnt hydrocarbons.
Now a days unleaded petrol is used
to minimize vehicular pollution.

The Water (Prevention and Control of Pollution) Act.

The water (Prevention and control
of pollution) Act was enacted in the year
1974. The act include the following —

- It defines water pollution.
- Describes penalties for those guilty of
water pollution.
- Setting of an administrative machinery
called Water Pollution Board at central
and at state level in order to prevent &
control water pollution.
- The coverage of the act includes streams,
rivers, inland waters, estuaries and

2) The state and central board are empowered to advise, co-ordinate & provide technical assistance for prevention & control of water pollution.

→ The act prohibits dumping of poisonous, toxic matters into streams, wells etc.

→ It also prohibits activity that impedes the proper flow of the water in stream.

→ The act subjects the discharge of ~~sewage~~ sewage of industrial effluents into streams or wells with the prior permission of the board.

3) The board is authorised to take action against polluters & prosecute them.

Human population and the environment

Initiations for achieving the goals of sustainable development:-

Ensure equal distribution of products.
Proper utilization of resources & management of waste products.

Ensure that human needs do not exceed the biotic potential of the environment.
Preservation of habitat, ecosystem and biosphere reserve.

Human Population & the Environment

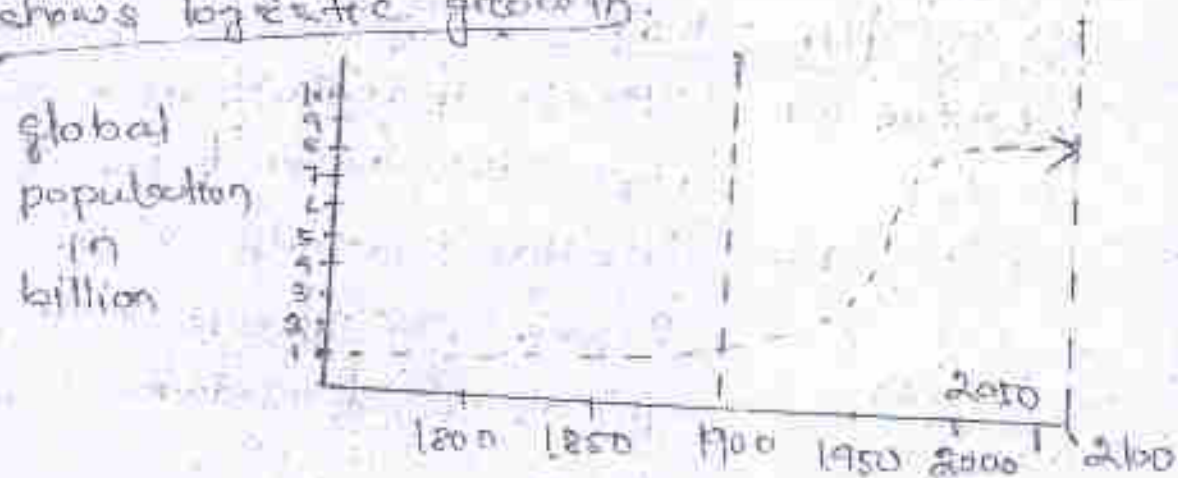
A group of organisms of the same species living in the same area is called population.

Population growth -

The most important features of population is the growth, i.e. the capacity of increase in individual members. It can be defined in following ways.

(a) Logistic growth -

When a population is allowed to grow in a limited space (environment), it shows logistic growth.



1. The lag phase,
2. Rapid growth phase,
3. Stabilization phase.

It consists of three phases. i.e. 1st phase shows slow rate called lag period. 2nd phase is accelerating stage. 3rd phase is equilibrium phase, where there is no net change in population called saturation level or carrying capacity. It is represented

$$\frac{dN}{dt} = rN(1 - N/K)$$

where, $\frac{dN}{dt}$ = rate of growth of population

r = Max^m per capita growth rate
for a population

N = No. of individual in a population

K = Carrying capacity

$(1 - N/K)$ = density dependent factor.

(b) Exponential growth

When a population grows, even
quickly begins to rise very steeply,
the population shows exponential growth.

It is J shaped.

$$N_t = N_0 e^{rt}$$

where N_t = The no. of individual in the
population after t unit of time

N_0 = Initial population size.

r = Exponential growth rate

e = The base of natural logarithm

(d.f.)

