UNIT – I

CONTENTS: Multidisciplinary nature of Environmental Studies: •Definition, •Scope and Importance •Sustainability: •Stockholm and Rio Summit. •Global Environmental Challenges: Global warming and •climate change, •acid rains, •ozone layer depletion, •population growth and explosion, effects. •Role of information Technology in Environment and human health. •**Ecosystems:** Concept of an ecosystem. •Structure and function of an ecosystem. - Producers, consumers and decomposers. •Energy flow in the ecosystem. •Ecological succession. •Food chains, •Food webs •ecological pyramids. •Introduction, types, characteristic features, structure and function of •Forest ecosystem, •Grassland ecosystem, •Desert ecosystem, •Aquatic ecosystems.

1. MULTIDISICIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Introduction:

Ecology is the scientific study of the interactions of living organisms and their environments. These interactions are studied with a view to discovering the principles which govern them. The term ***oekologie*** (ecology) was coined in 1866 by the German biologist, Ernst Haeckel from the Greek *oikos* meaning "house" or "dwelling", and *logos* meaning "science" or "study".

1. ECOLOGY:-

Ecology is a branch of biology that deals with the study of living organisms at their dwelling place.

2. ENVIRONMENTAL STUDIES:-

It is an integration of several subjects that include both sciences and social studies. Environmental science is a very close to nature and the study of environment is no longer limited to issues of health and sanitation but is now concerned with pollution control, waste management and conservation of depletion of natural resources.

3. SCOPE AND IMPORTANCE OF ENVIRONMENTAL STUDIES:

A. SCOPE:

Scope means existence or chance. It is an integration of several subjects that include both sciences and social studies. Environmental science is a very close to nature and the study of environment is no longer limited to issues of health and sanitation but is now concerned with pollution control, waste management and conservation of depletion of natural resources.

1. ***Environmental consultancy:-***

   It is mainly concerned to create environmental awareness in public many non government organizations and government bodies are engaged environmental consultancy for systematic studying and talking environmental related problems.

2. ***Green advocacy:-***

   There is need for environmental lawyers with the increase of environmental problems and other emphasis on implementing various acts and laws related to

environment. The environmental lawyers should be able to plead the cases related to water, air pollution, forest, wild life and industrial effluents.

3. ***Green marketing:-***

   Due to green marketing there is a great demand for environmental auditors and environmental managers to ensure the quality product with ISO mark, now there is an increasing emphasis on marketing goods that are environmental friendly. Such products have eco-mark or ISO (14,000) certification.

4. ***Research and development (R&D) in environment :-***

   Environmental scientists play an important role in examining and solving various environmental problems in a scientific manner and carry out R&D activities for decreasing the environmental problems. They develop theories or methods of monitoring and controlling environmental problems.

5. ***Environmental engineering :-***

   Environmental engineering are emerging as a new carrier opportunities for environmental protection and management. Environmental engineering is a challenging aspect with the increased knowledge in the fields of science, technology, environment and health.

6. ***Pollution control boards :-***

   Investing in pollution control technologies will reduce pollution. In India also the pollution control boards are seriously implementing pollution control laws and insisting on up grading of effluents to prescribed standards before they are discharged on land or into water body.

7. ***Environmental journalism :-***

   There is an increasing demand for people who can report on environmental issues to generate awareness among people environmental journalism is an emerging field which helps in bringing environmental problems to public notice.

8. ***Natural resource conservation :-***

   A part from providing innumerable resources, natural assets such as forest contribute towards maintaining a balance in the environment. Therefore, managing and maintenance of forest and wild life is an important task under natural resource conservation.

B. IMPORTANCE OF ENVIRONMENTAL SCIENCE:-

The study of the structure and functioning of the environment is essential for sustainable development of all living organisms on earth. Environmental studies are important because of the following reasons.

1. To understand current environmental problems, we need to study the physical, biological, chemical and social processes that form bases of these problems.
2. Environmental studies provide the skills necessary to obtain solutions to the environmental problems our planet is facing today.
3. Environmental studies aims to protect bio-diversity.
4. This discipline helps to educate people regarding their duties towards environmental protection.

5. It helps achieve sustainable development and understand the relationship between development and the environment.

4. SUSTAINABLE DEVELOPMENT:

"The development that meets the needs of the present without compromising the ability of future generations to meet their own needs" is called sustainable development.

Measures:- The measures of sustainable development are as follows:

- Implementing effective planning for population growth control.
- Promoting environmental awareness through education.
- Using efficient technological devices.
- Effective plans for regeneration of natural resources.
- Decrease in the consumption of non renewable resources.
- The three R's reduce, reuse and recycle helps in decrease of solid wastes.

5. MULTIDISICIPLINARY NATURE OF ENVIRONMENTAL SCIENCES.

Ecology is the study of various living organism in relation to environment in which they are living.

The word ecology was first coined by German zoologist Reiter in 1885, followed by Ernst Haeckel in 1886; it was warming who was responsible for giving us the real concept of ecology as "the study of various living organisms in relation to environment."

Famous Indian ecologist Prof.R.Mishra (1967) has defined ecology as "the study of interactions that determine the distribution and abundance of organisms in nature."

Environment is defined as the conditions that surround a single or group of organisms. According to Indian ancient Vedic environment is composed of "Panchabhootas"

Environment means surroundings. Environment is a highly complex part of nature. Environment has basically the following components. They are

1. Lithosphere
2. Hydrosphere
3. Atmosphere
4. Biosphere

Environmental studies are closely related to many branches of science. The following are some of the branches of science with which environmental studies are intimately related

1. **Anatomy:-** It is a branch of biology that deals with the study of internal structure. Internal environment of organisms like plants, animals etc…

2. Biology:-It is an important natural science that deals with the study of living organism. It has many branches.

3. Botany:-It is a branch of biology that deals with the study of plants which are living organisms present in nature.

4. Zoology:-It is a branch of biology that deals with the study of animals which are living organisms present in nature.

5. Microbiology:-It is also a branch of biology that deals with the study of micro organisms which are not visible to naked eye. It is related to environment.

6. Cell biology:-The branch of biology that deals with the study of various parts of cell, their structure and function are called cell biology. It is influenced by environment.

7. Cytology:-It is another branch of biology that deals with the study of cells and cell types only. It is also influenced by environment.

8. Chemistry:-It is a branch of physical science that deals with the study of chemicals. It is also related to environment.

9. Climatology:-Climate study is called climatology.It is also a part of environment.

10.Bacteriology:-Bacteria is a small organism.A branch of biology that deals with the study of bacteria is called bacteriology.It is also related to environment.

11.Virology:-virus are also living organisms that are smaller than bacteria.The branch of science that deals with the study of viruses is called virology.It is also related to environment.

12.Topology:-The study of the contour of any area is called topology.The branch of science that deals with the study of topology of any particular area is called topology.It is also related to environment.

13.Dendrology:-Dendron means a woody tree.They are useful in giving timber and also fuel finally useful for the formation of coal fields.So dendrology is also related to environment.

14.Pedology:-It is abranch of natural science that deals with the study of soil formation types of soils etc…It is very closely related to environment.

15.Hydrology:-It is a branch of geology that deals with the study of mineral water present in soil.It is also very intimately related to the environment.

16.Geology:-It is a branch of knowledge related to nature of formation of contenents and their structure.It is also a part of environment

17.Oceanography:-The branch of science that deals with the studyof seas and oceans in the world is called oceanography.It is also a part of environment as water occupies 2/3 surface area of earth.

18.Petrology:-It is a branch of geology that deals with the study of rocks and stones.The oil which is present between two layers of the earth is called Petroleum or rock oil,which is also the part of this branch.Hence the other name for this branch is Lithiology.It is also related to environment.

19.Physics:-It is afundemental branch of science that deals with the physical forces that are acting in nature.It is also related to environment.

20.Environmental Engineering:-Environmental engineering is the most wide, complex and fastest growing disciplines in engineering.The environmental engineering gives protection of the environment through preventive measures and the development of effective regulations.It includes issues of public health protection ,environmental protection and (Eco balance) protection of ecosystems.

6. GLOBAL ENVIRONMENT CHALLENGES:

The problems caused by pollutants such as NOx, SOx etc are now worldwide issues. Heating of earth surface; poor air quality in urban areas; the formation of acid rains, depletion of ozone layer; emission of gases are of our environmental issues which are to be studied.

6.1. GLOBAL WARMING AND GREEN HOUSE EFFECT:

Human activites are causing green house effect. The green house gases such as CO_2, CH_4, which are released into atmosphere by natural process and man made activites are not allowing infrared radiations (which are emitted by earth) to escape into atmosphere. The radiations are resultling in increasing temperature of earth which is called global warming.

Greenhouse gases are those that can absorb and emit infrared radiation. In order, the most abundant greenhouse gases in Earth's atmosphere are: water vapour; carbon dioxide; methane; nitrous oxide; ozone. In addition to the main greenhouse gases listed above, other greenhouse gases include sulfur hexafluoride, hydrofluorocarbons, CFC's etc..

A. FACTORS:

1. **Chloro Fluoro Carbons**: Man made CFC's which are discharged from coolants, refrigrators etc, are the main cause of stratospheric ozone depletion. CFCs have a lifetime in the atmosphere of about 20 to 100 years and as a result one free chlorine atom from CFC molecule can do a lot of damage. These are non – toxic; non-flammable contains fluorine, carbon and chlorine atoms. The five main CFCs are the :

CFC- 11 (Trichloro Fluoro Methane … $CFCl_3$)
CFC- 12 (Dichloro Fluoro Methane … CF_2Cl_2)
CFC- 113 (Trichloro Tri Fluoro Ethane … $C_2F_3Cl_3$)
CFC- 114 (Dichloro Tetra Fluoro ethane $C_2F_4Cl_2$)
CFC-11 5 (Chloro Penta Fluoro ethane C_2F_5Cl)

2. **Methane (CH_4):** The major source of methane is extraction from geological deposits known as Natural gas and used as fuel. Since it is a gas at normal conditions, methane is distributed through pipe lines. It is also called as LNG (Liquified Natural Gas). Methane reacts with halogens and produce Methyl Chloride (CH_3Cl), Chloroform ($CHCl_3$) and Carbon tetrachloride (CCl4).

3. **Carbondioxide:** CO_2 accounts for about 55% of the earth's Green House effect. Industrial revolution, deforestation, urbanisation, burning of fossil fuels has contributed to the increase in carbon dioxide in the atmosphere from 280 ppm to 390 ppm. These are the causes for increase of temperature of the earth.

4. **Nitrous Oxide (N_2O):** It also contributes for global warming. Each molecule of N_2O has a capacity to trap heat 230 times more than CO_2. It is released into atmosphere by nylon products, conversion of nitrogen fertilizers, live stocks and nitrate contamination in ground water.

B. EFFECTS: The following effects of global warming:

1. Global warming causes, rate of precipitation decreases on land and causes a decrease of rainfall by 40% all over the world.
2. Sea level raises and low lying areas will be inundated (to cover an area of land with water).
3. Global Warming change the direction of wind.
4. CFC's convert O3 into oxygen and oxygen radical and thus ozone depletes in the atmosphere.
5. Global temperature will increase atleast by 4oC.
6. Decrease of earth's albedo (the amount of sun light reflection by the earth's surface to the moon).
7. People suffer from many undiagnosible diseases.
8. CFC-11; 12 and 113 in the atmosphere for a longer period harmful to human beings.

C. CONTROL STEPS:

1. By reducing the emissions of Green House gases.
2. Clean electricity technologies such as wind mills/turbines; solar panels;tidal energy etc are to be used
3. Bio-fuels (eg: ethanol - a type of alcohol) and Bio-diesel could substantially cut down the CO2 emission.
4. By avoiding the driving of vehicles (walking / bicycling is to be followed).
5. Reducing the usage of sossil fuels.
6. Shifting to renewable resources.
7. Increasing green belt areas.
8. Using ecofriendly domestic goods.
9. Adopting better forest management.

6.2. OZONE DEPLETION:

OZONE FORMATION: Ozone is a form of oxygen that has three atoms in each molecule (O_3). Ozone is bluish colored and highly poisons gas that has a boiling point of 112^oC. At atmospheric pressure, ozone can partially dissolve in water. At standard temperature and pressure, the solubility of ozone is thirteen times that of oxygen.

Ozone is formed by the action of sunlight on oxygen. When normal oxygen absorbs solar – ultra violet radiation; splitting oxygen molecules into radical oxygen (O). This atomic oxygen quickly combines with further oxygen molecules to form ozone. This action takes place naturally in the atmosphere.

$$O_2 + UV \longrightarrow O + O$$

$$O + O_2 \longrightarrow O_3$$

DESTROY OF OZONE LAYER: *Two different processes destroy ozone naturally.* The first is when free oxygen radical combines with an ozone molecule to produce two diatomic oxygen molecules.

$$O + O_3 \longrightarrow 2O_2$$

The other process when ozone molecules absorb ultraviolet radiation and form one diatomic oxygen molecule and one free oxygen radical.

$$O_3 + UV \longrightarrow O + O_2$$

The CFC's released from refrigerants, air conditoners are causing harm to ozone layer. The U.V. radaitions separerates chlorine atoms. These chlorine atoms react with ozone molecule and releases O_2 molecule. Thus ozone layer thickness is decreasing gradually and called as Ozone depletion.

$$CFCl_3 + \text{electromagneticradiation} \longrightarrow CFCl_2 + Cl.$$

$$Cl + O_3 \longrightarrow ClO + O_2$$

$$ClO + O_3 \longrightarrow Cl + 2\,O_2$$

A. EFFECTS: Ozone layer absorbs harmful radiations before they nreach earth surface. It is called as umberella of earth. The effexcts of ozone layer depletion are as follows.

1. **Effect on plants:-** The increassed U.V. radiations effects plants by reducing size of leaf, they reduce yeild of crop. It reduces photo synthesis activity. Thus affects human beings.
2. **Aquatic animals:** The U.V. radiations can pass 10 to 20 mters deep into water. The raditons kills many aqyuatic animals like photo planktons and micro organisms. This affects the aquatic food chain and imabalances the aquatic ecosyste.
3. **Human beings:** The U.V. raditons which reach the earth surface effects human beings a lot as it causes skin cancer, skin aging, eye diseases, and decreases immune system of human beings.
4. **Climatic changes:** The U.V. radiations which reach to the earth surface continously are affecting humans as climatic changes occur. The temperature rises gradually on the earth's surface leading to changes on warth surface which affects the living organisms.
5. **Materials:** they cause damage to paints, fabrics, as they fade faster. The plastics material deteriorates faster when exposed to sun and U.V. radiations.

B. CONTROL STEPS:

1. Redesigning the machinary such that the CFC's are not directly discharged into atomsphere.
2. The CFC's are replaced by HCFC's and HFC's etc.
3. Human beings have to use Eco friendly coolants, AC's etc.

6.3. ACID RAINS:

Acid rain is a broad term that describes several ways through which acid falls out from the atmosphere. Acid rain includes acidic rain, fog, hail and snow.

$2SO_2 + O_2 \longrightarrow 2SO_3$

$2SO_3 + 2H_2O \longrightarrow 2H_2SO_4$

$NO_2 + (O) \longrightarrow NO_3$

$NO_3 + NO_2 \longrightarrow N_2O_5$

$N_2O_5 + H_2O \longrightarrow 2HNO_3$

A. ***Causes of acidification:*** Sulphur dioxide (SO_2) and oxides of nitrogen (NO_x); to some extent are the primary causes of acid rain. These pollutants originate from human activities such as

1. Combustion of burnable wastes.
2. Metal smelting technique releases sulphur oxides into air.
3. Motor vehicles releases large amount of nitrogen oxides.
4. Forest fires.
5. Volcanic eruptions.
6. Fossil fuels in thermal power plants.
7. Automobiles.

B. ***EFFECTS:*** Following are the effects of acid rains.

1. It affects forest resources.
2. It affects fertility of land.
3. It affects growth and yeild of plants
4. It leads to corrosion of material.
5. It causes skin irritation, some times skin cancer.
6. It causes various diseases to human beings
7. It affects biodiversity.
8. It contaminates water bodies both ground and surface water resources.
9. It alters pH of water which affects aquatic ecosystems.

7. ROLE OF INFORMATION TECHNOLOGY IN ENVIRONMENT:

Information Technology has tremendous potential in the field of environmental education as in other fields like business, economics, and politics. Development of Internet facilities, World Wide Web, Geographical Information System through satellites has generated a wealth of up to date information on various aspects of environment. A number of software's have been developed for environment and health studies in understanding the subject especially in India.

(a) Prediction of any natural calamity through the use of IT: Population in a State or country will be subjected to many environmental disasters. Scientists study and predict the same through information technology and express the possible occurrence of the natural disaster quite before. The predictions about any disaster that is about to occur in a short time, in future

should be studied well and the information about the forthcoming disaster should be informed to all people through the information technology or e – communication.

(b) Public awareness of environmental disasters through the information technology: Whenever any environmental disaster occurs, people concerned should prepare to do some activities to minimize the affects and it is possible only through IT.

(c) Database on Environment: It is usually in computerized form and can be retrieved whenever required. Database is also available for diseases like HIV / AIDS, malaria etc.. The Government of India under the Ministry of Environment and Forests established an Environmental Information System (ENVIS) as a plan and to provide environmental information to scientists, engineers, research workers all over the country. National Management Information System (NMIS) under the Department of science and Technology has compiled a database on Research and Development projects related to environmental information on environmental pollution (eg: ground water pollution, marine pollution, forest destruction etc).

(d) Other uses:

- It also provides information about over exploitation of natural resources.
- Informaion regarding population of animals and plant species.
- Information regarding control of population growth.
- Information regarding mineral resources.
- It provides medical records of human beings.
- It solves many biological problems.
- It provides data regarding many unsolved and critical problems.
- It helps in designing new equipment which is ecofriendly.
- It helps in storing data of patients, environment plans etc.

8. POPULATION GROWTH:

The population growth is the major problem faced in present day life.

A. CAUSES:

The following are the causes and effects of population growth:

1. ***Medical facilities: -***The improvement in medical facilities have provided cure for dreadful diseases and threatening diseases. This increase in medical aid provided cure for many people and this led to decrease in death rate which resulted in increasing population growth.
2. ***Poverty:-*** People who live in below poverty line wrongly believe that more children means additional hand to work, to help in fields, to work for daily wages, to help in household work etc.. This is also contributing to population growth.
3. ***Increase in sanitation:-*** Increase in sanitation which is providing good environment. As better sanitation provides healthy and hygienic conditions which decrease the spreading of contagious and harmful diseases like cholera, typhoid, dysentery etc.,

4. ***Customs and traditions:-*** Customs and traditions also play a prominent role in increasing population growth. Preference for male children due to blind beliefs and also parents believe that male children will help them at their old age financially. This is also resulting in increasing population growth.
5. ***Illiteracy:-*** Illiteracy is another factor contributing for the growth of population as people are unaware regarding effects of population growth.

B. Effects of Population growth:

Excessive growth of population causes many socio-economic problems. Some of them are as follows:

1. It increases deforestation activities due to essential commodities.
2. Forest areas are converted into agriculture areas to meet the productivity for demand of people.
3. Increases demand for water resource.
4. Increases demand for mineral resource.
5. Increases demand for energy resources.
6. Imbalances the ecosystems.
7. Leads to over exploitation of natural resources.

C. Techniques to control Birth rate:

Birth control is one effective method which is followed to control population growth. There are some temporary and permanent techniques to control birth rate.

The temporary methods not only control birth rate but also help people as they are sexually satisfied. The following are some temporary techniques.

1. **Diaphragm:-** The diaphragm is a small, dome shaped rubber shield over cervix. It prevents the sperms from entering the uterus hence stops pregnancy.
2. **Intrauterine devices**:- It is a small flexible plastic frame which is inserted into women's vagina which prevents from pregnancy.
3. **Condom:-** It is madeup of latex or polyurethane and is used during sexusl intercourse which helps in preventing pregnancy.
4. **Oral contraceptives**:- The pills are taken, generally these are taken with the direction of doctor which helps in preventing pregnancy. Male contraceptive are under development
5. **Chemical methods:-** Using spermicides which are generally in the form of jelly, foams etc., which decrease the activity of sperms.

Perminant methods:

1. ***Sterilization:-*** This is permanent method for both men and women. In women fallopian tubes are cutted or block so that the eggs does not reach ovary and this stops pregnancy. Vasectomy is the procedure which prevents the male.
2. ***Abortion:-*** This abortion is also a technique which helps in increasing birth rate. The abortion is legal on the grounds of the health of the mother, humanitarian or in case of risk of physical and mental abnormalities to the child. This legal abortion can be carried out based on medical termination of pregnancy act – 1971.

2. ECOSYSTEM

1. INTRODUCTION OF ECOLOGY:

The term "Ecology" was derived from Greek word **Oikes** means house or place of habitation and **ology** means a discussion or study. So, ecology is the **scientific study of the distribution** and the **interactions** between organisms and their natural environment.

The environment (surroundings) consists of: **living organisms (biotic**) and **non-living things (** abiotic **)** such as physical components of wind, temperature, rainfall, water, humidity , light, soil etc and chemical components of C,H,N,K,P,S etc..(in-organic components) and carbohydrates, proteins (organic components). Hence, Ecology involves studying the ecosystems.

According to **GEORGE JACKSON,** an Ecosystem is a natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all of the non-living things.

An ecosystem is the smallest unit of biosphere that has all the characteristics to support life. Pond ecosystem, forest ecosystem, desert ecosystem, marine ecosystem, urban ecosystem are some of the examples for ecosystems. An ecosystem varies in sizes from a few square kms to hundreds of square kms. Similarly an ecosystem may be temporary like a fresh pool, agriculture field or permanent like a forest and ocean.

2. Scope of ecosystem:

Ecology plays an important role in

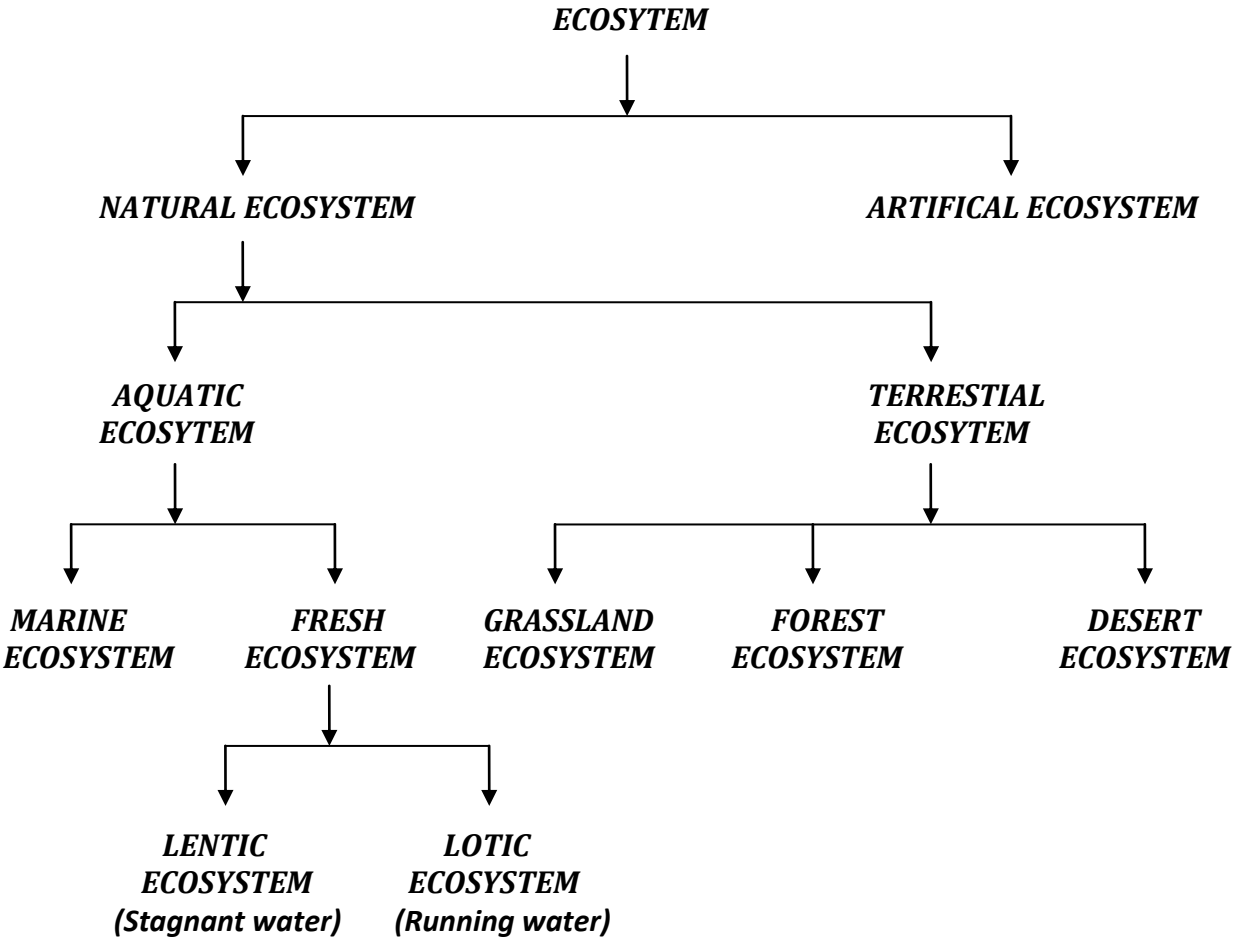
- → Agriculture crop rotation.
- → Weed control (unwanted plant).
- → management of grasslands, forestry etc.,
- → Biological surveys.
- → Fishery surveys.
- → Conservation of soil.
- → Conservation and protection of wild life.
- → Surveys of water bodies like rivers, lakes; ponds etc...

3. Concept of ecosystem:

In an ecosystem, the interaction of life with its environment takes place at many levels. A single bacterium in the soil interacts with water, air around it within a small space while a fish in a river interacts with water, other animals and rivals in a large space. Considering the operational point of view; the biotic and abiotic components of an ecosystem are so interlinked such that their separation from each other is practically difficult. So, in an ecosystem both organisms (biotic communities) and abiotic environment (rainfall, temperature, humidity) each are influencing the properties with other for maintenance of life.

4. Classification of Ecosystems:

Ecosystems are classified on the basis of habitat.



5. **KINDS OF ECOSYSTEMS**: Ecosystem may be natural or artificial.

Artificial Ecosystem: These are maintained or created artificially by man. The man tries to control biotic community as well as physico chemical environment.

Eg: Artificial pond, urban area development.

Natural Ecosystem: It consists of Terrestrial and Aquatic Ecosystems which are maintained naturally.

1. ***Terrestrial Ecosystem:*** This ecosystem relates to biotic components living on the land. Vegetation dominates the community and the types of vegetation affect the climate, soil structure and a rapid exchange of O_2, water and CO_2
   a) ***Forest ecosystem:*** Forest is a type of terrestrial (land) ecosystem. It consists of trees, shrubs or woody vegetation occupying an extensive area of land.
   b) ***Grassland ecosytem:*** Grassland ecosystem is defined as big open space with grasses. The grassland soil area is fertile as the roots of grass penetrate deep into the soil.
   c) ***Desert ecosystem:*** Deserts occur in regions when the annual rainfall is in the range of 250 to 500 mm and evaporation rate is high**.** Deserts occupy about 30% of land area on the globe.
2. ***Aquatic Ecosystem:*** This ecosystem relates to biotic community living in water. The types of water (fresh water, saline water, polluted water) dominate and affect the pH of water, depth of water, temperature of water etc.. Aquatic ecosystem has been sub-divided into **fresh water** and **saline water** based on the quality of water.
   a) **Fresh water ecosytem.**
   b) **Marine water ecosytem.**

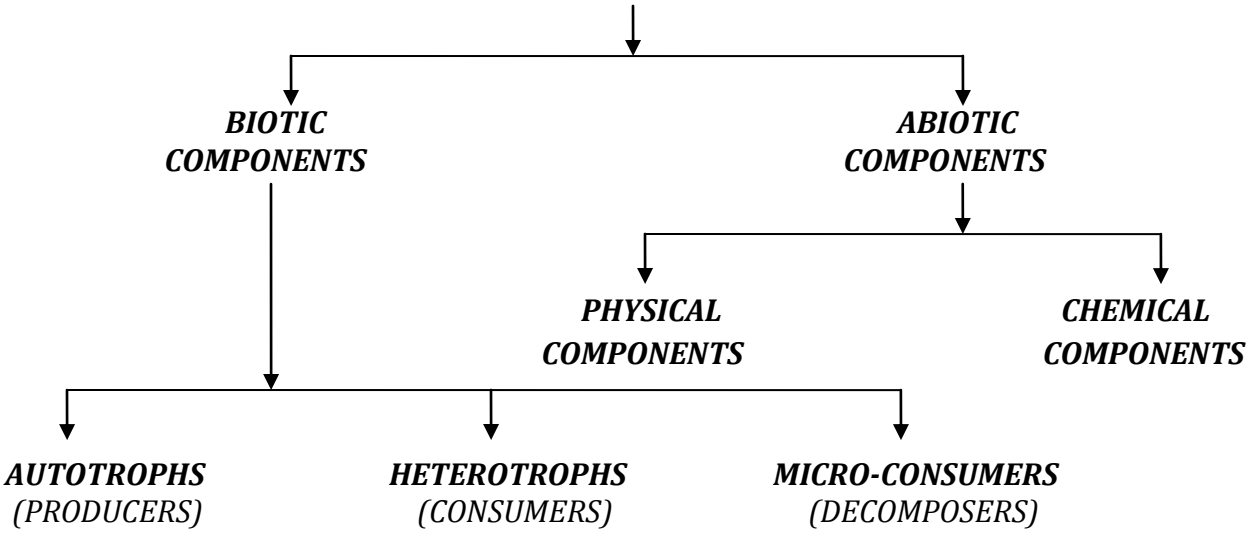
6. **STRUCTURE AND FUNCTIONING OF AN ECOSYSTEM:**

The two major aspects of an ecosystem are: (1) Structure and (2) Function together they illustrate the organization of an ecosystem.

1. **THE STRUCTURE OF AN ECOSYSTEM:**

The Structure of an ecosystem consists of the following components

ECOSYSTEM



a) **Abiotic structure** includes the **non-living things of the ecosystem** such as
   I. **Physical factors** – soil, temperature, light and water) and
   II. **Chemical factors** consisting of inorganic compounds (N, C, H, K, P, S) and organic compounds (carbohydrates, proteins).

b) **Biotic structure** includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as
   I. **Autotrophs** (Producers),
   II. **Heterotrophs** (Consumers)
   III. **Micro-consumers** (Decomposers) based on how they get their food.

2. FUNCTION OF ECOSYSTEM:

Function of ecosystem means how an ecosystem works or operates under natural conditions. The rate of biological energy flow ; the rate of nutrient cycles ie Bio- Geo-Chemical cycles and Ecological regulation (means regulation of organisms by Environment and regulation of Environment by organisms) plays a major role in the function of an ecosystem

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1. Autotrophic components (Producers):

Autotrophic means self nourishing. Since these organisms are self nourishing, they are also called producers. Eg: Algae, Green plants, Bacteria of photo synthetic. Green plants prepare their food themselves by making use of CO2 present in the air and water in the presence of sunlight through the process of **photosynthesis.**

$$6CO_2 + 12H_2O \longrightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

(Carbon dioxide) (Water) (Carbohydrates) (Oxygen) (Water)

A few micro-organisms which can produce organic matter (nutrients) through oxidation of certain chemicals in the absence of sunlight known as **chemo autotrophs.**

Eg: In the Ocean depths, where there is no sunlight, chemo-autotrophic bacteria make use of the heat generated by the decay of radioactive elements for preparation of their food.

2. Hetero-trophic components (Consumers):

Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a. **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg: Rabbits, Deer's, Insects.

***b. Carnivores (secondary consumers)*:** These carnivores (flesh eating) feed on the herbivores. Eg: Snakes, birds, Lizards, fox.

c. Tertiary consumers (or) Tertiary carnivores: These feed on the primary and secondary consumers. Eg: Lions, Tigers.

d. Omnivores: These consumers feed on both plants and animals. Eg Human beings, Birds (hawk) etc…

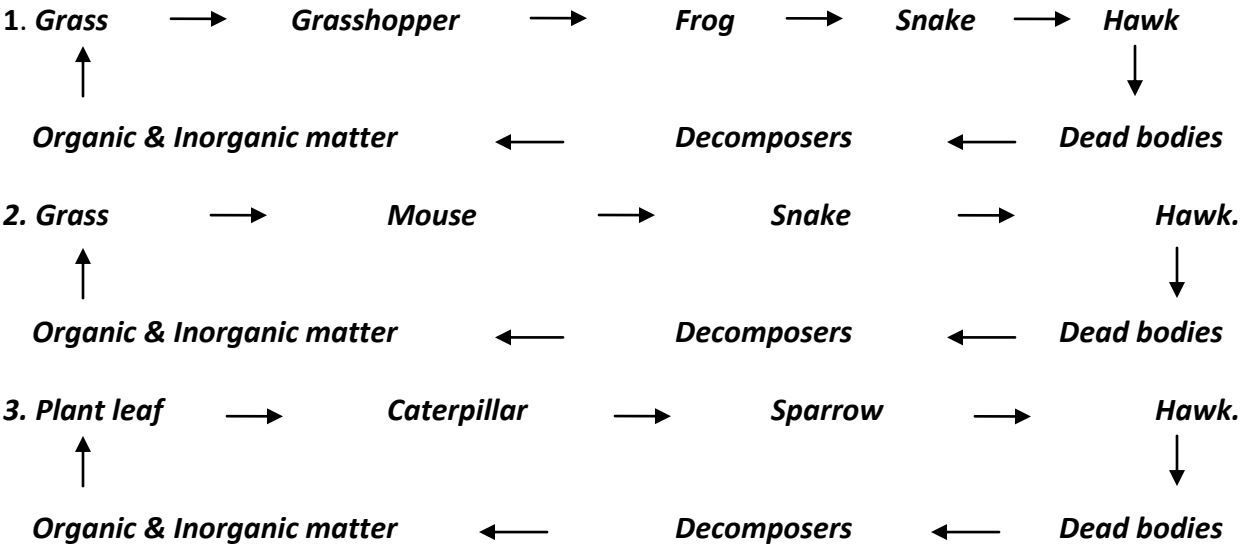
3. Decomposers or Micro consumers: They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds (nutrients) making them available to producers.

Eg: Bacteria, Fungi, and Flagellates. The decomposers are also called as "**Saprotrophs**".

7. FOOD CHAIN:

The transfer of food energy from the producers (plants) through a series of organisms (Herbivores, Carnivores) successively with the repeated activities of eating and being eaten is known as food chain. In an ecosystem(s), one organism is eaten by the second trophic level which in turn is eaten by the third trophic level and so on... This kind of feeding relationship is called food chain which is explaned below with few examples

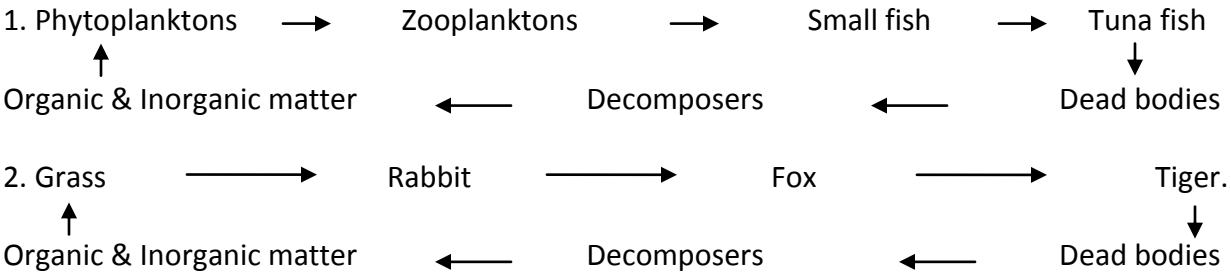
Examples of food chain:



Explanation: A caterpillar eats a plant leaf, a sparrow eats the caterpillar, and a hawk eats the sparrow. When they all die, they are all consumed by micro organisms like bacteria (or) fungi which break down the organic matter and convert it into simple inorganic substances that can again be used by the plants. In nature, there are two basic types of food chains.

1. Grazing food chain and (2) Detritus food chain

1. Grazing food chain: This food chain starts with green plants (primary producers) and goes to herbivores and on to carnivores and on to decomposers is called grazing food chain.



2. Detritus food chain: This food chain starts from dead organic matter (dead leaves/ plants / animals) and goes to Herbivores and on to Carnivores and so on. . The dead remains of plants, animals, dead leaves, flowers and fruits are degraded by decomposers (Fungi, Bacteria) and convert the organic matter into simple substances which are then taken up by the primary producers as nutrients. The food is transferred to higher trophic levels that is secondary, teritiary trophic levels is called Detritus food chain.

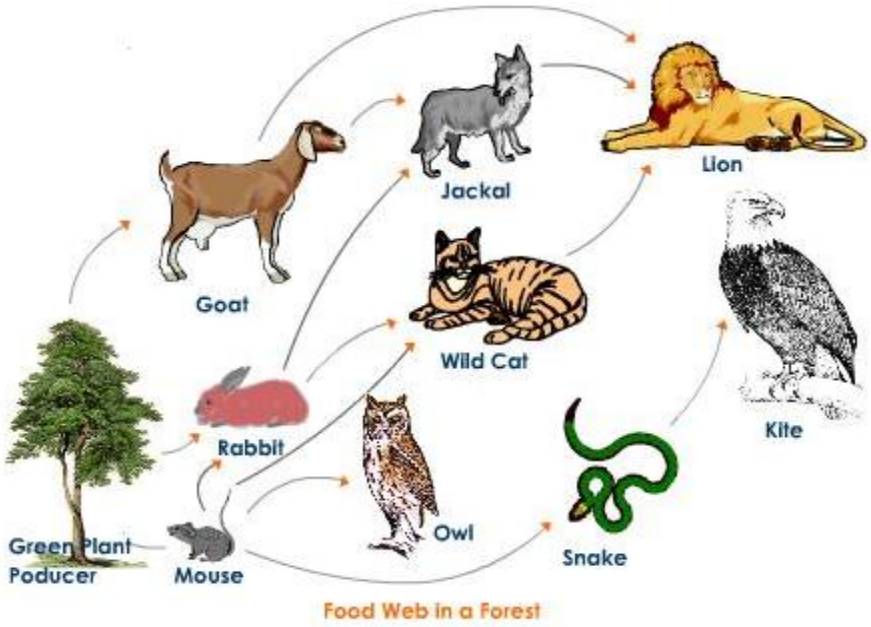
1.Leaves or dead plants → Soil mites → Insects → Birds .
2.Dead organic matter → Bacteria → Insects → Frogs → Snakes
3.Dead leaves → Algae → Fish → Man

Significance of Food chains: The study of food chains helps in understanding some of the important aspects of the ecosystem in particular and environment in general.

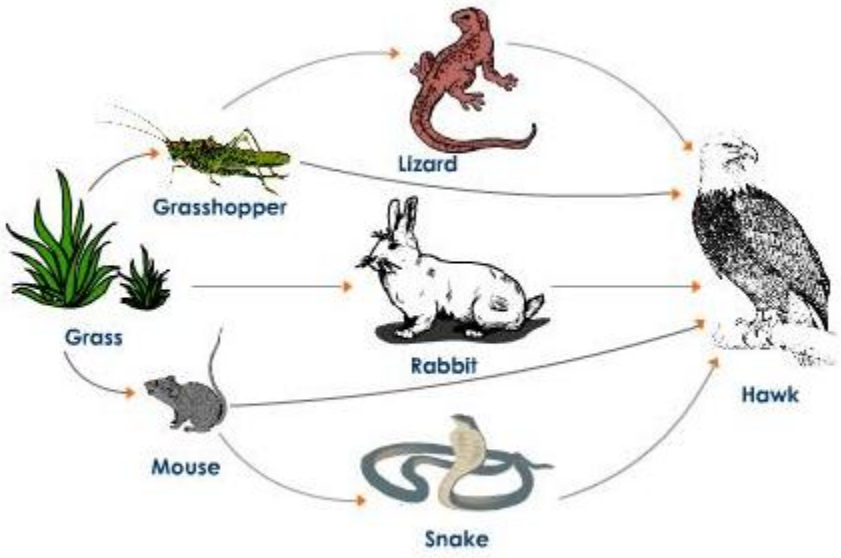
- → The food relationship among the different organisms in an ecosystem.
- → The food chains explains different living components of the biosphere
- → These are the vehicles of transfer of energy from one level to another.
- → It explains about transfer of materials and nutrients also take place.
- → The movement of some toxic substances (like DDT) in the ecosystem is transferred to the various trophic levels, their accumulation at the highest trophic level, (biological magnification), etc. can be studied.

8. FOOD WEB:

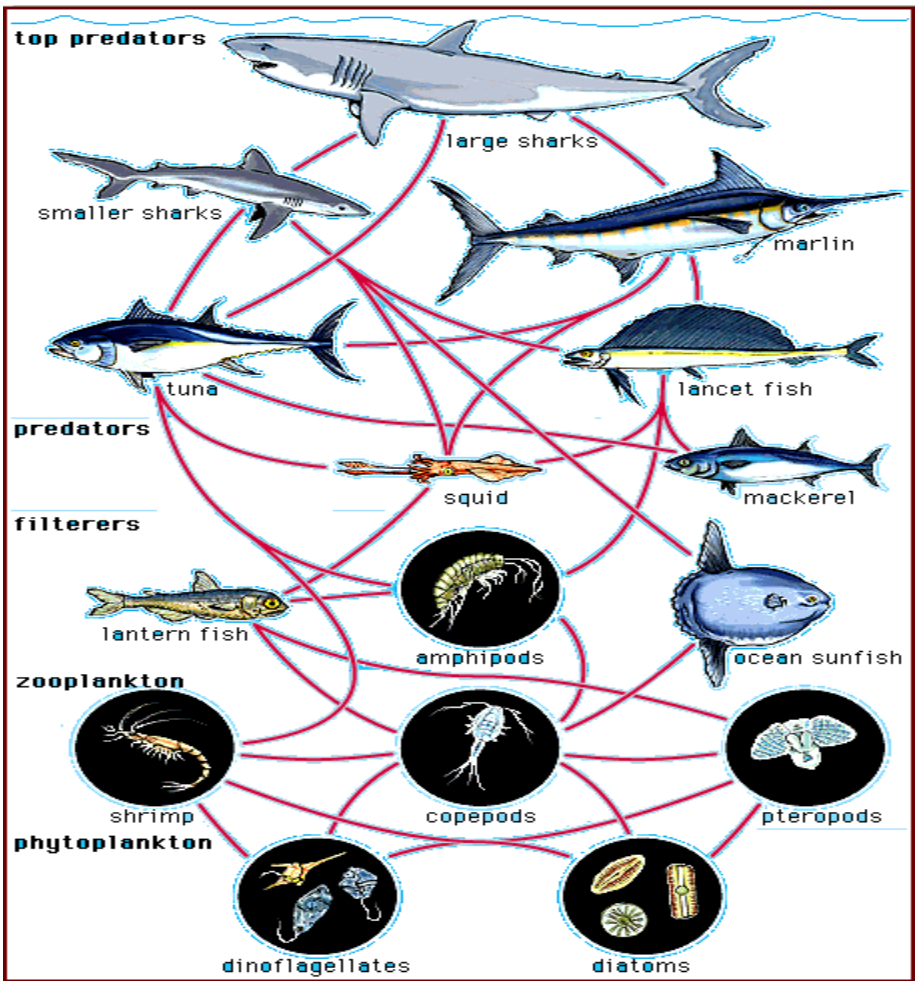
Food web is a net work of food chains where different types of organisms are connected at different trophic levels so that there are a number of options of eating and being eaten at each trophic level. (A trophic level refers to an organism's position in the food chain). In the above figure, it may be observed that there are 5 linear food chains in the food web of a grass land ecosystem.