(c) Geometric growth

The geometric growth equation,

$$N_t = N_0 \lambda$$

where, λ = Geometric growth rate.

Population growth :-

Demographers have projected that, there was 275 million in 1000 & increased to 486 million in 1650.

During 1650-1750, the world population was 791 million. There was an addition of 187 million people population in another 50 years i.e. from 1750-1800, reaching 978 million. From 1800-1850 it increased to 1260 million & crossing the 1st billion in 1804.

The world population was recorded to be 1650 million by 1900. It was 1601 million in 1920 and increased to 2524 million by 1950, crossing the 2nd billion in 1927. It took nearly 122 years to reach the 2nd billion. The population has further increased to 2630 million in 1970.

The 1st billion (100 crore) was reached by 1804. The 2nd billion was added in next 123 years i.e. in 1927.

3rd billion was reached in 1960.

4th " " " " 1979

5th " " " " 1987

6th " " " " 1999

& It will reach 8 billion by 2025.

Population growth variation among nations

The population of Europe was 163 million in 1750 and increased to 246 million in 1850. The population growth in Europe began due to socio-economic development, due to advances in medical technology.

The population increased to 597 million in 1950 & to 728 million in 1999 & projected to decline to 701 million in 2025.

The share of North America was 2 million in 1750 but reached 22 million in 1900 & 302 million by 1999. The population of Latin America & Caribbean island was 16 million in 1750, 38 million in 1850 and 166 million in 1950. Further increasing to 512 million in 1999.

The population of Asia was 592 million in 1750, and increased 819 million in 1850, further increased to 1492 million in 1950. The population of Asia increased its share of world population between 1950-1999 from its share of about 56-61%.

The 2 large Asian countries (Asian elephants) China & India alone added 28.6 million to the world population. The population in Africa was 108 million in 1750, fastest growth of population is

The growth rates aren't uniform in the world. In many countries the growth rate is less than 0.5% per year. In developing countries the growth rate is excessive.

Population growth in India: —

India's population was estimated as 120 million in 1800, 194 million in 1860 and 225 million in 1871. The population of India in 1891 was 267 million, which declined to 238.4 million in 1901.

In 1911, the population of our country was 252 million, which fell to 251.3 million in 1921.

As a result of improved agricultural techniques, advancement in medical & health technology to control epidemics & diseases, improved sanitation & health services, improved transport, communication & infrastructure facilities, the population of India progressively increased from 251.3 million in 1921 to 361 million in 1951. The population of India was more than doubled during 1951-1991. The population of India touched 1 billion mark on 11th of May, 2000. According to 2001 census the population of India was 1027 million.

Presently India ranks 2nd in size of population, next to China. India has only 2.4% of world land area, but it supports 16.7% of world population. Today for every 2 seconds, 1 baby is born in India and per year 17.6 million babies are born. Almost half of the country's population lives in 5 states, namely UP, Maharashtra, Bihar, West Bengal and A.P.

Population growth rate -

Measurement of how the size of a population change over time is called as population growth rate.

It depends upon the

→ Population size

→ Birth rate

→ Death rate

$$\text{Growth rate} = \frac{\text{No. of birth (b)} - \text{No. of death (d)}}{\text{Avg. population in time interval}}$$

ix Population explosion -

Population explosion means rapid increase in the size of the population. In 20th century population growth increased too much.

Social, economic, religious all

Birth rate in our country:

Reasons (Causes) of population explosion:-

Lower marriage age.

Lack of education.

Importance of male child.

Religious misbeliefs.

Decline in death rate.

Problems due to population explosion:-

Insufficient food supply.

Lack of space.

Unemployment.

Education problem.

Human health problems.

Energy crisis etc.

Reduction of population can be achieved by -

→ Proper education.

→ Mass media.

→ Raising ~~welfare~~ the marriage age from 18-22.

→ Family welfare programme.

National Family Welfare programme:-

Family planning programme was launched in India in 1952. India was the first country to do so.

In the year 1977, the name was changed to National family

National family welfare programme is one of the effective means to reduce the population.

Importance of family welfare program

1. The family welfare programme occupies an important position in the nation's socio-economic development.
2. India population which was 34 crores in 1947 has crossed 100 crore mark by 2000. India has only 2.4% of world land area but it supports about 15.5% of world's population.
3. India population is increasing by 1.8% every year. This galloping growth should be checked.

* Environment And Human Health

Environment is the main determinant of health status of a community. Poor housing is a contributor to low physical and mental efficiency. The relation between poor housing & disease is easily recognisable.