Food Web in a Forest



GRASSLAND ECOSYSTEM



AQUATIC ECOSYSTEM

9. ECOLOGICAL PYRAMID:

Ecological pyramids were first studied by a British ecologist **CHARLES ELTAN (1927).** An Ecological Pyramid is a graphical representation consisting various trophic levels with producers forming the base and top occupy the carnivores. In an ecological pyramid the huge number of tiny individuals form at the base and a few large individuals occupy the top / apex . This formation is known as ecological pyramid.

Hence, **all producers** (micro and macro plants) belong to the *I trophic level*; all primary consumers belong to *II trophic level* and **organisms feeding** on these consumers belong to the *III trophic level* and so on. The ecological pyramids are of three types. They are:

1. The pyramid of Numbers (showing population).
2. The pyramid of Biomass (showing total mass of organisms).
3. The pyramid of energy (showing energy flow).

1. The pyramid of Number:

It shows the relationships among the producers, herbivores and carnivores at successive trophic levels in terms of their number. Mostly the pyramid of number is straight (or) upright

with number of individuals in successive higher trophic levels goes on decreasing from base to apex.

The maximum number of individuals occurs at the producers' level. They support a small number of herbivores. The herbivores, in turn, support a fewer number of primary carnivores and so on….. Top carnivores are very few in number.

For eg: (1) In a grass land ecosystem.

Grass ⟶ Grasshoppers ⟶ Frogs ⟶ Snakes ⟶ Peacock / Hawk.

For eg: (2) In a pond ecosystem:

Phytoplankton ⟶ Zooplankton ⟶ Fish ⟶ Crane

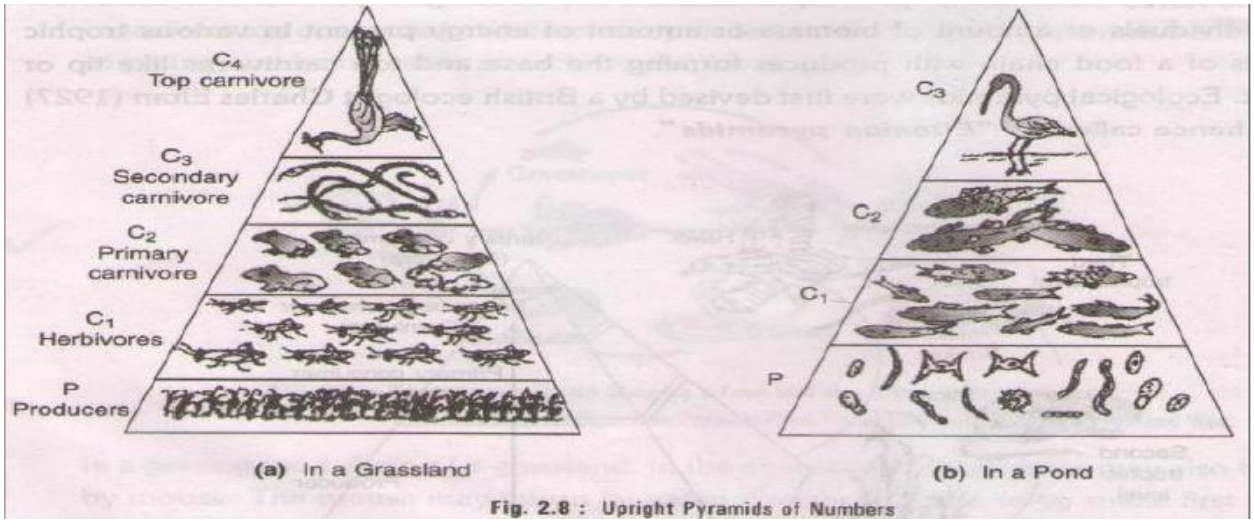


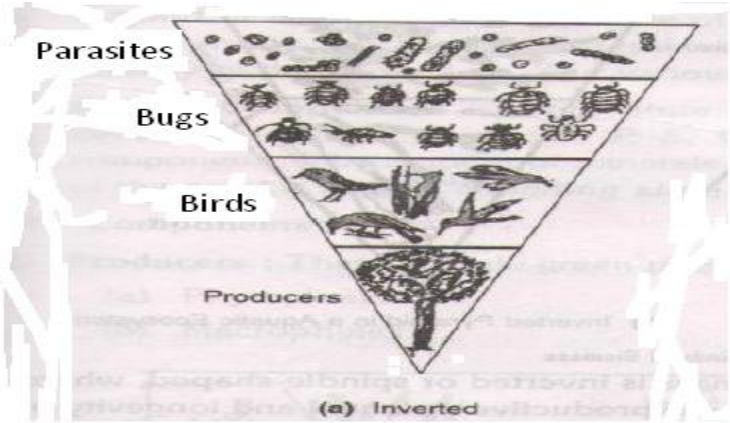
Fig. 2.8 : Upright Pyramids of Numbers

The pyramids may be inverted in a few cases :

A single plant may support the growth of many herbivores and each herbivore in turn provides nutrition to several parasites which support many hyper-parasites. Thus, from the producer towards consumers, there is a reverse position i.e., the number of organisms gradually shows an increase making the pyramid inverted in shape.

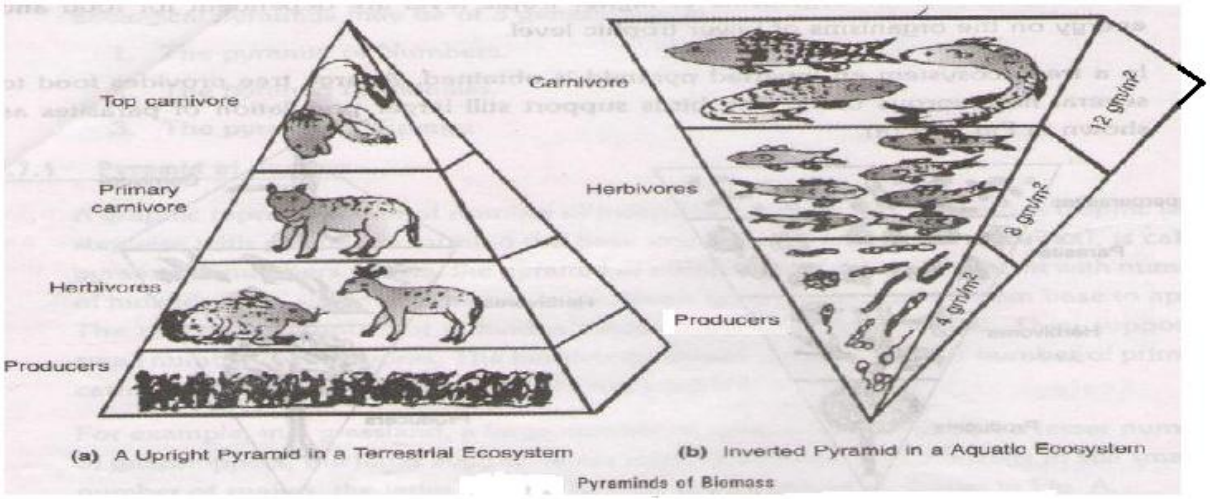
For eg: (3) in a Forest ecosystem

Tree ⟶ Birds / deer ⟶ Bugs ⟶ Parasites



2. The Pyramid of Biomass: The amount of organic matter present in environment is called biomass. In pyramids of biomass, the relationship between different trophic levels is mentioned in terms of weight of organisms**. The pyramid may be upright for grassland ecosystem and inverted for pond ecosystem.**

Eg: Vegetation produces a biomass of 1000 kg. Out of this 100 kgs of biomass for herbivores, which in turn only 10 kg of biomass for primary carnivores that gives rise 1 kg of biomass for second order carnivores and so on…



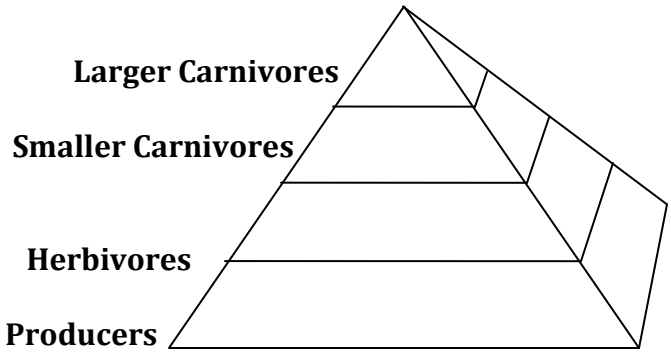
3. The pyramid of energy: The amount of energy trapped per unit time and area at different trophic levels of a food chain with producers forming the base and the top carnivores at the apex is called pyramid of energy. The energy content is generally expressed as K cal /m^2 / year or KJ / m^2 / year

Large Fish ---126 KJ / m2 / year

Small Fish ----840 – 126 KJ / m2 / year

Zooplankton ---- 7980 KJ / m2 / year

Phytoplankton (producers) --- 31080 KJ / m2 / year



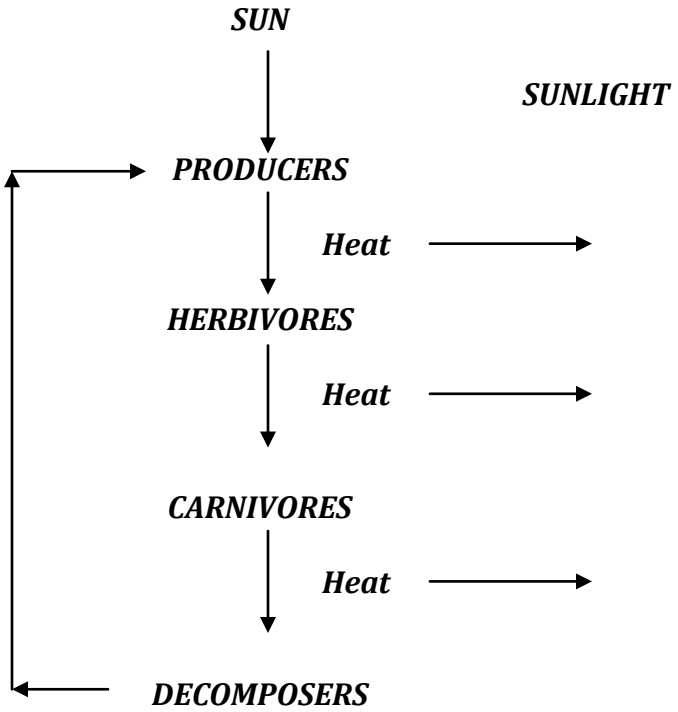
ENERGY PYRAMID

10. ENERGY FLOW /TRANSFORMATION OF ENERGY IN ECOSYSTEM

The movement of energy (or) transfer of energy through a series of organisms in an ecosystem from the external environment and back to the external environment again is known as **energy flow.**

In the universe, the main source of energy is SUN that produces energy in the form of light or solar radiation. Different ecosystems in the world receive variable quantities of solar energy depending upon their location on the globe. The other chief factors that control the amount of solar energy received by an ecosystem are Latitude and Longitude; Slope; Cloud formation; Pollutants in the atmosphere. The transformation of energy in an ecosystem begins first with the input of energy from the sun by the process of photosynthesis. Carbon dioxide is combined with hydrogen (derived from the splitting of water molecules) to produce carbohydrates (CH2O) and the energy is stored in the high energy bonds of Adenosine Tri Phosphate (ATP). ***Herbivores*** obtain their energy by consuming plants or plant products, ***carnivores*** eat herbivores and **micro-organisms** consume the droppings and carcasses (dead bodies). The organic and inorganic matter decomposed by bacteria is intaken by plants. In this manner energy is transferred from one trophic level to the other trophic level.

The diagram is given below.

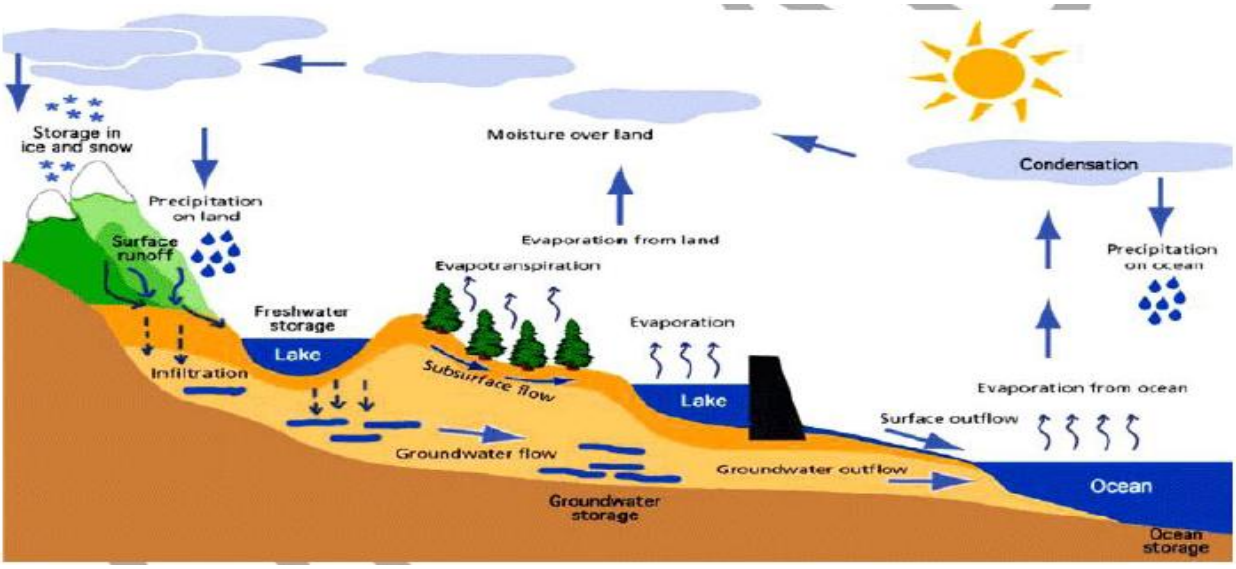


11. ***BIO – GEO-CHEMICAL CYCLES:*** In every ecosystem sunlight or solar radiant energy is accepted by producers (green plants) and the energy doesn't recycle through an ecosystem. But nutrients like Carbon; Nitrogen; Oxygen, Hydrogen; Water, Sulphur; Phosphorous etc move in circular paths through biotic and abiotic components and they are known as **Bio-geochemical cycles.** About forty chemical elements are considered to be essential for living organisms. They are macronutrients of C, H, O, P, K, I, N, S , Mg, Ca etc.. and micro nutrients of Cu, Fe, Co…While all inorganic nutrients have cycles, we focus on the following:

- **WATER CYCLE**
- **CARBON CYCLE**
- **NITROGEN CYCLE**
- **PHOSPHOROUS CYCLE**

1. THE WATER CYCLE OR HYDROLOGIC CYCLE

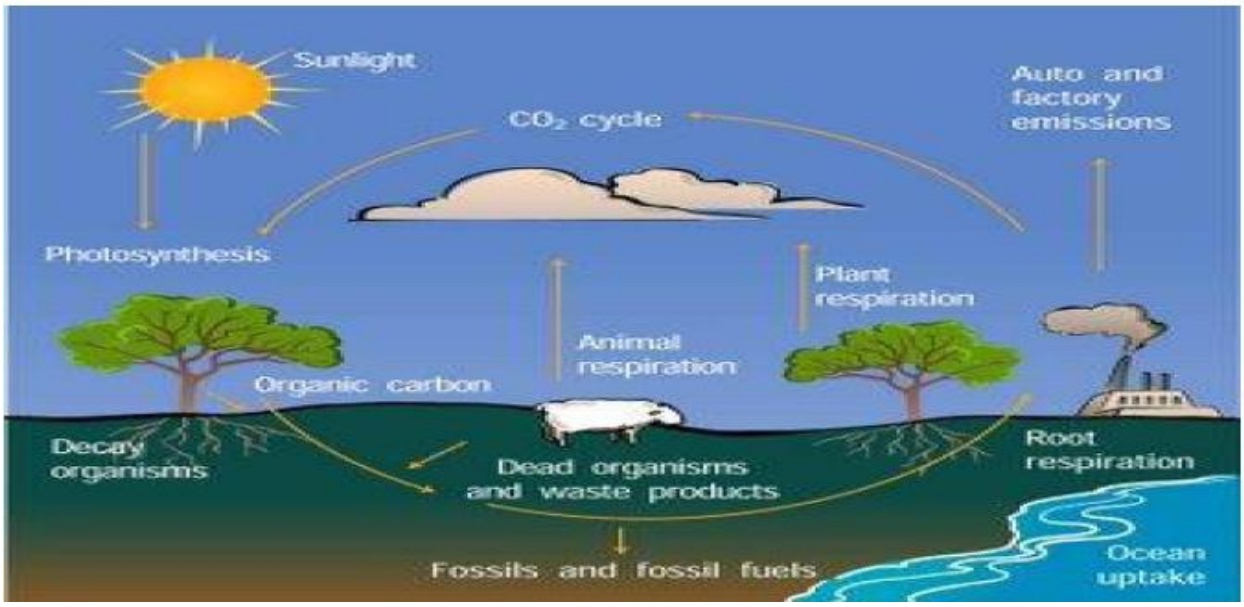
Due to the solar heat, water evaporates or water is lost to the atmosphere as vapour from the seas and oceans which are then precipitated back in the form of rain, snow, frost etc. The trees also participate in hydrological cycle. The leafs of plants and trees convert liquid phase of water to gasious phase of water known as Transpiraiton. The evaporation and precipitation continues for ever, and thereby a balance is maintained between the two. This process is known as Hydrologic cycle.



2. THE CARBON CYCLE:

All life is based on the element carbon and hence carbon is the main constituent of living organisms.. Carbon may be present in most organic matter from fossil fuels to the complex molecules (DNA and RNA). In fact, the lithosphere is only 0.032% carbon by weight. In comparision, oxygen and silicon make up 45.2% and 29.4% respectively of the Earth's surface rocks. Plants absorb CO_2 during photosynthesis whereas animals emit CO_2 during respiration. Animals obtain all their carbon through their food and thus, all carbon in biological systems ultimately comes from plants (autotrophs). The dead bodies of plants and animals as well as the

body wastes are decomposed by micro-organisms which release carbon in the form of CO_2. Even plant debris if buried a longer time results in the formation of coal, oil, natural gas and these releases carbon when they burned. Otherwise, the carbon in limestone or other sediments released to the atmosphere when they are subducted (using forces) or undergo chemical reactions. The weathering of rocks also contributes CO_2 into the environment.



3. NITROGEN CYCLE:

Nitrogen is used by living organisms to produce a number of complex organic molecules like Amino acids; Proteins; Nucleic acids; Enzymes; Chlorophyll etc... The largest reservoir of nitrogen is the atmosphere where it exists as a gas mainly N_2. But atmospheric nitrogen is not utilized directly. However, nitrogen gas undergoes many changes in the nitrogen cycle like: NITROGEN FIXATION; AMMONIFICATION; NITRIFICATION

Nitrogen fixation or conversion of free nitrogen into biologically acceptable form is referred to as Nitrogen Fixation.

$$N_2 + 2(O) \xrightarrow{\text{electric discharge}} 2\,NO$$

Nitrogen gas oxygen radical nitrogen oxides.

In physico chemical process; nitrogen combines with oxygen during lightning or electrical discharges in the clouds and produces different nitrogen oxides (N_2O_5). These nitrogen oxides get dissolved in rain water and react with mineral compounds to form Nitrates and Nitrogenous compounds on the earth.

$N_2O_5 + H_2O \longrightarrow 2HNO_3$

$2HNO_3 + CaCO_3 \longrightarrow Ca(NO_3)_2 + CO_2 + H_2O$

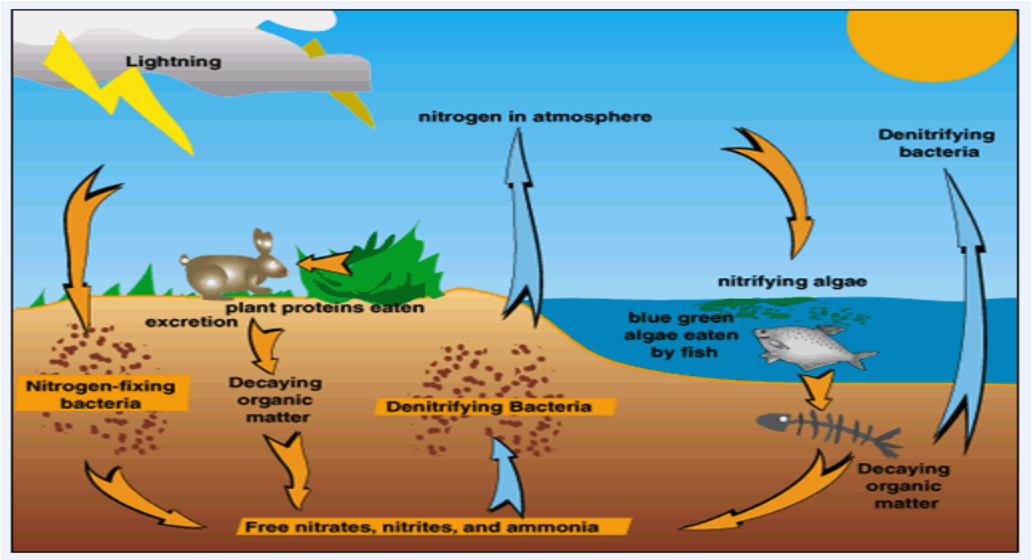
Nitrogen fixation is also carried out by biological process by means of blue – green algae in the oceans. (1) Eg: rhizobium bacteria fix nitrogen in the roots of Leguminous plants (2) Eg: Blue – green algae (Nostoc, Anabena) fix Nitrogen.

Ammonification: when plants or animals die or release waste, the nitrogen is returned to the soil as ammonia. The bacteria (nitrite bacteria) in the soil and in the water which take up

ammonia and convert it to Nitrite (NO_2). Other bacteria (Nitrate bacteria) take nitrite and convert it to Nitrate (NO_3) which can be taken up by plants to continue the cycle.

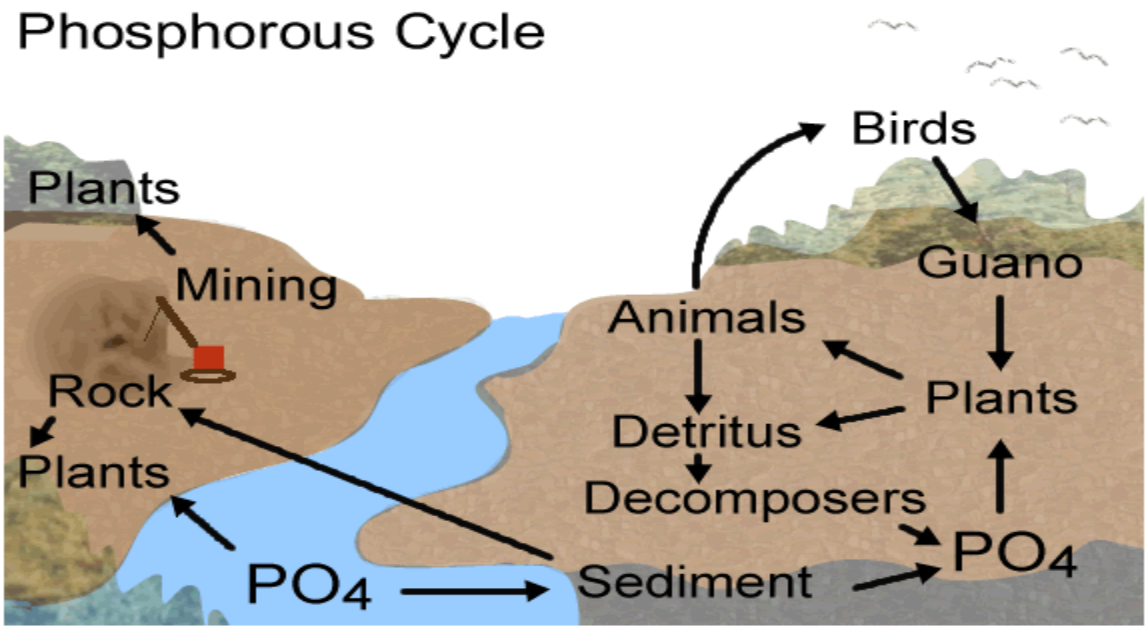
Nitrification means conversion of ammonia into nitrite by some of the bacterias such as Nitrosmonas, Nitrococcus in oceans and soils.

Denitrification: Conversion Nitrates and Nitrite into nitrogen by Thiobacillus and Denitrificans is called as Denitrification.



4. THE PHOSPHOROUS CYCLE:

Phosphorus is an important element for all forms of life. Phosphorous is an important constituent of cell membrane, DNA, RNA and ATP Phosphorous is present in rocks in the form of phosphate. When rocks containing phosphate are exposed to water, the phosphate goes into solution. It is in these rocks where the phosphorus cycle begins. When it rains, phosphates are removed from the rocks (via weathering) and are distributed throughout both soils and water. Plants take up the phosphate ions from the soil. The phosphates then moves from plants to animals when herbivores eat plants and carnivores eat plants or herbivores. The phosphates absorbed by animal tissue through consumption eventually returns to the soil through the excretion of urine and feces, as well as from the final decomposition of plants and animals after death. Phosphorus is not highly soluble, binding tightly to molecules in soil, therefore it mostly reaches waters by traveling with runoff soil particles. Phosphates also enter waterways through fertilizer runoff, sewage seepage, natural mineral deposits, and wastes from other industrial processes. These phosphates tend to settle on ocean floors and lake bottoms. As sediments are stirred up, phosphates may reenter the phosphorus cycle. Water plants take up the waterborne phosphate which then travels up through successive stages of the aquatic food chain. The Phosphorous forms sediments after final decomposition of aquatic animals after death. The phosphorous interacts with living and non living components and exists in environment.



12. STRUCTURE OF DIFFERENT ECOSYSTEMS:

1. AQUATIC ECO SYSTEM

Eco system that exists in water is known as aquatic ecosystem. This ecosystem relates to biotic community living in water. The types of water (fresh water, saline water) dominate and affect the pH of water, depth of water, temperature of water etc.. Aquatic ecosystem has been sub-divided into **fresh water** and **saline water** based on the quality of water.

Water is the primary requirement for life in biological community. The aquatic ecosystems range from a small pond to a large ocean. Varying quantities of nutrients are carried from terristrial (land) ecosystem by the movement of water and deposited in aquatic ecosystems. The life in aquatic communities is influenced mostly by physical factors like**:**

Water depth; amount light; temperature; salinity of water and amount of oxygen and Carbondioxide.

Aquatic ecosystems are broadly classified into ***fresh water*** and ***marine water*** ecosystems. In some regions, the marine and fresh water environments overlap creating "***Estuaries***".

I. PONDS and LAKE ECOSYSTEMS: A pond is a small area of still water, especially is artificial whereas a lake is a large area of water body and the water is natural. The life span of ponds range from a few weeks or months and whereas the life span for lakes depend upon their location, size and depth.

Structure of ecosystem is as follows:

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. **Physical factors** – Heat; light, pH value of water; sunlight, Dissolved oxygen content.

ii. **Chemical factors** consisting of inorganic compounds (water, CO2, O2, Ca, N,) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. **Autotrophs (Producers):** Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Eg: green plants, bacteria, rooted plants of Trapa, Typha, Sagi Haria.

ii. **Heterotrophs (Consumers):** Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

   a) **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg: larvae, beetles, molluscus.
   b) **Carnivores (secondary consumers):** These carnivores (flesh eating) feed on the herbivores. Eg: insects, small fishes.
   c) **Tertiary consumers (or) Tertiary carnivores:** These feed on the primary and secondary consumers. Eg: large fishes.

iii. **Micro-consumers (Decomposers):** They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg: Aspergillce, Pencillium.

2. STREAM and RIVER ECOSYSTEMS: Rivers and streams are flowing fresh water bodies. Out of all natural ecosystems, rivers are the most intensively used ecosystems by man. The organization of river and stream ecosystem includes:

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. **Physical factors** – Heat; light, pH value of water; sunlight, Dissolved oxygen content

ii. **Chemical factors** consisting of inorganic compounds (water, CO2, O2, Ca, N,) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

ii. **Autotrophs (Producers):** Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Eg: algae, grass.

ii. **Heterotrophs (Consumers):** Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

   a) **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg:Larvae, beetles.
   b) **Carnivores (secondary consumers):** These carnivores (flesh eating) feed on the herbivores. Eg: krills, water insects, snails, fishes.
   c) **Tertiary consumers (or) Tertiary carnivores:** These feed on the primary and secondary consumers. Eg: crocodiles, reptiles.

iii. **Micro-consumers (Decomposers):** They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg:fungi, bacteria.

3. *OCEAN OR MARINE ECOSYSTEMS:* The marine environment is characterized by its high concentration of salts and minerals. The major oceans of the world are Atlantic; Pacific; Indian, Arctic and Antarctic. These are deep and life extends to all its depths. The sea water contains salt content in the form of NaCl and rest are Mg, Ca, K . Temperature ranges from 0o to 30o C and pressure of 1 ATM at surface and 1000 ATM at bottom of oceans.

The ocean ecosystem consists of the following;

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. **Physical factors** – soil, temperature, light, rainfall, humidity, Dissolved oxygen content and water

ii. **Chemical factors** consisting of inorganic compounds (water, CO2, O2, Ca, N, Na, Cl, Mg) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. Autotrophs (Producers): Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Eg: Phytoplanktons, red algae, brown algae, Ruppia, Zostera.

ii. Heterotrophs (Consumers): Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a) Herbivores (Primary consumers): These animals feed directly on living plants or remains of plants. Eg: Crustaceans, molluses.

b) Carnivores (secondary consumers): These carnivores (flesh eating) feed on the herbivores. Eg: shad, squid, krill.

c) Tertiary consumers (or) Tertiary carnivores: These feed on the primary and secondary consumers. Eg:shark, seals, etc.

iii. Micro-consumers (Decomposers): They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg:Bacteria, fungi.

4. ESTUARINE ECOSYSTEM: Estuary is the area at the mouth of the river joins the sea and continents. It has a free connection with the open sea and is thus strongly affected by tidal action. Estuaries are mixed with fresh water from land drainages. River mouth, coastal bay etc are the examples for estuarine ecosystem. Estuaries are one among the naturally fertile in the world. The components of Estuarine ecosystem are given below:

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. **Physical factors** – soil, temperature, light, rainfall, humidity, Dissolved oxygen content and water

ii. **Chemical factors** consisting of inorganic compounds (water, CO2, O2, Ca, N, Na, Cl, Mg) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. Autotrophs (Producers): Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Eg: Macrophytes, seaweeds, marsh grasses.

ii. Heterotrophs (Consumers): Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a) Herbivores (Primary consumers): These animals feed directly on living plants or remains of plants. Eg: zooplanktons, molluses etc.

b) Carnivores (secondary consumers): These carnivores (flesh eating) feed on the herbivores. Eg: snails, small fishes, birds etc.

c) Tertiary consumers (or) Tertiary carnivores: These feed on the primary and secondary consumers. Eg:large fishes etc.

iii. Micro-consumers (Decomposers): They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg: bacteria, fungi etc.

2. ***Terrestrial Ecosystem:*** This ecosystem relates to biotic components living on the land. Vegetation dominates the community and the types of vegetation affect the climate, soil structure and a rapid exchange of O_2, water and CO_2

1. ***FOREST ECOSYSTEM:*** Forest is a type of terrestrial (land) ecosystem. It consists of trees, shrubs or woody vegetation occupying an extensive area of land. Forests are important renewable resources.

Types of forests:

1. Savannas: These forests develop where a seasonal rainfall occurs. The grasslands of North Africa are known as savannas. Eg: North Africa, America, Burma and India.

2. Tropical forests: These exits in areas of good rainfall (>200cm per year) with uniform warm temperature. The Soils found in there forests are old, acidic in nature and poor in nutrients. Eg: Amazon rain forest (South America, India).

3. Deciduous forests (or) Temperate forests: Deciduous forests consists of broad leaved trees and occur where rainfall is plenty (750 - 1000 cms per year). Eg: Europe and North-East America.

4. Coniferous forest: These occur in areas with long winters with heavy snowfall. In other words, where moisture is limited and rainfall is low. Herbivores (animals eating plants) and insects exist in these forests. Eg: Moscow.

(5) Tundras: These are the large flat Arctic regions of Northern Europe, Asia and North America where no trees grow and where the soil below the surface of the ground is always frozen. The growing season is short and plants grow very slowly.

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. Physical factors – soil, temperature, light, rainfall, humidity and water.

ii. **Chemical factors** consisting of inorganic compounds (N, C, H, K, P, S) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. **Autotrophs (Producers):** Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers.Eg: Trees, Herbs, Shurbs.

ii. **Heterotrophs (Consumers):** Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a) **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg:deer, elephant, insects etc.

b) **Carnivores (secondary consumers):** These carnivores (flesh eating) feed on the herbivores. Eg:snakes, lizards, fox, wolfs, etc.

c) **Tertiary consumers (or) Tertiary carnivores:** These feed on the primary and secondary consumers. Eg: tiger, lion etc.

iii. **Micro-consumers (Decomposers):** They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg: Bacteria, Fungi, etc.

2. ***GRASSLAND ECOSYSTEM:*** Grassland ecosystem is defined as big open spaces with grasses and few plants and trees. The annual rain fall ranges between 500mm to 900mm. the grassland soil area are more fertile as the roots of grass penetrate deep into the soil. The grass land are classified into 2 types

1. **Tropical grassland:** Grassland that are close to equator and are hot thought out the year.
2. **Temperature grassland:** These are far from equator and hot in summer.

The structure of ecosystem is as follows:

A. Abiotic structure includes the **non-living things of the ecosystem** such as

i. **Physical factors** – soil, temperature, light, rainfall, humidity and water and

ii. **Chemical factors** consisting of inorganic compounds (N, C, H, K, P, S) and organic compounds (carbohydrates, proteins).

B. Biotic structure includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. **Autotrophs (Producers):** Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Ex; Grass, Scattered trees. Etc.

ii. **Heterotrophs (Consumers):** Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a) **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg:insects, termites, bugs etc.

b) **Carnivores (secondary consumers):** These carnivores (flesh eating) feed on the herbivores. Eg: Snakes, lizards, mouse etc.

c) **Tertiary consumers (or) Tertiary carnivores:** These feed on the primary and secondary consumers. Eg: hawks, kites etc.

iii. **Micro-consumers (Decomposers):** They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg: bacteria, fungi etc.

3. ***DESERT ECOSYSTEM:*** Deserts occur in regions when the annual rainfall is in the range of 250 to 500 mm and **evaporation rate is high.** Deserts occupy about 30% of land area on the globe. Deserts are found 30 above north and below south of the equator. Deserts are characterized by extremely hot days and cold nights. The largest deserts are found in the interiors of continents where moisture bearing winds do not reach. The desert soils has very little organic matter but rich in minerals. The desert plants have adapted to the dry conditions and conserve water by having few or no leaves.

eg: (1) A plant namely Saguaro cactus has a stem that can expand to store water

(2) Many desert plants have thorns or toxins to protect themselves from being grazed by animals.

(3) Some desert plants have wax – coated leaves that minimize the loss of moisture.

(4) Some desert plants have deep roots that reach the ground water.

(5) A few desert plants have shallow roots that collect water after any rain and store it in spongy tissues.

Desert ecosystem is characterized by scanty flora and fauna. The organisms which with stand the extreme temperatures can survive here. Desert animals are usually small in size and come out during the nights for food.

A. **Abiotic structure** includes the **non-living things of the ecosystem** such as

i. **Physical factors** – soil, temperature, light, rainfall, humidity and water and

ii. **Chemical factors** consisting of inorganic compounds (N, C, H, K, P, S) and organic compounds (carbohydrates, proteins).

B. **Biotic structure** includes plants, animals and microorganisms present in an ecosystem form the biotic component. These organisms have different nutritional behavior and status in the ecosystem and are known as

i. **Autotrophs (Producers):** Autotrophic means self nourishing. The set of living organisms which can prepare their own food are called producers. Eg: Throny shrubs, Cactus, Aloe, Optanita etc.

ii. **Heterotrophs (Consumers):** Hetero-trophic means dependent on others for nourishment directly or indirectly upon the autotrophs (producers) for their food. These are of the following types:

a) **Herbivores (Primary consumers):** These animals feed directly on living plants or remains of plants. Eg:insects, camels, bugs etc.

b) **Carnivores (consumers):** These carnivores (flesh eating) feed on the herbivores. Eg:reptiles, rodents, birds etc.

iii. **Micro-consumers (Decomposers):** They feed on organic compounds of dead or living plants and animals for their food and energy. They absorb some of the products from decomposed material and release organic compounds. Eg: Bacteria, fungi, etc.

13. ECOLOGICAL SUCESSION:

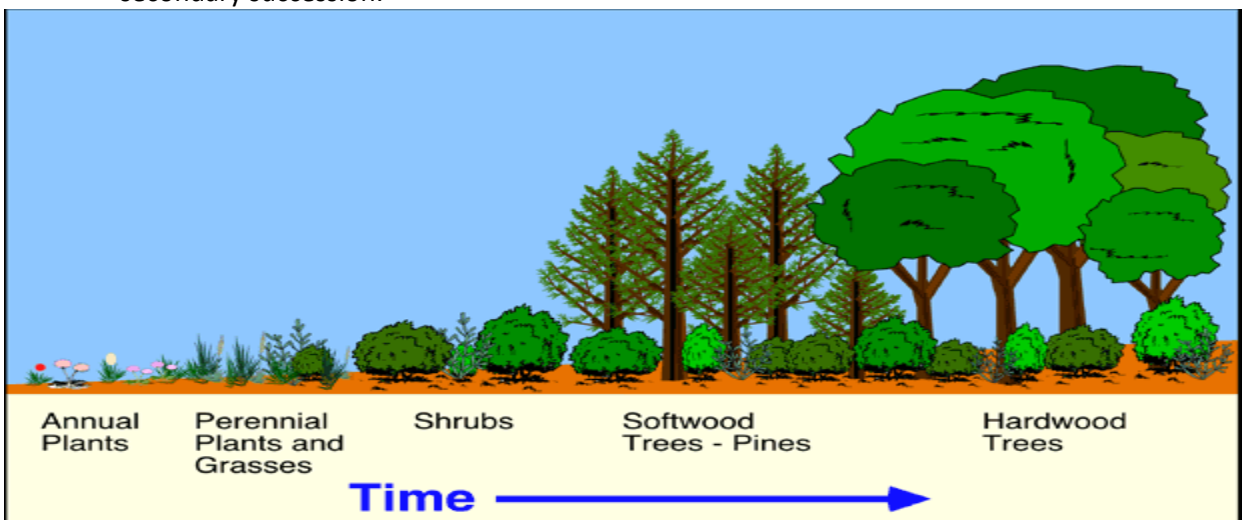
In nature the communites are not stable they are dynamic and more or less they change regularly over time and space. They never found permanently in complete balace with their compound species or with physical environment like climate or activites of species.

The occurance of relatively definte sequence of communities over a period of time in the same are is known as ecological succession. Ecological succession may take place in pond, forest, lakes or grassland systems.

The sucession activites have high impact on himans. These activities drastically restructre the land and completely disrupt a previous stabilised ecosystem.

Types: Ecological succession may be of following types

1. **Primary succession:** Succession that begins in new habitats, uninfluenced by pre-existing communities is called primary succession.
2. **Secondary succession:** Succession that follows disruption of a pre-existing community is called secondary succession.



PROCESS OF ECOLOGICAL SUCCESSION: The following steps are invoved in ecological succession of any natural area.

a. **Nudation:** The process of creation of a bare area devoid to any palnt or animal population is called nudation.
b. **Invasion:** The process of sucessful establishment of new species in the bare area is called invasion. The stpes of invasion are as follows:
   i. **Migration:** The first stage of invasion, the seeds, spore and other propagules of species reach the bare area this process is known as migration.
   ii. **Ecesis (establishment):** After reaching the bare area they start to grow and plants start to grow in adults and grow to certain extent. They can reproduce that is the

plants able to procduce seeds and animals able to reproduce. This is called establishment.

iii. **Aggregation:** The population of the species constantly rises as a result of increased reproduction. This process is known as aggregation.

c. **Competition:** As the population of species increase the availability of area decreses and the living organisms have to face competition for food, water, and space. This stage is called competition.

d. **Stabilization:** After passing through all the stages. The strong and dominant species stay in that area and weaker species migrate to a new area. The species occupy completely and stay there. They can survive in that area for some period of time is called stabilization.

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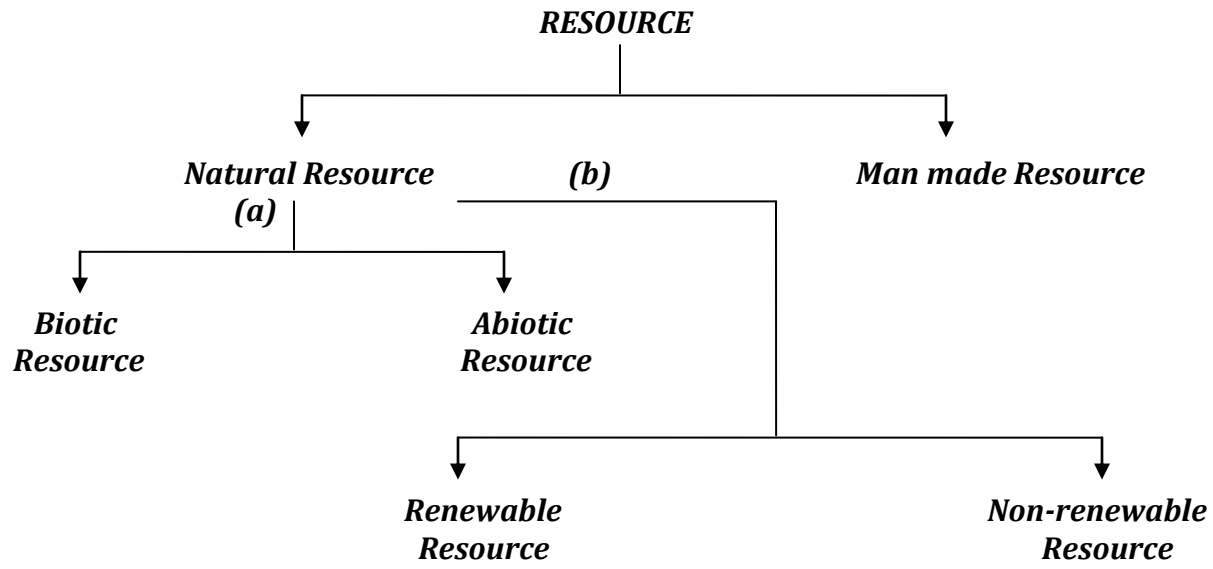
UNIT – II: NATURAL RESOURCES

CONTENTS: Natural resources – Classification and associated problems ◆**Forest resources** – Use and over exploitation, deforestation, Timber extraction, Mining, dams and other effects on forest and tribal people. ◆**Water resources** – Use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams – benefits and problems. ◆**Mineral resources**: Use and exploitation, environmental effects of extracting and using mineral resources. ◆**Food resources**: World food problems, changes caused by non-agriculture activities-effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. ◆**Energy resources**: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. ◆**Land resources**: Land as a resource, land degradation, Wasteland reclamation, man induced landslides, soil erosion and desertification. ◆Role of an individual in conservation of natural resources. ◆Equitable use of resources for sustainable lifestyles.