If we aimed to obtaining optimum conditions for physical & mental well being. In addition to preventing disease, we must include improve housing conditions.

Environment is defined as all the external factors (living or nonliving, material or non material) present around man.

So, it is the entire medium in which the population lives & interacts.

The environment may be divided into 4 components -

1. Physical environment
2. Biological environment
3. Social environment
4. Cultural environment

① Physical environment - It is defined as all those non living things and physical forces present around man. The important component of physical environment are water, air, housing, temperature, lighting, noise and vibration.

② Biological environment - It is defined as the all those living things (plants, animals, insects) around us.

③ Social environment - It is defined as the social interaction between the individuals such as their region & the way of living, standard of living and availability & utilization of health care facilities.

* Cultural environment — It is the culture, in which the individual lives. It includes their knowledge, attitudes, beliefs, behaviour etc.

The word sanitation covers the whole field of controlling environment with preventing diseases. It is a known fact that in the countries where environmental sanitation is good (USA, European countries) the communicable disease problem is less where as in countries where environmental sanitation is poor (like India, African countries etc.), the communicable disease problem is very high.

* Value education —

Man acts to satisfy his needs.

Anything which satisfies a human need becomes a "thing of Value".

Value has been defined variously by different educationists, but on the whole it is interpreted to be either a set of feeling or an action. Human behaviour is governed by his values. Value is a dynamic term used in different aspects.

The progress and development of a nation depend upon the quality of the values cherished (protected & come from) by its citizen.

Important values:- Important values may be classified as:-

(i) Religious value:- It is defined in terms of faith in God.

(ii) Social value:- It is defined in terms of love, kindness and sympathy for people. Effect to serve God through the service of mankind.

(iii) Democratic value:- This value is characterised by respect for individuality, absence of discrimination among persons on the basis of sex, language, religion, caste, colour & family status.

(iv) Aesthetic Value:-

It is characterized by appreciation of beauty, love for fine arts, drawing, painting, music, dance, poetry, love for literature.

(5) Economic Value:- This value stands for desire for money & material gains.

(6) Knowledge value:-

This value stand for love of knowledge and love of discovery of truth.

(7) Hedonistic value:- It is the conception of loving pleasure and avoiding pain. For a hedonist the present is more important than future.

(8) Power value:- It is defined as the conception of ruling over others and also leading others.

(9) Family prestige value:-

(10) Health value:-

It is the consideration for keeping the body in a fit state for carrying out one's normal duties and function.

Role of Information Technology in Environment and Human Health →

Just as chemical or metallurgical or electrical technologies enables the processing of raw materials into usable goods, to satisfy man's and societies need, Information technology (IT) also help the storage, processing, transmission and exploitation of information to satisfy a person's, company's, society's or Govt's need for information.

Information technology is commonly pictured by computers in extending man's mind or brain. Information technology devices like microprocessors and becoming mass appliances from pace makers for heart, hearing aids and efficiency enhancements in automobile engines & device to steer space vehicles on the moon.

Like banking, learning & teaching, librarying, & other sectors of human activity, information technology has revolutionised use in the field of

Apart from the development of software for environment and health studies facilities like internet, world wide web geographical information system (GIS), information through satellite are also developed. These all are helpful in environment and health studies.

Media has the capability to influence people's opinion as it has highlighted and participated in some of the important environmental issues & helped in making people aware.

The ministry of environment and forest, Govt. of India has taken up the task of compiling a DATABASE on various biotic communities. Database includes wildlife database, conservation database, forest cover database etc. Database is also available for diseases like HIV/AIDS etc. They are in computerized form. The ministry of environment and forest, Govt. of India has created environmental

ENVIs has many centres all over the country for generating a network database in different areas like pollution, environmental management, wildlife etc.

www.mshc.com/environmental science and multimedia digital content Manager (DCM) in the form of CD-ROM are the online centre, which provide the most current and relevant information on environmental science.

With the help of computers & internet not only we can have knowledge of the patients but also we can get information about the diseases, their medicines and alternative medicines. CT scanning, CAT (computer axial tomography) are the examples of information technology in human health.

IT expanding rapidly with increasing applications in the field of environment and human health.