INTRODUCTION:

The word resource means a source of supply. The natural resources include water; air, soil, minerals, coal, forests, crops and wildlife etc. . All the resources are classified based on quantity, quality, re-usability, and availability.

CLASSIFICATION OF RESOURCES:



(a) Based on availability
(b) Based on renewability

1. ***Man made Resources:-*** Man made resources are defined as resources created by humans. They do not occur naturally and are produced and consumed by humans. Examples of these are plastic, bleach, steel, nylon etc..
2. ***Natural Resources:-*** The resources occur naturally within environments that exist relatively undisturbed by humanity, in a natural form. Examples of these are water, air, soil etc..

A.1. Biotic Resource: Biotic resources that are obtained from the biosphere (living and organic material), such as forests and animals, and the materials that can be obtained from them. Fossil fuels such as coal and petroleum are also included in this category because they are formed from decayed organic matter.

A.2. Abiotic Resources: Abiotic resources are those that come from non-living, non-organic material. Examples of abiotic resources include land, fresh water, air and heavy metals including ores such as gold, iron, copper, silver, etc.

B.1. Renewable Resources: These resources have the capacity to reappear themselves by quick recycling with a reasonable span of time. Eg: forests, wildlife.

B.2. Non-renewable Resources: Resources that exist in a fixed quantity in the earth's crust are called non–renewable resources. These resources lack the ability of recycling and replacement. Eg: minerals, fossil fuels etc..

→ A few mineral resources which occur in the earth's crust namely copper, aluminum, mercury, gold etc.., minerals of asbestos, clay and mica are considered non-renewable resources.

→ Fossil fuels are derived from organic matter that accumulated during hundreds of millions of years of early bio-geological history. There is no way of recycling the energy in fossil fuels.

Among the natural resources, Forest resources; Water resources; Mineral resources; Energy resources; Land resources are the major ones to discuss.

1. FOREST RESOURCES

INTRODUCTION

Forests are one of the most important renewable natural resources on this earth predominantly composed of trees, shrubs, woody vegetation etc… Approximately 1/3rd of the earth's total land area is covered by forests. Forests are one of the most precious gifts of nature.

1.1. *FUNCTIONS OF FORESTS:* Forests have three types of functions

1. ***Productive functions:*** This includes the production of timber, bamboos and a variety of compounds such as resins, alkaloids (poisonous substance in plants), oil and pharmaceuticals.

2. ***Protective functions:*** It includes conservation of soil and water, prevention of drought, protection against wind, cold, radiation, noise, odours etc…

3. ***Regulative functions:*** This includes absorption, storage and release of gases like CO_2 and O_2. Droughts and particularly CO_2 is regulated by forests. The regulative functions of forests improve atmospheric and temperature conditions.

1.2. *TYPES OF FORESTS:* Forests are important ecologically and economically. Forests are the important renewable resources which contribute sustainability to the economic development of a country.

1. ***Tropical forests:*** These exist in areas of good rainfall (>200cm per year) with uniform warm temperature. The Soils found in there forests are old, acidic in nature and poor in nutrients. Eg: Amazon rain forest (South America, India).
2. ***Deciduous forests (or) temperate forests:*** Deciduous forests also known as temperate forests with broad leaved trees and occur where rainfall is plenty (750 - 1000 cms per year). Destruction of these forests results in soil erosion and loss of biodiversity in the eco system. Eg: Europe and North-East America.
3. ***Coniferous forest:*** These occur in areas with long winters with heavy snowfall. In other words, where moisture is limited and rainfall is low. Herbivores (animals eating plants) and insects exist in these forests. Eg: Moscow.

1.3. *USES OF FORESTS:* The uses of forests are as follows:

A. Commercial Uses:

i. ***Edible products:-*** Forests provide a large number of commercial goods which include timber, firewood, pulp wood, food items, gums, resins, non-edible oils, rubber, bamboos etc..

ii. ***Medicinal plants:-*** The leaves, barks, and wood of forest trees contain hundreds of compounds that are valuable to the field of medicines. The plant species found in India are of tremendous medicinal value.
Ex:- Barberry, Blueberries, Cinchona, Neem

iii. ***Employment opportunities:*** Forests are helpful in generating employment opportunities and also contribute to the GDP of the country.

B. Ecological uses:

i. ***Production of O_2:*** Trees help in the production of O_2 by photosynthesis. The leaves take CO_2 and release O_2 for us to breathe which is necessary for life on the Earth. The forests are also called lungs of earth. Forests absorb 31.45 tons of Carbon per year.

ii. ***Reducing global warming:*** CO_2 is absorbed by the forests as a raw material for photosynthesis. These forests reduce the problem of global warming caused by green house effect.

iii. ***Wild life habitat:*** Forests are the homes for millions of wild animals and plants. About 7 million species are found in the forests alone.

iv. ***Soil conservation:*** Forests bind the soil particles tightly in their roots and prevent soil erosion.

v. ***Pollution moderators:*** Forests can absorb many toxic gases and help in keeping the air pure and fresh. In addition to the above, forests protect people from drought and floods; protect from radiation etc…

vi. ***Maintaining Biodiversity:*** Forests contain the greatest number of species compared to any other terrestrial ecosystem. Biodiversity at genetic, species and ecosystem level is present in forests.

→ Forests help in studying Ethrobotony
→ Forests are sources of apiculture (growing honey bees).
→ Forests are chief sources of plants that produce aromatic oils.

vii. ***Minimizing natural hazards:*** Natural hazards such as floods, droughts, landslides, storms etc. occur largely due to depletion of forest cover. Forests contribute significantly towards minimizing these natural hazards and preventing droughts.
→ They help in reducing soil erosion.
→ They help in reducing desertification and land degradation.

C. Other uses:

i. ***Regulation of hydrological cycle:*** The moisture in the air above the tropical forest comes from the transpiration of trees which helps in bringing rains. Trees absorb the rainfall and also recharge the ground water. It also helps in purifying ground water. So trees help in regulation of rainfall and hydrological cycle.

ii. ***Timber:*** The timber provided by forests can be utilized for the manufacture of plywood, doors, sports etc. It is also used for furniture making and paper production. The use of timber is increasing day by day. It helps in establishing small scale and large scale forest based industries. Ex: Puri, Orrisa, etc.

iii. ***Contribution to National income:*** Forests contribute in raising income and thus strengthen nation's economy. A typical tree provides US 200,000 worth of ecological benefits in the form of O2, air purification, soil fertility, water recycling, humidity control, and wild life protection in its life time.

iv. ***Tourism:*** Forests increase the beauty of landscape and also opening new avenues for tourism called ecotourism. Wild tourism is growing fast in India. The tourist hot spots in India are Corbett National park (Uttaranchal), Gir National Park (Gujrat), Periyyar Santuary (Kerala) etc..

1.4. OVER EXPLOITATION OF FORESTS:

Forests come under renewable resources which are replenished through natural cycles. The highest rate at which the forest resources can be used indefinitely without reducing their available supply is called sustainable yield. If the utilization rate exceeds the natural replacement rate, the available supply begins to shrink and leads to rapid degradation of forests

A. Reasons for over exploitation:

1. To meet basic needs, people are forced to over exploit the forest resources.
2. Ignorance and lack of awareness of over exploitation.
3. To have a good economical support and profit.
4. Illegal exploitation of resources.
5. Carrying improper and irregular research activities.

B. Effects of over exploitation:

1. It imbalances the hydrological cycle and ecosystems.
2. Changes in climatic conditions of the area
3. Increase in average temperature of particular area.

4. Accumulation of pollutants and effects human beings, plants and animal.
5. It leads to soil erosion.
6. Loss of biodiversity and unique flora and fauna.
7. Loss of medicinal plants.
8. Depletion of forest resources.
9. Many tribals become land less and without work.

1.5. DEFORESTATION

Deforestation is defined as the removal or reduction of trees in the forests. The removal of trees leads to adverse conditions. Forest ecosystems are extremely good and hold a good quantity of water. About 80% of the original forests on the earth have already been cleared. Only 20% of forest area (63 million hectares) is seen based on satellite data as per National Forest Policy.

A. CAUSES:

1. ***Firewood Collection:*** The majority of rural population and a large number of people living in small towns and cities of developing countries, the only fuel is wood which is burned to cook food and to provide heat in chilly winters. Firewood collection contributes much to the depletion of tree cover.
2. ***Expansion of Agriculture:*** Expanding agriculture is one of the most important causes of deforestation. As demands on agricultural products raise more and more, land is brought under cultivation for which forests are cleared.
3. ***Timber Harvesting:*** Timber resource is an important asset for a country's prosperity. Commercial wood finds ready national as well as international markets. As a consequence of which natural forests are being mercilessly exploited.
4. ***Natural calamities:*** Natural calamities such as heavy rainfall, forest fires, and volcanic eruptions are destroying forest areas.
5. ***Urbanization:*** Construction of highways, roadways, industries and expansion of habitat areas is leading to deforestation.
6. ***Mining:*** Extraction of minerals in dense forest areas is also leading to deforestation.
7. ***Over exploitation:*** Excessive extraction of forest resources is also resulting in increasing deforestation.
8. ***Dams and Projects:*** Construction of dams and projects also leads to the deforestation and affects tribal people as their habitat is affected by deforestation and also wild life is effects by this construction of dams and projects.

B. ***DISADVANTAGES OF DEFORESTATION:*** Deforestation results in many negative consequences which are stated below:

1. A variety of food products such as coffee, tea, spices, nuts, fruits etc will be reduced.
2. Various living beings may come down resulting in the imbalance of forest ecosystem.
3. Soil erosion increases to a great extent.
4. Rainfall decreases to a great extent.
5. Climatic conditions are changed.
6. Wildlife is diminished.

7. Historical values are lost.
8. Increase in natural hazards like floods, droughts and so on
9. Loss of habitat place of tribal people
10. Increase in socio economic problems in long run.

C. CONTROL STEPS:

1. Afforestation or planting more & more trees on waste land & hill slopes.
2. People should be educated to concentrate on other sources of energy other than fuel wood.
3. People should not be allowed to cut young & healthy trees.
4. Forest Protection Force Should be fully trained & equipped with Latest technology to check deforestation.
5. People should be educated against the hazards of deforestation.
6. National parks and natural sanctuaries have to be constructed.
7. The environmental laws and legal provisions should be strictly enforced.
8. Mining activities should be prohibited in areas declared as protected forests.

1.6. TIMBER EXTRACTION:

The wood of large tree is called timber. The trees in forest are large in size and grow very tall. The stem of a forest tree that has reached maximum size contains hard wood and soft wood. The wood of a tree is called timber. Timber should be collected in specific manner from the forest some of the timber trees are Tectona grandis (teak wood), Dalbergis latifolio (rose wood), Tamarindus indica (Turmeric), Pinus and Cedrus (plywood) and so on.

Timber extraction method: The timber extraction is done by the following steps:

→ ***Marking***
→ ***Felling***
→ ***Log collection***
→ ***Seasoning***
→ ***Grading***
→ ***Transportation***
→ ***Marketing***

A. ***Marking:*** First of all the area in a forest from which we want to collect timber should be thoroughly surveyed and area is selected. In that area trees are marked from which timber is to extracted. Some of the types of trees are Teak wood, Rose wood, Mahogany, Yellow wood, Plywood etc..
B. ***Felling:*** Severing the tree from the stump is referred to as felling. Historically this was carried out with an axe or bow-saw. The development of the chainsaw increased the efficiency for a person to fell a tree.
C. ***Log collection:*** Converting the cut trees into huge logs. These logs are collected and placed in forest.
D. ***Seasoning:*** After extracting logs from selected area they are subjected to process called seasoning.

E. ***Grading:*** The samples are collected from logs and based upon quality of wood the gradings are given to the logs.
F. ***Transportation:*** The logs are now transferred to nearby depots.
G. ***Marketing:*** Now the timber is supplied to consumer in the form which they require.

♠ ***Case studies of deforestation and timbering:***

1. ***Chota Nagpur:*** This hilly region used to be good forested area and tea – garden. Due to over exploitation of forests the tea – garden started disappearing. Forest area and rainfall declined in Chota Nagpur.
2. ***Udhagamandalam:*** The forest area on Nilgiri Mountains has been found to be closely associated with declining forest covering region. These hills have luxuriant forest cover annual rainfall used to much higher. There is decrease in rainfall as there is increase in deforestation activity.
3. ***Cheerapunjee:*** It was the wettest spot on Earth because it has maximum rainfall in the world. But because of over exploitation of forest by humans the rainfall has decreased.
4. ***Araku valley:*** It is a good forest area in Visakhapatanam with great scenic beauty. The over exploitation of forest led to the decrease in scenic beauty and rainfall.
5. ***Chipko and Apoko movement:*** The main motto of these two movements was to prevent felling of trees for any purpose. Chipko movement has prevented contractors from entering into forests for cutting and felling trees. It was started by Sundarlal Bahuguna who lives in that area and knows the impact of quarrying leading to Eco destruction of Allahabad. This was called Chipko movement.

   Apoko movement was spread in parts of Kumaon, Garhwal, Naina Tal and Rami Khat Hills. The mining activity lead to destruction of forest area which led to more accumulation of Carbon dioxide and less release of Oxygen which led to "Global warming" in that area and leading to Green house effect. There is decrease in rainfall in that area and disturbing natural eco – balance. This moment was started to protect and preserve ecology of that place.

1.7. MINING:

Extraction of valuable minerals or other geological materials from the earth is called mining. Mining is required to obtain any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory. Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas, or even water.

A. Advantages of Mining:

The advantages of mining are as follows:

→ Mining of ores will enable people to get useful elements with significant profit.
→ Mining will give unemployed people to get at least the simplest job.
→ Mining of ores might result in finding something new and valuable material.
→ It helps in increasing industrialization.
→ It contributes to the growth in national income.

B. Consequences of Mining:

The mining activity has advantages. At the same time it has disadvantages which are stated below:

- → It leads to Environmental issues such as soil erosion.
- → It leads to the formation of sinkholes.
- → It leads to loss of biodiversity.
- → It leads to contamination of soil, such as land degradation.
- → It leads to ground water and surface water by chemicals from mining processes.
- → It affects forest resources if mining is carried in forests.
- → The contamination resulting from leakage of chemicals can also affect the health of the local population if not properly controlled.
- → It causes destruction and disturbance of ecosystems and habitats.
- → It destroys areas of farming and it may disturb or destroy productive grazing and croplands.
- → In urbanized environments mining may produce noise pollution, dust pollution and visual pollution.
- → It causes air pollution while extracting minerals.
- → It causes radioactive pollution as explosives are used during mining technique.
- → It produces large amount of solid non degradable waste materials which effects Environment.

C. Control steps:

The necessary remedial steps of mining activity are as follows:

- → Atmospheric pollution due to mining and associated activities can be minimized by planning and using dust extractors.
- → Adapting method so that it optimizes the blast designs.
- → Maintenance of roads and sprinkling of water for easy movement of dumpers.
- → Using eco generators (sound proof) at mining area.
- → Proper maintenance of equipment and the machines not only minimize the air pollution but also the noise generation.
- → Minimizing usage of explosives in mining area.
- → Recreating and re - habitating the mining area with green belts will help in decreasing the environment pollution.

♠ *Case studies*:

1) Aravalli hills in Rajasthan: The Aravalli hills spread across Haryana, Rajasthan and Gujarat control the climate and drainage system of the region. Mining activity is being taken in this region due to immense mineral wealth (Talc, marble, granite). Rajasthan state alone has 9700 industrial units connected with mining and 90% of forest has been depleted over the past 20 years. When the mining activity reached below the underground water level, a cone of depression was formed in the surrounding areas and ultimately bore wells, dug wells, dried up

and affected agriculture in a massive level. Several studies have pointed out that the natural drainage system and the ground water table of the entire region has been badly affected. Pollution levels have also increased. Lung diseases, silicosis were attacked by the laborers. In November 2002, the Supreme Court imposed a blanket ban on mining activities in the Aravalli hills. The court ruling closed all 9700 units. The environmentalists have alleged that mining has affected the water, forest and the land.

2) Uranium mining in Nalgonda: The Uranium Corporation of India proposed to mine Uranium from the deposits of Lambapur and Peddagattu villages of Nalgonda dist. Processing unit was proposed at Mallapur village in Nalgonda dist by offering employment opportunities. But experts didn't propose mining activity because of possible contamination of water. The proposed mines are just 1 km away from human habitation and 10 km from Nagarjuna Sagar dam and 4 km away from Akkampalli reservoir, which is a source for drinking water.

***3) Udaipur*:** There are about 200 open cast mining and quarrying centers in Udaipur. Building stone, Phosphate rock, Dolomite are available there. These mines spread over 15,000 hectors. To extract minerals 150 tons of explosives are used per month in blasting. Thus it is causing major problems to environment as hills are suffering from soil erosion, pollution of water, air, loss of fauna, birds have disappeared from mining area.

4) Gold mining in Europe: Potassium Cyanide is used during the process of gold treatment. In 2000, the ***Baia Mare Gold mine*** in Romania (Europe), released 80 million litres of less concentrated cyanide into the Tisza River. The cyanide flowed 500 km via Hungary and Serbia cities caused for diseases.

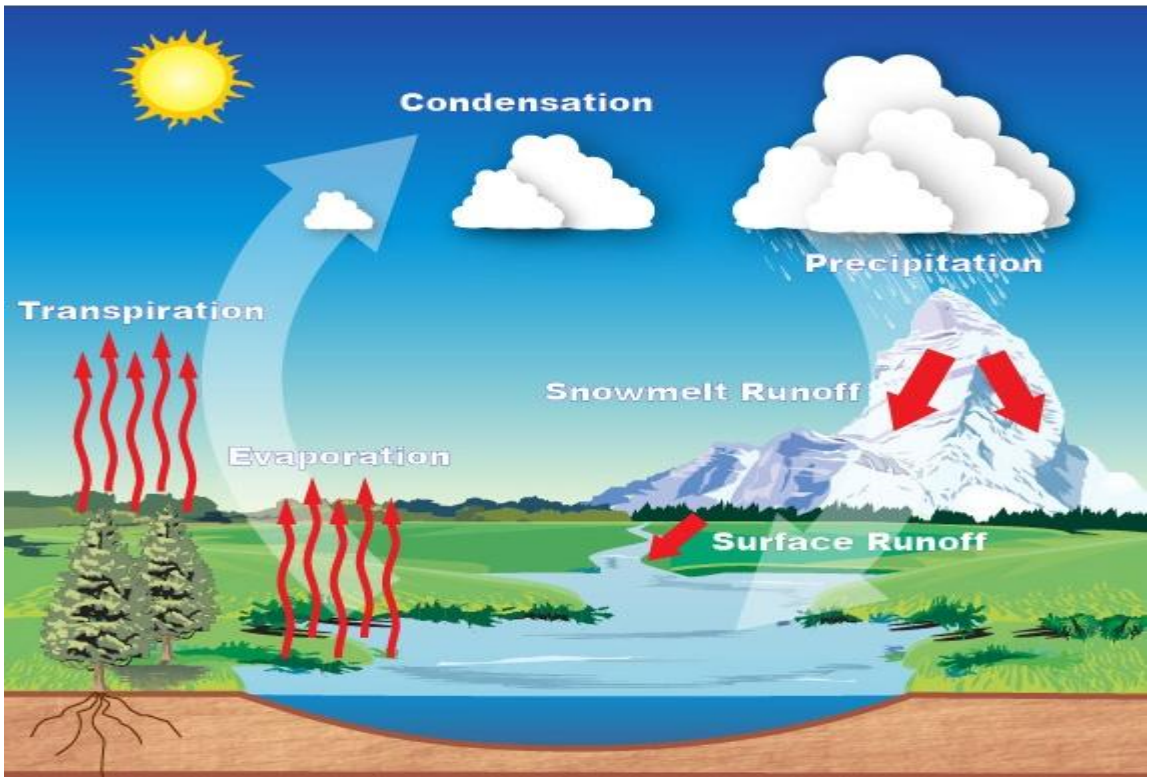
2. WATER RESOURCES

INTRODUCTION:

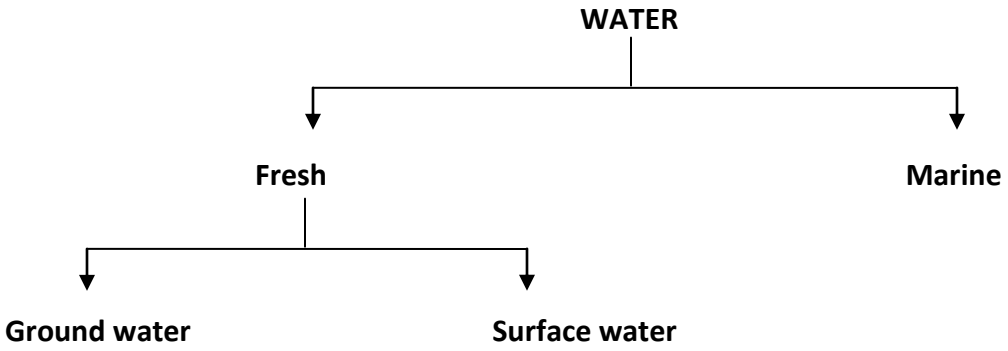
Water is the main constituent of hydrosphere and is a renewable resource. It is the second essential component of biosphere. The distribution of water resources is not uniform over the earth's surface. About 97% of it is salt water in the seas and oceans, 2.6% is trapped in polar ice caps and glaciers. Only 0.4% is available as fresh water.

2.1. HYDROLOGIC CYCLE:

The continuous circulation of water from land, water bodies etc., which joins the atmosphere and finally condenses into the form of precipitation. A part of water is lost by evapo-transpiration and certain portion percolates into the ground to form ground water reservoir and the remaining water flows on the ground as runoff and joins the streams, rivers and finally into sea. This cycle is continuously repeated.



2.2. CLASSIFICATION OF WATER



2.3. USES OF WATER:

The distribution of fresh water is geographically uneven varying greatly from country to country and even one region to another region.

1. *DOMESTIC USE:* Water used in the houses for the purposes of drinking, bathing, washing clothes, cooking, sanitary and other needs. The recommended value according to Indian standard specification for domestic use is 135 liters/day.

2. *INDUSTRIAL USE:* Water is required for various industries such as cement, mining, textile, leather industries.

3. *PUBLIC USE:* This includes water used for public utility purpose such as watering parks, flushing streets; jails etc.

4. *FIRE USE:* Water is used in case of accidents and to prevent the fire issues.

5. *IRRIGATION:* To wet the agricultural lands and to grow crops large amount of water is used to acquire food.
6. *OTHER USES:* Hydro electric power generation requires water.

- ***The reasons for shortage of water are:***

1. Increase in population,
2. Increasing demand of water for various purposes.
3. Unequal distribution of fresh water.
4. Increasing pollution of water sources cause over exploitation.

2.4. *Effects of over use of ground water*:

Excessive uses of available ground water and surface water will show the following bad effects on human population. Water will not be sufficiently available for the drinking purpose, domestic purpose and other purposes. Groundwater has the following effects.

1. ***Lowering of water table:*** Excessive use of ground water for drinking, irrigation and domestic purposes has resulted in rapid depletion of ground water in various regions leading to lowering of water table and drying of wells.
2. ***Reducing surface water flow:*** Ground water pumping alters the flow between under water and stream, lake or wetland as ground water flow recharges into the surface water body.
3. ***Water logging:*** Excessive irrigation using ground water gradually leads to water logging and salinity problem.
4. ***Degradation of water quality:*** Under natural conditions, the boundary between the fresh and salt water remains relatively stable. Due to over exploitation many inorganic minerals may contaminate water which leads to decrease in quality of water.
5. ***Increased salt content:*** Excessive extraction of ground water may increase the concentration of salts in water and convert water unsuitable for drinking purpose.
6. ***Scarcity of water:*** Insufficiency of water leads to many problems. As water is not available for drinking, domestic, agricultural purposes. people have to suffer a lot.
7. ***Ground subsidence:*** When ground water withdrawal is greater than its recharge rate, the sediments in the aquifer become compacted. This is called ground subsidence which may cause damage of buildings, destroy water supply systems etc.
8. ***Effect on fisheries:*** Fishery industry gets affected as ground water gets depleted.
9. ***Stagnation:*** Water gets polluted because of stagnation. It is not good and not suitable for agricultural practice.

2.5. *WATER CALAMITIES:*

A number of calamities are related to fluctuations in water supply of a region. These may be caused both by abundance and deficiency of water. Floods and droughts are the most common problems.

A. FLOODS:

A large area of land with water for several days in continuation is called flood. Floods have been regular features of some parts of India and Bangladesh. Floods are caused by both natural as well as human factors.

Types of floods:

1. **River floods:** These floods may be caused by precipitation over large areas or melting of snow or sometime both. They build up seasonally and slowly and continue for days or weeks.
2. **Flash floods:** These floods may be caused suddenly due to heavy rainfall, cyclones which over fills the dams, rivers.
3. **Coastal floods:** These floods are associated with cyclonic activities like hurricanes, tropical cyclones etc. The intensity of rainfall is very high which leads to the over flow of water.

A. Factors:

1. Deforestation
2. Construction activities
3. Diversion of river channels causes floods.
4. Over-grazing also causes floods.
5. Climatologically (due to rain),
6. Failure of dams (i.e., excessive release of water)
7. Flooding also takes place when the river channels are unable to contain the discharge.

B. Effects:

Floods show the following bad effects on land and people.

→ Power supply gets disrupted.
→ Land communications are cutoff.
→ Food and essential commodities cannot be transported.
→ Many villages and areas will be seized by water.
→ Loss of food grains as crops get destroyed.
→ Problem in transportation and travelling.
→ Many areas people suffer a lot.
→ The flooded area becomes unhygienic and diseases spread a lot.
→ The environment gets polluted because of floods.

C. Control steps:

Floods can be controlled by taking the following steps

→ By regulating the flow of water in river by constructing barrages
→ By releasing excessive water into irrigation canals.
→ By promoting and carrying afforest ration.
→ Maintaining grasslands prevents floods.
→ Soil conversion helps in controlling floods.
→ Trenching will help in controlling floods.
→ Growing grazing grasses for animals will help in controlling floods.
→ They may be controlled by constructing dykes at regular intervals.

B. DROUGHT:

The condition of dryness for prolonged period is called drought due to drop of average rainfall. Drought causes famine and starvation of human and animal population of region concerned.

Types of droughts:

1. ***Hydrological drought:*** Hydrological drought refers into deficiencies in surface and sub surface water supply.
2. ***Agricultural drought:*** Agricultural drought occurs when there is inadequate soil moisture to meet the needs of a particular crop at particular time.
3. ***Meteorological drought:*** Meteorological droughts occur when the actual rainfall in an area is significantly less than the climatologically mean of that area.
4. ***Socio economic drought:*** Socio economic droughts occur when physical water shortages start to affect the health, well being and quality of life of the people.

A. Causes:

→ Occurs due to failure of monsoon.
→ It is due to the absence of rains for a long time.
→ It is due to deforestation.
→ It may be due to irregular pattern of cropping.
→ It may be due to irregular movement of ground water.
→ Drought is the most serious physical hazard to agriculture.
→ It may be due to total absence of ground water.

B. Effects:

→ Shortage of water for even the basic needs is the main problem in the drought areas.
→ Shallow rooted plants don't grow.
→ The fertility of soil decreases gradually.
→ Sand dunes are formed in that area and decrease the fertility of soil.
→ The productivity of food decreases.
→ The climatic conditions change and affect living organisms,
→ The GDP decreases.

C. Control steps:

The following steps are to be followed which minimize the drought conditions.

→ Increase in forest areas which help in regulating hydrological cycle.
→ Construction of artificial canals helps in transferring water from rivers to water scarcity areas.
→ Following proper methods of cultivation which decreases usage of excess water.
→ Consumption of excess amount of ground water should be minimized.
→ Over grazing of fields should be minimized.
→ Infiltration wells.
→ Construction of dams.
→ Water sheds are being taken up in drought prone areas.
→ Cloud seeding techniques, artificial rains etc., are to be implemented.

2.6. DAMS AND PROJECTS:

1) DAMS: The construction of dams has its own benefits and drawbacks. Excess amount of water flowing in rivers which join Sea can be stored as reservoirs by constructing the dams across the rivers. The dams such as Bhakra-Nangal, Heerakud, Nagarjuna Sagar, Srisailam etc are very useful to generate electricity, to supply drinking water.
Pandit Jawahar Lal Nehru called these dams "THE TEMPLES OF MODERN INDIA".

2) PROJECTS: Multi projects are constructed across the river which not only help store water but also help in generating hydro electric power and provide jobs to youngsters. It also helped in regulating floods. It helps in providing water for domestic and industrial usage, for fishing and navigation.

Some of the important projects are

Bhakra dam – Sutlej River,
Chambal valley project – Chambal,
Hirakud Dam – Mahanadi,
Tungabhadra Dam – Tungabhadra.

A. USES:

1. More land can be brought under irrigation.
2. Hydro-Electric power can be generated.
3. Water can be supplied to towns and cities.
4. They help in making a large reservoir of fresh water, thus enhance the aesthetic and scenic beauty of that area.
5. It is regarded as a tourist spot Ex:- Mysore
6. They help in increasing green revolution.
7. They help in the development of fisheries that is blue revolution.
8. They help in increasing employment.
9. They help in increasing GDP of any country.
10. It helps in storing water and use in summer season.
11. We can construct artificial canals and transfer water to drought areas and water scarcity areas.

B. DISADVANTAGES:

There are number of disadvantages associated with dams. Not only they are expensive to construct but also cause several environmental problems in the long run.

1. ***Deforestation and loss of biodiversity:*** The deforestation is leading to loss of biodiversity that is loss of rare and medicinal plants, wild animals and aquatic animals.
2. ***Sinking of agricultural and forest land:*** The construction of dams and projects affects large area of agricultural and forest lands.

3. ***Tribal people and their home land:*** It is estimated that some 40 to 80 million people have been displaced by dams worldwide. The construction of dam affects the habitat of tribal people and they cannot lead their life happily due to lack of food and shelter.
4. ***Degradation of catchment area:*** If there is excess flow of water in rainy season it affects the catchment area as water level is more in that area and pollutants and impurities will enter the fields of catchment area.
5. ***Aquatic animals:*** The extraction of electric power has led to severe losses to fragile land, affected delicate plants, faunal population.
6. ***Change in the microclimate:*** The construction of dams leads to the changes in the climatic conditions at the project site.
7. ***Increase in water borne and soil borne diseases:*** Dams and reservoirs become breeding grounds for mosquitoes, snails, and flies, leading to the spread of diseases.
8. ***Increase in flash floods:*** Excess amount of water flow leads to flash floods and converts that into flood areas.
9. ***Increase in the frequency of Earthquakes:*** High pressure of water in dams leads to enhanced seismic activities. The water in reservoir exerts tremendous pressure on the earth's surface causing earthquakes.
10. ***Increase in water logging and salinity:*** Construction of dams leads to an increase in water table around the dam sites. It may lead to varying degree of submerged land by water leads to water logging and salinity.
11. ***Increase in aquatic weeds:*** Excess amount of water leads to increase in aquatic weed plants which decrease the quality of water.

2.7. ***Conflicts over water:*** Conflict means a situation in which people, groups, countries are involved in a serious argument. Water is an essential resource for sustaining life and environment. The available water resources are under tremendous pressure due to increased demands. Conflicts over sharing of river water between neighboring countries or different states of a country have now become quite common. The conflicts over water a continuing phenomena and lead to wars. Some examples of such conflicts in past and at present are listed below:

1. ***Sharing of Sindhu water through SYL canal:***

Sutlej – Yamuna – link canal was to connect the river Yamuna a tributary of Ganga River and Sutlej a tributary of Sindhu River. The link canal runs through Punjab and Haryana states. Recently there was a problem in sharing of water between those two states. Central government is now seized with the situation and a solution to this problem may emerge soon.

2. ***Alamatti dam:***

Two dams in the upper reaches of river Krishna are at place called Alamati and Narayanapur in the state of Karnataka. The state is storing water in them but not letting water as per Bachawat tribunal award to lower states like Andhra Pradesh. Some parts of the state are

suffering from severe drought conditions. They even went to Supreme Court to obtain a verdict.

3. ***The Cauvery water dispute:***
   The Cauvery water dispute is between the states of Tamil Nadu and Karnataka. Tamil Nadu, occupying the downstream region of the river, wants to use the upstream water whereas the upstream state Karnataka refused to do so. There was some confrontation between two states as Government acted quickly and made Karnataka government to release some amount of water so as to release the anguish of Tamilnadu riots.

4. ***The Farakka Barrage*****:** The construction of Farakka Barrage across the Ganga has become a dispute between India and Bangladesh. The Barrage is intended to divert water into river Hoogly to protect Calcutta port.

Rivers and Disputing states

1. Yamuna	⟶	Delhi, Haryana, Rajasthan, Himachal Pradesh, Uttar Pradesh.
2. Narmada	⟶	Maharashtra, Gujarat, Rajasthan, Madhya Pradesh.
3. Krishna	⟶	Andhra Pradesh, Maharashtra, Tamil Nadu, Karnataka.
4. Godavari	⟶	Andhra Pradesh, Maharashtra, Orissa, Madhya Pradesh.
5. Cauvery	⟶	Tamil Nadu, Karnataka.

3. MINERAL RESOURCES

INTRODUCTION

Minerals are naturally occurring inorganic, crystalline solids having a definite chemical composition with a certain physical properties or a substance that is naturally present in the earth and is not formed from animal or vegetable matter. In any country, the growth and development of industry depends on the availability and quality of deposits of minerals of economic importance.

3.1. CLASSIFICATION OF MINERALS

Mineral resources can be classified under three main types. They are

1. Metallic,
2. Nonmetallic,
3. Atomic minerals.

1. ***Metallic minerals:*** Metallic minerals include native elements such as gold and silver; hematite and magnetite (iron); Cuprite (copper); Laterite (aluminum).
2. ***Non metallic minerals:*** Non-metallic minerals include sand (quartz), steatite (talc); muscovite (mica).
3. ***Atomic minerals:*** Atomic minerals include Pitchblende (Uranium, Thorium).

Minerals are used in a large number of ways for domestic, industrial, commercial sectors etc… Generation of energy by using coal (lignite / anthracite); uranium, gold, silver, platinum, diamond are used in jewellery. Copper, Aluminum etc are used as cables for transmission of power.

3.2. MINING:

Extraction of valuable minerals or other geological materials from the earth is called mining. Mining is required to obtain any material that cannot be grown through agricultural processes, or created artificially in a laboratory or factory. Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas, or even water.

3.2.1. Types of mining:

1. ***Open cast mining:*** It is a surface mining technique of extracting rock or minerals from the earth by their removal from an open pit or borrows. This form of mining differs from extractive methods that require tunneling into the earth such as long wall mining. Open-pit mines are typically enlarged until either the mineral resource is exhausted, or an increasing ratio of overburden to ore makes further mining uneconomic.
2. ***Underground mining:*** Sub-surface mining consists of digging tunnels or shafts into the earth to reach buried ore deposits. Ore along with waste rock, disposal, are brought to the surface through the tunnels and shafts. The mineral or ore is extracted.

3.2.2 ***POLLUTANTS:*** While mining some pollutants are released. These pollutants are also a kind of minerals which are of two types.They are

1. Bio degradable pollutants
2. Non degradable pollutants
3. Hazardous pollutants

1. ***Bio degradable pollutants:*** This is the first variety of pollutants. These pollutants degrade themselves after a period of time. These decompose easily in natural environment. Ex: - Paper, Cotton cloth, fruit peels etc.
2. ***Non degradable pollutants:*** The second variety of pollutants is called non degradable pollutants. These materials do not decompose easily in environment. Ex: - Aluminum cans, plastics, etc.
3. ***Hazardous pollutants:*** These are the third category of pollutants. They are salts of heavy metals such as mercury, lead, cadmium, chemicals such as DDT etc.

3.3. Advantages of Mining:

The advantages of mining are as follows:

→ Mining of ores will enable people to get useful elements with significant profit.
→ Mining will give unemployed people to get at least the simplest job.
→ Mining of ores might result in finding something new and valuable material.

- → It helps in increasing industrialization.
- → It contributes to the growth in national income.

3.4. Consequences of Mining:

The mining activity is advantageous.At the same time it has disadvantages which are stated below:

- → It leads to Environmental issues such as soil erosion.
- → It leads to the formation of sinkholes.
- → It leads to loss of biodiversity.
- → It leads to contamination of soil, such as land degradation.
- → It leads to groundwater and surface water by chemicals from mining processes.
- → It affects forest resources if mining is carried in forests.
- → The contamination resulting from leakage of chemicals can also affect the health of the local population if not properly controlled.
- → It causes destruction and disturbance of ecosystems and habitats.
- → It destroys areas of farming and it may disturb or destroy productive grazing and croplands.
- → In urbanized environments mining may produce noise pollution, dust pollution and visual pollution.
- → It causes air pollution while extracting minerals.
- → It causes radioactive pollution as explosives are used during mining technique.
- → It produces large amount of solid non degradable waste materials which affects Environment.

3.5. Control steps:

The necessary remedial steps of mining activity are as follows:

- → Atmospheric pollution due to mining and associated activities can be minimized by planning and using dust extractors.
- → Adapting methods so that it optimizes the blast designs.
- → Maintenance of roads and sprinkling of water for easy movement of dumpers.
- → Using eco generators (sound proof) at mining area.
- → Proper maintenance of equipment and the machines not only minimize the air pollution but also the noise generation.
- → Minimizing usage of explosives in mining area.
- → Recreating and re - habituating the mining area with green belts will help in decreasing the environment pollution.

3.6. CASE STUDIES OF MINERAL RESOURCES

1) Aravalli hills in Rajasthan: The Aravallis hills spread across Haryana, Rajasthan and Gujarat and control the climate and drainage system of the region. Mining activity is being taken in this region due to immense mineral wealth (Talc, marble, granite). Rajasthan state alone has 9700 industrial units connected with mining and 90% of forest has been depleted

over the past 20 years. When the mining activity reached below the underground water level, a cone of depression was formed in the surrounding areas and ultimately bore wells, dug wells, dried up and affected agriculture in a massive level. Several studies have pointed out that the natural drainage system and the ground water table of the entire region has been badly affected. Pollution levels have also increased. Lung diseases, silicosis were attacked by the laborers. In November 2002, the Supreme Court imposed a blanket ban on mining activities in the Aravalli hills. The court ruling closed all 9700 units. The environmentalists have alleged that mining has affected the water, forest and the land.

2) Uranium mining in Nalgonda: The Uranium Corporation of India proposed to mine Uranium from the deposits of Lambapur and Peddagattu villages of Nalgonda dist. Processing unit was proposed at Mallapur village in Nalgonda dist by offering employment opportunities. But experts didn't propose mining activity because of possible contamination of water. The proposed mines are just 1 km away from human habitation and 10 km from Nagarjuna sagar dam and 4 km away from Akkampalli reservoir, which is a source for drinking water.

3) Udaipur: There are about 200 open cast mining and quarrying centers in Udaipur. Building stone, Phosphate rock, Dolomite are available there. These mines spread over 15,000 hectors. To extract minerals 150 tons of explosives are used per month in blasting. Thus it is causing major problems to environment as hills are suffering from soil erosion, pollution of water, air, loss of fauna, birds have disappeared from mining area.

4) Gold mining in Europe: Potassium Cyanide is used during the process of gold treatment. In 2000, the ***Baia Mare Gold mine*** in Romania (Europe), released 80 million litres of less concentrated cyanide into the Tisza River. The cyanide flowed 500 km via Hungary and Serbia cities caused for diseases.

4. FOOD RESOURCES

INTRODUCTION:

Food refers to any substance that is ingested and is utilized by the body for growth and sustenance of life. In other words natural or artificially produced materials which are used as food to derive metabolic energy are called food resources. The **green revolution** however changed traditional agricultural practices with a rapid increase in food production in developing countries. An American agricultural scientist, **Norman Borlaug** developed a high yielding variety of wheat through new concepts in plant breeding. By the mid 1960s, the green revolution was fully adopted in India.

4.1. SOURCE

The main sources of human food are plants and animals. Food is the ultimate source of metabolic energy required for growth, body repair, and body heat balance and for daily activities. There are 3 major sources of human food supply.

1. ***Agricultural crops:*** Human beings consume almost all parts of plants in the different forms of ***cereals*** (wheat, barley, millet, rye, oats, maize, corn, rice etc);

pulses (peas, red grams, green grams);
vegetables (carrot, cauliflower, beans);
fruits (banana, orange, grapes, pineapple) and
spices (pepper, cloves).

2. ***Live stock:*** A number of products such as milk, butter, eggs, meat, honey, birds etc., are obtained from animals and they are used as food material globally. They provide 17% of food to human beings.
3. ***Fisheries:*** Fisheries that supply the remaining 7%. Aquatic organisms such as crabs, prawns, shrimps etc., are eaten by some sections of the society.

4.2. AGRICULTURAL SYSTEMS:

There are two types of agricultural systems:
(1) Traditional system and
(2) Modern and Industrialized system
The traditional system is again subdivided into two types namely:
(a) ***Traditional Subsistence Agriculture (TSA):*** In this system, only enough crops or livestock are produced for the use of family and a little surplus to sell to meet the needs.
(b) ***Traditional Intensive Agriculture (TIA):*** Farmers increase their inputs of human labor, water fertilizers to get higher yields for the use of their families and to sell a small quantity for getting income.

4.3. FACTORS CAUSING FOOD PROBLEMS:

The following factors contribute to food problems across the globe.

1. ***Geographical condition:*** Many countries geographical conditions do not favor agricultural yield.
2. ***Population growth:*** Food resources are diminishing with increase in population. Production of food is increasing but it is insufficient to meet the demands of the population growth.
3. ***Lack of rainfall:*** The decrease in production of food grains and failure of crops take place due to failure of monsoons. Availability of water is decreasing because of monsoon failure and water is required to carry irrigation.
4. ***Natural hazards:*** Natural calamities such as floods, droughts, earth quakes, storms etc, damage agriculture on large scale which is affecting the food resources.
5. ***Inadequate distribution system:*** Today there is enough food produced in the world to feed all the people. Starvation and malnutrition occur because the availability food is more but it is not equally distributed. This unequal distribution may be due to lack of transportation, high cost of grains, insufficient distribution system, human greed etc.
6. ***Poor quality of soil:*** Infertile soil is not productive and hence causes a decline in food production.

4.4. OVER GRAZING:

Live stock plays a crucial role in the rural life of our country. India leads in live stock population in the world. The huge population of live stock needs to be fed and grazing land or

pasture areas are not adequate. Over grazing of a land is defined as the practice of grazing by a large number of animals.