4. Biodiversity and it's Conservation

- The term "Biodiversity" is short form of "Biological Diversity". The term Biodiversity was coined by Walter G. Rosen in 1986.
- Biodiversity may be defined as, Biological diversity means the variability among living organisms and it includes diversity within species, between species and of ecosystem.
- According to Harvey B. Lilly White (2002), it refers to the "the variety of variability among living organisms and the ecological complexes in which they occur."
- Biological diversity is the total variety of life on our planet. Total no. of races, varieties or species i.e. sum total of various type of microbes, plants, animals present in a system is referred as Biological diversity or simply as Biodiversity.

Genetic, species and ecosystem diversity

Biodiversity is usually analysed at 3 levels. i.e. species, genetic & ecosystem.
1. Diversity of Biotic communities & Ecosystem

Depending largely upon the availability of abiotic resources and

conditions of their characteristics community of living organism.

example - A small pond constitutes an ecosystem and possesses a set of flora and fauna different from a river which is another type of ecosystem.

2. Diversity of species composition within a community:-

The biotic component in an ecosystem may be composed of a few species only or a large no. of species of plants, animals and microbes, which interact with each other and with the abiotic factors of the environment. The richness of species in an ecosystem is usually referred to as species diversity.

3. Diversity of genetic organization within a species:-

Within a species there are often found a no. of varieties which slightly differ from each other in one, two or more of characters such as shape, size, quality of their product, resistance to insects, pests and diseases, ability to withstand adverse conditions of environment etc. These differences are due to slight variation in their

This diversity in the genetic make up of a species is called genetic diversity.

A. Biogeographical Classification of India

The study of distribution of biota (flora + fauna) are collectively called Bio geography.

India is one of the 12 Mega diversity countries in the world. India is divided into 13 biogeographical regions. The wide variety in physical features and climatic conditions are found in India, which resulted in a diversity of ecological habitats like forests, grass lands, wetlands, coastal ecosystem, marine ecosystem and desert.

India is rich in biological diversity. India has only 2.4% of land area of the world, and it accounts for 7-8% of recorded species of the world.

There are 13 biogeographical regions have been identified in India. There are -

- | | |
|--------------------|-------------------------------|
| ① Himalaya | ⑤ Laccadive Islands |
| ② The Desert | ⑥ Maldivian / Chagos Islands |
| ③ Deccan peninsula | ⑦ Western Ghats |
| ④ Malabar | ⑧ Eastern / Bengalian forests |
| ⑨ Andaman Islands | ⑩ Nicobar Islands |
| ⑪ | ⑫ Marine coast |
| ⑬ | ⑭ |

* Values of Biodiversity :-

Biodiversity is valuable for the survival of mankind. Many plants and animals including wildlife are very important for human being. They can be used directly or indirectly to have consumptive, productive, social, ethical, aesthetic and option values.

* Consumptive value :-

Most of the developing countries obtain fuel wood from forests. Still more than 1500 million people cook their food by burning wood. Consumptive value also includes hunting of wild life, use of grass with some commercially important plants as fodder.

Various tribal societies fully depend on forest (biodiversity) for their habitation, and livelihood. They use tubers, roots, bark, seeds and meat of wild animals as their food.

* Productive value :-

Bamboos, grasses, canes, essential oils, tanning materials, dyes, gums, resin, drugs, spices, poisons, insecticides, soap substitutes, rubber, latex, honey wax,

Other seeds are forest product. and they have high commercial values. In addition to these, there are various herbs & animal body parts which are sold in commercial market, both at national & international levels. Some benefits like education, scientific research, regulation of climate etc are indirect values to biodiversity, which provide economic advantages to the people without consumption.

* Social Values:-

The biodiversity has some social values attached with different societies. Goods and services, provided by ecosystems to our society include.

- (i) Provision of food, fuel and fibre.
- (ii) Provision of shelter & building material.
- (iii) Control of pests & diseases.
- (iv) Purification of air and water.
- (v) Medicines and other products.

* Ethical values:-

Ethical or religious value is also one of the indirect values of biodiversity. The ethical or religious value of biodiversity is rooted in the understanding that humanity is part of nature. Many type of trees are worshipped in tribal & Hindu.

Societies i.e. peepal, Banyan, Tulsi etc.
Some animals like cow is worshipped by
Hindus in all over India.

* Aesthetic value:-

The aesthetic values of biodiversity have been expressed in many ways through art, poetry, songs, literature, music and dance. Forest are closely linked with our religion & culture. Human race has a great evolutionary attachment with forests as our ancestors lived in forest.