EFFECTS:

1. ***Soil erosion:*** Due to overgrazing by cattle, the cover of vegetation almost gets removed from the land. The soil becomes exposed and gets eroded by the action of strong wind, rainfall etc. when the grass is removed the soil becomes loose and the susceptible to the action of wind and water which cause soil erosion.
2. ***Land Degradation:*** Due to over grazing the soil is excavated, soil gets compact and soil death declines. So the roots cannot go much deep into soil.
3. ***Disturbance in Ecosystem:*** Due to soil erosion Organic and Inorganic recycling declines in Ecosystem.
4. ***Loss of useful species:*** Over grazing affects the composition of plant population and their regeneration capacity. Sometimes thorny plants may grow leading to loss of species.
5. ***Drought:*** overgrazing increases on land surfaces which in turn lowers surface temperature and reduces the quantity of rainfall thereby increasing chances of droughts.

4.5. MODERN AGRICULTURE:

Modern system of agriculture uses large amounts of soil-fuel energy, excess water, chemicals, fertilizers and pesticides to produce huge quantity of crop or live stock. In the system of ***modern and industrialized agriculture***, a large extent of land will be brought under agriculture and huge quantities of fuel, energy, water, chemical fertilizers, pesticides used to produce large quantities of single crops purely for sale. This system is spreading in India in the name of Green revolution. But this modern agricultural system has its own adverse effects on Environment. The following are the effects of modern agriculture:

1. ***Soil erosion:*** Vast agriculture expansion has caused large scale damage to natural vegetation and forests. Excessive ploughing accelerates the erosion due to wind and water. Low concentration of organic matter in soil further accelerates soil erosion.
2. ***Loss of fertility:*** Use of modern, heavy machines increases soil compactness which adversely affects soil fertility and other soil quantity.
3. ***Sedimentation:*** Increased soil erosion adds huge amounts of sediments in lakes, ponds, and rivers. Excessive sedimentation degrades water quality. Decrease in the depth of the water body affects fisheries and accelerates the loss of biodiversity.
4. ***Change in land use pattern:*** Modern agriculture has led to an increase in the area under wheat and rice cultivation while there is a decrease in area under pulses. Wheat and rice are considered as soil – depletion crops. While pulses are considered as soil nourishing crops. Use of repeated cultivation of wheat and rice crops means draining the soil of nutrients.
5. ***Over grazing:*** Over grazing by the agricultural animals increases soil erosion. Due to over grazing, important plant species are replaced by spiny and non – palatable alien species.
6. ***Global warming:*** A number of agricultural activities are increasing global warming. The factors like deforestation due to agriculture expansion, burning of fossil fuels for operating agricultural machines burning of weeds etc., leads to increase in CO_2 content in atmosphere leading to increase in global warming.

7. ***Effects on Biogeochemical cycles:*** Use of fertilizers, deforestation, rapid soil erosion etc. These adversely affect the biogeochemical cycles.
8. ***Loss of genetic diversity:*** Traditional agricultural system encourages diversity of crop weeds; modern agriculture encourages monocultures of crops and hybrid varieties to maximize grain production.
9. ***Intensification of inequality:*** The poor famers cannot afford to purchase new seeds and more fertilizers and pesticides from the market. And some farmers can afford these chemicals and this is leading to inequality in the production well as inequality of food grains.
10. ***Eutrophication:*** The excessive N P K fertilizers in agriculture fields are often washed off with water and leads to ***algal blooming*** and ***Eutrophication.***

4.6. *USE OF CHEMICALS*:

a. ***Fertilizers*** are defined as materials having definite chemical composition that supply nutrients to plants. Most of the chemical fertilizers are inorganic in nature. Plants need water; sunshine, CO_2 and nutrients for their successful growth and production. The nutrients are of two types.
   (a) ***Macro Nutrients*** (N, P, K) and
   (b) ***Micro Nutrients*** (Ca, Mg, S, Fe, Zn, Ba).
   Farmers are tempted to use fertilizers in excessive quantities to get more yields by ignoring the presence of nutrients in the soil naturally. The excessive fertilizers percolate along with water into the soil and pollute the ground water.

b. ***Pesticides*** are used in order to prevent the damage caused by several types of insects, weeds and micro-organisms. . Pests are undesirable parasites or predators. The major agriculture pests are insects that feed on leaves and stems of plants. . Pesticides are of few types.

(a) ***Insecticides*** (insect killers)
(b) ***Nematocides*** (worm killers)
(c) ***Rodenticides*** (rat and mouse killers)
(d) ***Weedicides*** (remove unwanted plants)
(e) ***Fungicides*** (Pathogen killers)
(f) ***Molluscicides*** (to kill snails, Molluscs).

PROBLEMS:

1. The pest species may develop resistance to those chemicals.
2. The useful micro organisms may die.
3. The chemicals last long in the soil as their half-life is of long period.
4. The water may contaminate which is a threat to aquatic life.
5. N P K levels may be distributed (Micro nutrients may imbalance) and lead to decrease in food grain production.

4.7. *WATER LOGGING:*

Agricultural field requires water for raising crop. Supply of required quantity of water is generally called irrigation. If the agriculture fails to drain the excess water from the field it leads

to stagnation. The stagnation of water in the soil in the upper layers causes ***water logging*** which causes for less oxygen availability for respiration of plants.

EFFECTS:

- → Soil gets excessively wet or soaked.
- → Pores in the soil get filled and air does not reach to the roots of the plants.
- → Salts in the soil will mix with water which is a major disadvantage.
- → All the waste products in the soil will mix up with water and will contaminate the water. The contamination is spread throughout the field.
- → Waste materials do not allow crop to grow.
- → Some weed plants enter into the crop and they will grow rapidly in the area.
- → Bio fertilizers like blue green algae will grow.
- → Crop plants may die due to non supply of soil air.
- → It leads to overgrowth of Weeds.
- → It may lead to Eutrophication.

4.8. SALINITY:

Crops present near the sea shore generally have salinity. Generally amount of salt water coming into the fields is high. The salts deposits in the field as a layer on the surface of soil. This is called saline soils. Saline soils are not good for agriculture.

EFFECTS:

- → Soil gets degraded and it results in decreasing the fertility of soil.
- → It affects the productivity of food resources.
- → It affects the GDP of that area.
- → It affects climatic conditions of that area.
- → In long run it may lead to drought conditions.

♠ ***CASE STUDIES RELATED TO SALINITY AND WATER LOGGING***

(1*) Salinity in Haryana and Punjab*: Thousands of hectares of land area in Haryana and Punjab are affected by soil salinity and alkalinity.

(2) Water logging in Punjab, Haryana, and Rajasthan: About 1.2 million hectares of land in Haryana resulted in rise in water table followed by water logging and salinity due to canal irrigation.

(3) Haryana: The soil water containing salts seep into the pipes slowly and is drained out of the fields. The Central Soil Salinity Research Institute (CSSRI) in Karnal dist of Haryana converted the barren lands into productive lands.

(4) Punjab: Green Revolution has increased in Punjab. Use of chemicals also increased in that area. This has affected micro nutrients like Zinc, Iron, Copper, Manganese, Molybdenum and boron. This has affected the quality of food grains.

(5) Excess Nitrate: Excessive use of chemical fertilizers to boost up the crop yield. Contaminate groundwater with nitrate. The presence of excess of nitrate in drinking water is dangerous for

human health. Excess Nitrate reacts with hemoglobin and causes for "**Blue *Baby Syndrome***" which kill the infants.

5. ENERGY RESOURCES

INTRODUCTION:

The term energy means capacity to do work. Energy can neither be created nor destroyed but transformed from one form to other. Energy is closely related to force. When a force causes an object to move, energy is being transferred from the force to kinetic energy. Energy is present in a number of forms such as mechanical, thermal, chemical, biological energy etc. Energy production and utilization have become essential to carry out many activities in modern life. Energy is one of the important requirements that a country needs for its economic growth. At the same time, energy production has its impact on environment due to pollution and finally affects the quality of life of people.

The energy is used for the following purposes:

a) Cooking, heating and lighting
b) Transporting people and goods by means of vehicles.
c) Manufacturing consumer goods and equipment
d) Conversion of fuels into other forms of energy for various use.. For eg:
(1) Burning coal to produce electrical energy or mechanical energy
(2) Chemical to electrical by dry cell batteries
(3) Using water in dams to produce electricity through mechanical energy.

5.1. TYPES OF ENERGY SOURCES:

There are two types of energy sources namely:
(1) Renewable energy sources and
(2) Non – renewable energy sources.

5.1.1. ***Renewable energy resources:*** The energy extracted from renewable resources which are unexhausted and the resources have the capacity to reappear themselves by quick recycling with a reasonable span of time. Eg: Solar energy, wind energy etc.
Some of the renewable energy sources are as follows:-

a. ***Solar energy:*** The energy which is derived from the sun is known as solar energy. It can be used for direct heating or sun's heat is converted into electricity. Photo voltaic cells convert direct solar energy into electricity. A number of solar equipments have been developed to utilize sun rays to heat water, to cook food, to pump water and to run certain machines and used for street lighting, railway signals etc. But the major problem with solar energy is that during cloudy weather it is available in fewer quantities than on sunny days.

b. ***Hydro-Power energy:*** Electrical power is generated by hydro-electric projects in which dams are constructed across the river. The kinetic energy of water is converted into mechanical energy by means of turbines and in turn, the mechanical energy is transferred into electrical energy by generators. Hydro power projects lead to several environmental problems like destruction of animal habitats, deforestation, migration of people etc.

c. ***Geothermal energy:*** Geothermal energy found within rock formations. Inside the earth the temperature rises with depth .The temperature in earth's crust is around 4000^{o} C. Geysers (a natural spring that emits hot water) and hot springs are examples for geothermal energy where the steam and hot water come to the surface, in areas where the steam is tapped by drilling. The obtained steam is then used to generate power. Air pollution results in case of geothermal energy where the gases like H_2S, NH_3, and CO2 present in the steam coming out of the geothermal sources.

d. ***Wind energy:*** Wind energy is the kinetic energy associated with the movement of atmospheric air. Wind mills convert the wind energy into electrical energy. On an average wind mills can convert 30 – 40 % of available wind energy into electrical energy at a steady wind speed.

e. ***Ocean Thermal Energy Conversion:*** The oceans collect and store huge quantities of solar on the surface of the water while the temperature of deep waters is very low. Using this temperature difference it is possible to convert heat into electricity.

f. ***Tidal energy:*** Tidal waves of the sea can be used to turn turbine and generate electricity. Asia's first tidal power plant of 800 - 1000 MW capacity is proposed to be set up at Kandla in Gulf of Kutch.

g. ***Wave energy:*** The wind blowing over water generates waves. A unique property of ocean waves is their ability to travel vast oceanic distances with negligible loss of energy and ultimately arrives the continental margin of that basin. India's first wave energy power plant of 150 KW capacity has been commissioned in Thiruvananthapuram, Tamil Nadu. 1 MW wave energy plant is being set up in Andaman and Nicobar islands.

h. ***Bio mass energy:*** Bio-mass is an organic material from living beings or its residues. It is a renewable source of energy derived from the waste of various human and natural activities. The bio-mass energy sources include Wood, animal manure, sugarcane waste, agriculture crops, house hold waste, roots of plants, garbage etc. The simplest way of using bio-mass energy sources is to allow them to dry out in the sun and burn them.

i. ***Bio-gas:*** Bio-gas is a sustainable source of energy by virtue of its production from available natural organic wastes of cattle dung, human excreta, poultry waste, plant leaves, paddy husk etc…. Bio-gas is a mixture of methane (68%), CO2 (31%) and N2 (1%). Methane gas (CH4) is produced by bio-gas plants and this gas is utilized as cooking gas. Bio-gas is commonly produced from cattle dung in a bio gas plant known as Gobar Gas plant. Bio-gas is a clean, cheap fuel

5.1.2. ***Non-renewable resources:*** Resources that exist in a fixed quantity in earth's crust are called non–renewable resources. These resources lack the ability of recycling and replacement. The energy extracted from such resource is called Non renewable energy resources. Eg: minerals, fossil fuels etc.

Some of the non renewable energy sources are as follows:-

a. ***Fossil fuels:*** Fossil means the remains of an animal or a plant which have become hard and turned into rock. All these found in earth's crust which has been formed in the past by the geological processes. Fossil fuels are solid coal (lignite), liquid (crude oil / petroleum) and gases (natural gas).

→ ***Coal :*** Huge quantity of plant materials buried under earth's crust and altered by geological process and converted into carbon rich fuel. It is a non – renewable source because it takes a very long period (millions of years) for its formation.

→ ***Crude oil:*** It is obtained in the form of liquid. The crude oil is heated up to 600^{o} C in the oil refinery and condenses the vapors of hydro – carbons. Petrol and other petroleum products are refined fuels from crude oil. Petroleum products are used in large quantities in the manufacture of detergents, plastics, fertilizers, pharmaceuticals, synthetic rubber, transport sector, agricultural sector etc.

→ ***Natural Gas:*** Gas deposits are trapped from the sedimentary formations by means drilling holes into the rock formations. While burning of natural gas, the emission of CO2 is less and thus reduces green house effect and global warming.

b. ***Nuclear Energy or Atomic power:*** It is the energy which is trapped inside the atom. It is non–renewable source of energy. Nuclear Energy is produced by two processes namely (1) Nuclear Fission and (2) Nuclear Fusion.

→ ***Nuclear Fission:*** The nucleus in atoms is split by fast moving neutrons and in turn a tremendous amount of energy in the form of heat, light etc is released by a chain of reactions. Uranium is used as fuel. The energy released slowly in this process is utilized to generate electricity or else released suddenly all at once, results a tremendous explosion as in the case of Atom bomb.

→ ***Nuclear Fusion:*** Nuclear energy can be generated by fusion process which involves two hydrogen atoms combine to produce one helium atom. Eg: hydrogen bomb. The disposal of nuclear wastes during mining, fuel production and reactor operation for a long time period resulting in adverse effects on environment. Disposable of nuclear waste is a national and global problem.

5.2. Energy conservation in our country:

Energy conservation or management helps in reducing energy usage and also reduces environment pollution. The energy management steps are as follows:

→ Use efficient lighting equipment.
→ Use energy efficient electric appliances.
→ Depending more on renewable energy sources.

→ Plant more trees.
→ Turn off electronic devices when not in use.
→ Use mass transportation.
→ Bring awareness in people regarding consumption of energy.
→ Using cycle or preferring walk to nearby distance.

5.3. CASE STUDIES:

1. ***Oil – related disaster:*** During gulf war, oil installations burned for 2 weeks polluting the air with poisonous gases. It has produced over a million tons of air borne pollutants including SO_2 a major cause of acid rain. The oil spills also polluted air, water and polluted coastlines, killing plants and fish.
2. ***Hydel power in Western Ghats:*** The hydro power dam was built by Tatas in Western Ghats of Maharastra. It is the source of energy to run cotton textile mills in Bombay as he found people were getting respiratory problems due to coal – driven mills. Therefore he asked British government to permit him to develop dams in Western Ghats to generate electricity. The important feature of Tata Power projects is that they use the high rainfall areas for generation of hydel power.
3. ***Narmada project:*** The Narmada Bachao Andolan in India is a movement against large dams. The gigantic Narmada river project has affected the livelihood of hundreds of extremely forest dwellers. This Sardar Sarovar dam will derive maximum economic benefit where as the poor tribal people have left their farms and traditional way of life. The dam will destroy the livelihood of fishermen at the estuary.

6. LAND RESOURCES

INTRODUCTION:

Land is the major part of the lithosphere. Land is made up of soils, rocks and is considered very important resources of earth. Land plays a major role for growth of crops, vegetation, forests etc., Soils are formed due to disintegration of rocks by various physical processes like change in temperature, pressure, blowing wind and flow of water. The top layer of soil consists of mixtures of Humus (dead leaves and plants), some of the living organisms and Inorganic components which supply nutrients to the soil. Soil fertility depends on inorganic matter, organic matter, water, air and a variety of micro-organisms viz., bacteria, fungi, which help in the decomposition of organic matter and regeneration of nutrients.

6.1. Types of Indian Soils

Different types of soils are identified by taking into account the geographical extent, physical and chemical properties for the purpose of agriculture, nutritional factors.

(a) ***Alluvial soils*** ⟶ North Indian Plains; Indo–Gangetic Plain; Ganga and Brahmaputra Plains (Alkaline)

(b) ***Black soils*** ⟶ Andhra Pradesh (Krishna and Tungabhadra basins), Maharashtra (Deccan Traps) and Madhya Pradesh (Clay and sandy loams).

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(c) ***Red soils*** — Andhra Pradesh, Tamil Nadu and parts of Bihar, Orissa and Western Ghats of Karnataka (Iron component).

(d) ***Laterite soils*** ⟶ Western Ghats, Northern part of Eastern Ghats, North of Bangalore and West of Hyderabad (Hydroxides of Ferrous and aluminum).

(e) ***Mountain soils*** ⟶ Aravallis and East of Himalayas (stony).

(f) ***Desert soils*** ⟶ Areas of Rajasthan and Kutch (annual rainfall is less than 50 cms per annum).

(g) ***Saline soils*** ⟶ Arid (no rain) and Semi arid (partly rain) regions of northern plains and Maharashtra (salt and water retention).

6.2. LAND DEGRADATION:

Land degradation can be defined as any change in the land that alters its conditions or reduces its quality. Land degradation occurs due to both natural disasters and human induced activities

A. CAUSES:

1. ***Natural disasters:*** Natural disasters such as volcanic eruptions, earthquakes, heavy rains, fire etc are leading to land degradation.
2. ***Heavy rains:*** Heavy rains lead to removal of top soil which makes the soil infertile and hence unsuitable for agriculture methods.
3. ***High speed winds:*** Winds of high intensity and storms are also responsible for land degradation. This accelerates soil erosion and causes land degradation.
4. ***Expansion of deserts:*** Activities such as salinity of water, water logging, soil acidity, and other natural phenomenon are leading to an expansion of deserts. The fertile lands are becoming infertile lands.
5. ***Mining:*** Mining generates a lot of waste that destroys vegetation. Disrupt water circulation over large tracks leads to land degradation.
6. **Urbanisation:** ***The growing urbanization all over the world is a major cause of concern*** as it is causing land degradation.
7. ***Deforestation:*** The indiscriminate cutting of trees leads to deforestation which leads to degradation of land.
8. ***Construction of dams and canals:*** Construction of dams and canals lead to degradation of lands as various pollutants will settle on the surrounding area and lead to land degradation.
9. ***Industrial Wastes:*** Dumping of industrial waste will affect the quantity and quality of land in physical, chemical and biological properties.

B. EFFECTS:

→ It leads to infertility of soil.
→ In long run leads to drought and soil erosion.
→ It affects growth of crop.
→ Decrease in productivity of crops.

→ It decreases food grains and imbalance economy.
→ It leads to soil pollution.

C. CONSERVATION METHODS

The methods that are followed for the prevention of land degradation are called soil conservation methods. Some of the popular methods are;

(a) Contour farming: The land is prepared with alternate furrows (a long narrow cut in the ground) and ridges at the same level. The water is caught and held in furrows and stores which reduces run off and erosion.

(b) Mulching: Stems of maize, cotton, tobacco etc are used as a mulch (decay of leaves) to reduce soil moisture, evaporation.

(c) Crop rotation: Growing same crop year after year depletes the nutrients and land becomes unproductive. This is overcome by changing the crops and cultivating legumes (plants like peas, beans) after a regular crop.

(d) Strip cropping: It consists of planting crops in rows or strips along contours to check flow of water.

(e) Agrostological methods: Korean grass, Mexican grasses are grown as erosion – resisting plants.

(f) Miscellaneous methods: Construction of bunds, drains, widening of gullies, Afforestation methods prevent the soil erosion.

6.3. SOIL EROSION:

The contamination of top layer of the earth is called as soil erosion. It can also be defined as 'The detachment and transportation of the fertile layer of soil by water or air'

A. CAUSES:

1. ***Deforestation:*** Mining, industrial, urban developments etc cause deforestation and leads to exposure of the land to wind and rains causing soil erosion. Cutting trees leads to deforestation which in turn leads to the loss of organic matter in the soils.
2. ***Overgrazing:*** When sufficient amount of grass is available for the organisms usually the entire land /area may be subjected to exhaust and the land is exposed without grass and ultimately the land is exposed to wind/rain causing soil erosion.
3. ***Industrialization:*** Different processes carried out by industries and mining operations cause soil pollution which leads to degradation of land.
4. ***Floods:*** Floods accelerate soil erosion due to rapid flow of water along slopes of hills, forests and fertile soil. The top soil layer gets washed away due to flow of water resulting in soil erosion.
5. ***Improper Agricultural techniques:*** Improper agriculture techniques such as excess ploughing and use of excess fertilizers lead to soil erosion.
6. ***Dry violent winds:*** Soil particles are taken away along the wind leading to soil erosion.

B. EFFECTS:

→ Decrease in productivity of land.
→ Conversion of fertile land to deserted land.

→ Decrease in the GDP which leads to imbalance in food.
→ Contamination of water.
→ Decrease in Economy of the country.

C. CONTROL STEPS:

→ Conservation of wetlands.
→ Avoiding over grazing.
→ Learning unploughing grass strips in fertile land.
→ Increasing biological diversity by planting several different of plants together.
→ Use of wind blocks.
→ Construction of check dams.

6.4. DESERTIFICATION:

The process of conversion of productive lands to unproductive lands is called desertification. This occurs due to loss of top layer of soil by erosion. Erosion of top layer results in loss of water holding capacity and finally converted in to unproductive areas.