* Option value:-

Option value is the indirect value of a species or biodiversity to provide economic benefits to human society at some point in near future.

The option value refers to the possibility of a natural resources having some value in the future. It is often used in discussions about finding and developing new medicines.

* Biodiversity at Global, National and Local levels:

① Biodiversity at Global level: —

The data related to different species in different parts of world are different. Examples → Approx 20000 species of plants are in South America, but some other Botanist are of different opinion. → Precipitation (may be rain, snow) & temp. are the most important determinants of biodiversity.

Terrestrial biodiversity of the earth is best described as biomes, which are the largest ecological unit present in different geographic areas.

It is also estimated that about 12500 flowering plant species in tropical forests, but only about 1-3% are known. These are known.

Millions of species of plants, birds, amphibians, insects as well as mammals are found in tropical rain forests. It is said that they are the earth's largest store house of biodiversity. About 70% of global biodiversity lies in these.

The terrestrial biomes are

regarded as the richest in biodiversity.
There are 12 mega biodiversity countries
and these are:—

- | | |
|-------------|---|
| ① Brazil | ⑥ Democratic republic of Congo (Kinshasa) |
| ② Colombia | ⑦ India |
| ③ Venezuela | ⑧ China |
| ④ Peru | ⑨ Malaysia |
| ⑤ Ecuador | ⑩ Australia |
| ⑥ Indonesia | ⑪ Mexico |

② Biodiversity at National level:—

India is located in south Asia, between latitude 6° and 38° N & longitudes 69° and 97° E. The Indian landmass extending over a total geographical area of about 200 million hectares, is bounded by Himalayas in the north, the Bay of Bengal in the east, the Arabian sea in the west & Indian ocean in the south. The Indian region is a vast geographical area & it is quite rich in biodiversity, with endemic (particular) flora & fauna.

These vary from the humid tropical Western Ghats to the hot desert of Rajasthan, from the cold desert of Ladakh and the icy mountain of Himalayas.

In India, about 1,12,000 species of plants & animals have been identified & described. For example - The following crops arose in the Indian and spread throughout the world. These are rice, sugarcane, jute, mango, banana, several spices, several medicines.

Indeed, India is recognized as one of the world's top 12 megadiversity nations.

In flora, India accounts 45,000 species and which account 11% of the known world plant.

India is very rich in fauna and flora, therefore known as megadiversity country.

③ Biodiversity at local level :-

The Biodiversity at local level can be well understood by determining and marking off the hotspots of places, zones rich in biodiversity. This can be understood by combining plants & animals of same habitat.

We can also study the local biodiversity on following lines →

- ① Richness of species at a given place.
- ② Physical characteristics of habitat and vegetation in particular area.

- ③ Local diversity based on climate, geographical and ecological processes.

Temp. play an important role in affecting the biodiversity of an area.

* Threats to Biodiversity —

One of the threats to Biodiversity is space, food and resource competition expanding human and plant establishment. This is more serious for developing countries like India. Due to human population and its impact on ecosystem, thousands of species and subspecies become extinct every year.

There are some causes and issues related to threats to biodiversity →

* Habitat loss —

Habitat loss is mainly due to human activities. The natural forest & grass lands, which were the natural homes of thousands species including wild life species, are going cleared day by day for ~~conversion~~ conversion into agricultural land or for developmental projects.

Due to pollution & the presence of toxic & hazardous pollutants, our fresh water resources have suffered, have been

Electric power plant, which causes thermal pollution in biosphere affected all aquatic communities and their natural food chains.

Large amount of habitat are lost each year as the world's forests are cut down. Problems of acid rains & global climate change are also responsible for habitat loss.

* Poaching of Wildlife:-

Poaching of wildlife is another threats to biodiversity. Hunters, collectors & smugglers are the major threat to a no. of species including endangered species. They collect horns, tusks and some live specimen, herbal product and smuggled to others for millions of dollars. Examples -

- (i) The cost of Bengal tiger coast is more than one lac dollars.
- (ii) A single orchid cost more than 5000 dollars.

It is an illegal trade. Over collection, over-exploitation are the main cause of disappearance of plants of scientific and medicinal value.

Man - Wildlife Conflict

Struggle for existence. This is applicable to both man and wild animal. Due to habitat loss, animals come out of the forest and destroy the crops, later on they become dangerous to human being. Further villagers and affected people kill them.

There are many causes of conflict between man and wildlife.

Man and wildlife conflicts also occur during human interference into forest area.