A. CAUSES:

1. ***Low rainfall:*** Prolonged drought conditions and failure of rainfall triggering the creation of desert at any particular place.
2. ***Excessive evaporation:*** excessive evaporation leads to water loss in such conditions amount of rainfall received is also les which leads to desertification.
3. ***Salinity of soils:*** If the soil type of any region is saline in nature then it leads to desertification.
4. ***Deforestation:*** Deforestation leads to soil erosion, loss of fertility and loss of water which is accelerating the process of desertification.
5. ***Over grazing:*** Heavy grazing by increasing cattle population in grassland, resulting the land becoming barren and leads to soil erosion which again accelerates desertification.
6. ***Excess ploughing*****:** Excess ploughing and use of excess fertilizers lead to soil erosion which again accelerates desertification.

B. EFFECTS:

→ Increase of soil erosion.
→ Desertification shifts the climatic patterns by increasing the temperature of soil in that area.
→ Decrease in productivity of crops.
→ It also makes life of humans miserable as there is imbalance in economy of food grains.
→ It also causes water loss of that area leading to disturb vegetation of that area.

C. CONTROL STEPS:

→ Promoting large scale plantation of trees.
→ Changing agriculture practices and promoting dry land farming.
→ Control of overgrazing.
→ Improving water management in those areas.

→ Soil binding grass species should be planted along with marginal lands.
→ Development of water catchment areas.

6.5. LANDSLIDES AND MAN INDUCED LANDSLIDES

Landslides always exist on this planet and the term land slide is used to describe a wide variety of process that result a downward movement of rocks under gravitational forces. In other words, mass movement of rocks, debris and soil down a slope of land. Landslides are primarily associated with steep slopes. Surface run-off and changes in drainage also cause for landslides.

A. CAUSES:

Landslides can also be initiated by

→ Rainfall.
→ Earthquakes.
→ Volcanic activity.
→ Changes in groundwater movement or any combination these factors.
→ Urbanization.
→ Excavation – collapses in mining (eg: coal mine).

B. *EFFECTS*:

→ Landslides cause property damage.
→ It causes injury and death.
→ Adversely affect a variety of resources. For example, water supplies, fisheries etc.
→ They discharge large amount of sewage disposal systems,
→ Forests, dams, and roadways are affected.
→ It shows negative impact on economic.
→ Loss of property value.
→ Disruption of transportation routes.
→ Water availability, quantity and quality will be affected.
→ Loss of biodiversity.
→ Effects tribal people.

C. CONTROL STEPS:

→ Increase in afforestation.
→ Migrating tribal people to safer places.
→ Surveying the mountains and hilly regions after completion of mining activity.
→ Proper care should be taken while carrying urbanization near hills and mountains.
→ Educating people regarding the safe guard steps of landslides.

7.ROLE OF CONSERGVATION OF NATURAL RESOURCE:

There are many factors which lead to decrease and depletion of natural resources. The objective of conservation of natural resources is to attain some success towards the decrease of consumption of natural resources which helps to long run of the resources. Individuals can conserve resources but following few methods or adapting the following methods:

1. ***Conservation of forest resources:-***
   - → They should not cultivate the forest land.
   - → They can collect the products from trees of forest without causing harm to trees.
   - → The timbering activity must be followed by massive plantation.
   - → The unnecessary and illegal deforestation should be avoided.
2. ***Conservation water resources:-***
   - → They should stop using excessive water.
   - → They should build check dams.
   - → They should adopt sprinkling drip irrigation which avoids excess usage of water.
   - → They should use ground water properly.
3. ***Conservation of mineral resources:-***
   - → They should avoid mining and quarrying in dense forest areas.
   - → They should extract minerals based on demand and utilize it in proper planned way.
   - → They should exploit every natural resource in the country and use it properly.
   - → They have to use proper and eco-friendly mining methods.
4. ***Conservation of food resources:-***
   - → They should avoid wasting of food unnecessary.
   - → Food grains should not be used unnecessarily.
   - → Production form all sources should be increased.
5. ***Conservation of energy resources:-***
   - → Use of solar energy helps in decreasing the consumption of non renewable energy resources.
   - → Ride a bicycle whenever possible.
   - → Electronic and kitchen appliances should be unplugged when not in use.
   - → Increasing use of renewable energy sources.
6. ***Conservation of land resources:-***
   - → They should not dump waste material directly in land.
   - → They should use minimum chemical for irrigation purpose.
   - → They can convert waste land to cultivation land or forest areas.
   - → They have to adapt good modern agricultural methods.
   - → They should adapt recycle and reuse methods.

8.EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLE:

The equitable use of resources means minimizing inequality with in nation and among nations. The resources should be equally distributed among the people in the country. It helps in receive minimum requirements for people to lead a good life style. In order t ensure equitable use of resources, the following points should be kept in mind.

- → Encourage recycling of resources and reuse of paper.
- → Alternative use of energy resources such as solar energy for domestic heating.
- → Ensure better use and maintenance of non renewable resources.
- → Equitable distribution of water resource thought out India.

→ Equitable use of food resources and equitable distribution of food resource must be done.

→ Every natural resource has to be protected and utilized by people in nation.

By following above steps we can distribute the resources equally. We should be glad that we had an economic growth of 6 to 8%. We should have future goals of economy for sustainable development of country and individual.

Future goals of economy:

→ We should increase our foreign exchange resource.

→ We should not spend over money on unnecessary items.

→ We should sped money on items that are benefit to people especially poor people.

→ Government should spend money on plans which are benefited to poor people.

→ Water wars between states should be solved between those two states such as SYL canal, Krishna River, Cauveri River.

→ Government of India is planning a project of interlinking of all major rivers, which helps in equal distribution of water resources which help in increasing economy of India.

→ Care should be taken in consumption of non renewable resources.

These future goals help in sustainable development of all human beings. These help in proper growth of economy and proper use of economy which helps for sustainable development of people.

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UNIT III – BIODIVERSITY AND ITS CONSERVATION

Contents: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-sports of biodiversity - Threats to biodiversity: habitat loss, man-wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: conservation of biodiversity.

INTRODUCTION:

In forests we notice a large variety of plant life, ranging from grasses to huge trees, a wide variety of animal life from, from tiny insects to large mammals and numbers of micro-organisms in the soil are present which are not visible to naked. The forests are the best example for Bio-diversity. The term Bio-diversity is made of two words Bio means living and diversity means variety. The variety or variability of organisms and eco-system is referred to as bio-diversity.

1. IMPORTANCE OF BIO-DIVERSITY:

Bio-diversity is an excellent phenomenon of ecological system. It helps to humans in many ways:

1. This helps in the availability of food in various types i.e. it helps in increasing optional food resources.
2. The genetic variability will enable different plant and animal species.
3. It helps to increase agricultural techniques.
4. Helps in the production of ideal species.
5. Helps to increase the population of endangered species.
6. Modern science like bio-technology and genetic engineering give a wide scope.
7. The availability of good medicines is increased.
8. Production of Trans – gene plants are found useful.
9. To prolong the life of fruits and vegetables and food goods.
10. We can also produce medicinal fruits which can be used instead of capsules.
11. New species and ideal species can be created in future.
12. Biodiversity is important for the proper functioning of many organisms and ecosystems.
13. Biodiversity plays an important role in the formation and enriching of soil.
14. Biodiversity influences the water cycle and biogeochemical cycles in the ecosystem.
15. Human populations depend on the varieties of plants and animals for their food, clothing, shelter etc. That means biodiversity influences human life.
16. Biodiversity is a biological wealth of a country or region.

2. CLASSIFICATION OF BIODIVERSITY

Bio-diversity of a region can be divided into 3 categories: Genes, species and eco-system. These are categorized by different aspects of living organisms:

1. ***Genetic Diversity***: Genes are the basic units of hereditary information, character or quality that has been passed on from one generation to the other. They (i.e., genes) contain and control the quality a living organism needs to develop, grow and maintain itself through life. Genes are the basic source of biodiversity. Each species, from bacteria to higher plants and animals, trees and immense amount of genetic information. Variation among the same species may be formed as genetic diversity. This is the type of diversity that gives rise to different varieties of crops, fruits, etc.

2. ***Species Diversity***: A species can be defined as a group or population of similar organisms that reproduce by interbreeding within the group. For example, human beings belong to a single species, as they can successfully inter-breed with each other and produce off springs. Similarly, all dogs belong to a single species, since they can interbreed and produce off springs. Species are distinct units of diversity each playing a specific role in an eco-system. The diversity which arises due to variations among species present in specific areas is called species diversity. Eg: Horses and donkeys are distinct species.

3. ***Eco-system Diversity***: Eco-system is a self sustained community of living organisms which interact with non-living components. Therefore, eco-system diversity refers as habitat of diversity including the different life forms within them. The term also refers to the variety of eco-systems found in bio-geographical boundary.

3. BIO – GEOGRAPHICAL CLASSIFICATION OF INDIA:

India has high biodiversity. It has high proportion of endemic species of vegetation and wildlife. India is divided into a number of Bio – geographical religions. Those Bio – geographical regions are:

1. ***Trans-Himalayan Zone***: This is the birth most area of country. This is filled with ice and these mountains are rich in fauna and herbal plants. The goat and sheep found in this area are of great quality in the whole world, snow leopard and migrating birds like black necked crane are famous in this region.

2. ***Himalayan Zone:*** The hilly region with good flora and fauna and national parks are famous here as the maximum bio-diversity is available here. This is also one of the best places for tourism. These regions have pine forest and alpine shrubs.
3. ***Desert Zone:*** This is a part of Rajasthan area from where the great desert of India starts. Thai desert. This contains sand dunes which are the best centers for the study of soil erosion and famous for desert plants.
4. ***Semiarid Zone:*** it starts in Rajasthan and extends upon the state Punjab. In this area ground water and surface water are very less, fauna. Very few bamboo bushes, ferns and other plants are seen.
5. ***Eastern Ghats:*** The Eastern Ghats have tropical dry deciduous thorny forests. A small northern area, bordering Orissa, Possesses moist deciduous forests. These regions are also is important for wildlife.
6. ***Western Ghats:*** It represents the mountainous Western Zone of South India which is rich in flora and fauna with tropical rain forest extended from Maharashtra to Kerala. Kerala is also known as Malabar Coast of the Sea. Our banana, mango, citrus, black pepper is found abundantly here.
7. ***Deccan plateau:*** Deccan plateau represents in the states of Madhya Pradesh, Maharashtra, Andhra Pradesh, Orissa, Tamilnadu, Karnataka and Kerala. It is rich in flora and fauna and availability of medicinal plants like Ranwolffia, serpentine, Cinchona that gives quinine which cures malaria, vinca rosea (catharanthas) which gives vincristine and viniblastin that is used for the treatment of cardiovascular ailments, pilocarpus – eye ailments, black mulberry and moreton bay chestnut – act against AIDS Virus, Ephedra – respiratory troubles.
8. ***Indo-Gangetic plain:*** This is a very fertile land Zone of the centre of North India through which mighty rivers like Indus and Ganges along with their tributaries flow well enriching that land Zone. These regions consists of tropical moist deciduous forests and tropical dry deciduous forests. Littoral and mangrove forests are also found.
9. ***North East India Zone:*** This zone is of 7 small sisters which are mountain states like Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Tripura and Manipur. All these having rich culture and resources. The vegetation of these regions consists of tropical west evergreen forests, tropical semi – ever green forests, sub tropical broad – leaved hill forests. These regions have one of the finest bamboo forests in our country. These regions represent high diversity of orchids, bamboo, tree ferns, etc.
10. ***Coastal Zone:*** This part of South India is having rich continuous Western Ghats and not so rich Eastern Ghats which are discontinuous and not very rich in flora and fauna like Western Ghats because of shortage of rainfall.
11. ***Islands around the mainland:*** Andaman and Nicobar islands are a chunk of South India and having undisturbed dense forest of different types in the Bay of Bengal.

Lakshadweep Island is in the Arabian Sea. They have Indian and African affects resembling that of Madagascar of African Zone and Kerala state of India. These islands have many species of mammals and marine animals.

4. VALUE OF BIO-DIVERSITY:

The earth has a variety of plants and animals both domestic and wild life. Human beings depend upon these animals and plants for their survival, food, medicine, clothing and other forms of needs are bio-diversity is important to human beings for the following reasons:

1. ***Survival:*** Human beings would perish in the absence of biological diversity. Bio-diversity meets the basic survival needs of a vast number of people. In the forest belt of Ghana, most men are hunters whose survival depend on the availability of animals such as antelopes, rabbits snails etc.

2. ***Medicinal value:*** A large number of communities depend on traditional medicines for 1 health care, most of which are derived from plants and animals. Moreover, a large percentage of the world's population is now utilizing medicines derived from plats. It is suggested that India should include medicinal plants by the tribes and indigenous communities under the Indian Medicine Control Council Act 1970.

3. ***Food Value:*** Bio-diversity is critical for agriculture. All our food requirements are met by the biological world. Cereals, pulses like ginger, mint, and turmeric are used as spices all over the world. Along with this tea, coffee is used to prepare non-alcoholic beverages, while grapes are used to prepare alcoholic beverages.

4. ***Productive Value:*** Bio-diversity also has a productive value. There are many products which are used by humans. For example cinchona plant is used to make medicines, wood is used as fuel, production of charcoal through plants and trees and a number of dyes and dye based products are also obtained from plants. A number of wild gene resources can be traded for use by scientists for introducing traits in the crops and domesticated animals. Animal products like tusks of elephants, musk from musk deer, silk from silkworms, wool from sheep, fur from fur-bearing animals, lac from lac insects, etc. can be traded in the market many industries are dependent upon the productive use value biodiversity, e.g. paper industry, plywood industry, textile industry, leather industry, etc.

5. ***Ethical Value:*** Each species is unique and has the right to exist, while humans do not have right to eliminate any species. It is based on the concept 'live and let live'. Ethical use has deep roots within human culture, region and society. In order to obtain a sustainable world,

it is important to develop and incorporate the concept of ethical use into our culture. we have a moral obligation to preserve other organisms because extinction of other living organisms will threaten the very existence of man. For instance, we are not deriving much benefit from kangaroo, zebra or giraffe, but all of us feel that these species should exist in nature. This means, there is an ethical value or existence value each species.

6. ***Aesthetic value:*** Bio-diversity adds aesthetic value to the planet. Each species, eco-system adds richness of beauty of life on Earth. Perhaps no medium can match the sheer joy of watching a sunset over an ocean, leaping deer, the sounds of birds, the smell of wet earth after the first shower of rain, bird-watching, gardening etc. In order to maintain aesthetic value we are protecting biodiversity.

7. ***Ecological value:*** Species evolve to fill particular niches n an eco-system or habitat. It is impossible for a species to exist independently of others. Many species depend on each other in intricate ways for survival. Destroying one species can lead to further extinctions or changes. For example, single tree provides innumerable products and food but also helps in increasing fertility of soil, decreasing Global warming etc.

8. ***Consumptive value:*** Consumption is a property shown by different types of consumers in various eco-systems present in any area. All consumers are heterotrophic in nutrition. These may be herbivores, carnivores, decomposers, who consume different and variety of species for their survival. Biodiversity provides a number if products having consumptive use value, such as food, drugs, fuel, fiber, etc. Let us have a brief discussion of some of the products having consumptive use value.
   I. ***Food:*** A large number of wild plants provided by biodiversity are consumed by human beings as food. About 80,000 edible plant species have been reported from the wild forests. About 90% of present day food crops have been domesticated from wild tropical plants.
   II. ***Drugs and Medicine:*** Biodiversity provides plants for drugs and medicines. About 75% of the world's population depends upon plants and plant extracts for medicines. For instance, the wonder drug Penicillin, used as on anti biotic, is derived from a fungus called Penicillium. Similarly, we get tetracycline from a bark of cinchona tree. Digitalin, an effective cure for heart ailments, is obtained from foxglove. Recently, vinblastin and vincristine are two anti-cancer alkaloids. A large number of marine animals possess anti-cancer properties which are yet to be explored systematically.
   III. ***Fuel:*** Biodiversity provides fuel. Forests have been used since ages for fuel wood. The fossil fuels like coal, petroleum and natural gas are also products of fossilized biodiversity.

9. ***Social Value*:** Social value is the value associated with the social life, customs, religion and psycho-spiritual aspects of the people. Many of the plants are considered holy and sacred in our country, e.g., Tulsi (holy basil), Neem, mango, lotus etc. The leaves, flowers and fruits of these plants are used in worship. Social life, Songs, dances and customs are closely woven around the wildlife. Many animals like cow, snake, bull, peacock, owl, etc. have significance in our psycho-spiritual arena and thus hold special importance.

10. ***Option values:*** Option values include the potentialities of biodiversity that are presently unknown, but that can be explored. For instance, there is a possibility that we may have some potential cure of AIDS or Cancer existing within the depths of marine ecosystem or tropical rain forests. Thus, option value is the value of knowing that there are biological resources existing in the biosphere that may one day prove to be an effective option for something important in the future. Thus, the option value of biodiversity suggests that any species may prove to be a useful species some day. The biodiversity is the precious gift that nature presented to us. The option value also includes the values in terms of the options to visit areas where a variety of flora and fauna or specifically some endemic, rare or endangered species exist.

11. ***Legal Value:*** The earth is not only the home of mankind, but is also the home of all other lives. So, all other organisms also have a right to live. We have to guarantee to them the right to exist. So, there arises the need for attaching legal value to biodiversity. Unless we attach legal value to biodiversity, it will not be possible to check the rapid extinction of many valuable species.

12. ***Economic Value:*** Bio diversity has economic value. That is, the economic welfare of the people and their nations depends on biotic resources, Everyday, we use thousands of products whose source is biodiversity, i.e., diversity of plants and animals. It may be noted that the welfare of the people and the nations depends on how fittingly and intelligently we make use of our biotic resources.

5. BIO-DIVERSITY AT DIFFERENT LEVELS:

The diversity of existence species of various living organisms is generally called Bio-diversity. It can be observed in different levels:

→ ***Local Bio-diversity***: If we take a village as a unit, we know that our country India is well-known for its village customs and traditions. Population live in villages are called rural population. Fields are surroundings of a village where variety of crops are grown or

cultivated. The towns, cities are developed which have less bio-diversity. That means bio-diversity is maximum in rural areas. This is called rural diversity. i.e. regional level diversity.

→ ***National bio-diversity***: Country level bio-diversity is called the national level bio-diversity. Country has divided into many geographical zones like Himalayan Zone, Lake Zone, Mangrove Zone, Marine Zone, Plain Cultivated Land Zone, etc. They are rich in flora and fauna. They give our country a place of pride in the international arena in the field of bio-diversity.

→ ***Global Level of Diversity***: There are many countries in the word. They are having specific hot spots which are areas of bio-diversity with dense and dynamic ever-changing flora and fauna which is stated as follows:

1) ***Bio-diversity in North America***: Alaska is a country where ice is in abundance in fact it is covered with ice called cryophytes.
   - ***A. West Coast of California***: It is very good for its forest area.
   - ***B. Pennsylvania:*** It exhibits diversity because of forest area
   - ***C.*** **Mexico**: It is also well known for flora and fauna and sandy beaches.

2) ***Bio-diversity in South America***: Brazil, Argentina, Peru etc. countries have forest area and are rich in bio-diversity of flora and fauna and the grasslands of this area are called pampas.

3) ***Bio-diversity in African Continent***: Africa is the oldest continent and generally called 'Dark Continent in olden days. It is well-known for Egyptian Civilization.
   - ***A. Cape Region***: This is the oldest part of the world which is rich in flora and well known for its dense forest area.
   - ***B. Madagascar Region***: This is an island and it is famous for its richness in flora and fauna and tribals live in this placed belonging to the ancient ages.
   - ***C. Northern side***: It is famous for Sahara desert and river Nile flows in this area and ancient civilization is Egyptian civilization is originated in this area and have a touch of ancient along with modern civilization which is a god example of bio-diversity.

4) **Bio-diversity in Eurasia (Europe and Asia) Continent**:
   - ***A. Eastern Himalayas***: This is the oldest part of the world where large varieties of species are available. It is also rich in flora and fauna.

B. ***Western Ghats***: These are of range of mountains which show bio-diversity as they are rich in flora and fauna. The seasonal rivers flow. The rivers like Godavari, Krishna and Cauvery flow here.

C. ***Andaman and Nicobar islands of India and Srilanka***: These areas are filled with forests. These are also rich in flora and fauna. The place is not only known for diversity of flora and fauna but also the ancient tribal men and women live in that dense forest area.

D. ***Malayan Archipelago***: The oceanic islands such as Sumatra, Java, Borneo, Celbs etc. are combinedly called Malayan Archipelago which is rich in flora and fauna. Java is also called sugar bowl of the world.

E. **Philippines**: These are small group of islands with Mamla as its capital. It is also rich in flora and fauna and well known for its bio-diversity.

5) ***Bio-diversity in Australia***: This is small continent with maximum bio-diversity. The islands like Newzealand, Tasmania contribute to bio-diversity of the continent. It is also well known for its flora and fauna and endemic species like kangaroo, ostriches etc.

All these are called Global Level Diversity and hot spots of the world.

6. *INDIA AS A MEGA-DIVERSITY NATION:*

India is a sub-continent which occupies major part of South Asia and rich in flora and fauna. It is one of the world's 'Mega Diversity Nations'. It consists of bio-geographical zones which have 75,000 species of animals (fauna) and over 45,000 species of plants (flora) are found in India. India has high biodiversity. It has high proportion of endemic species of vegetation and wildlife.

1. ***Trans-Himalayan Zone***: This is the birth most area of country. This is filled with ice and these mountains are rich in fauna and herbal plants. The goat and sheep found in this area are of great quality in the whole world, snow leopard and migrating birds like black necked crane are famous in this region.

2. ***Himalayan Zone:*** The hilly region with good flora and fauna and national parks are famous here as the maximum bio-diversity is available here. This is also one of the best places for tourism. These regions have pine forest and alpine shrubs.

3. ***Desert Zone:*** This is a part of Rajasthan area from where the great desert of India starts. Thai desert. This contains sand dunes which are the best centers for the study of soil erosion and famous for desert plants.

4. ***Semiarid Zone:*** it starts in Rajasthan and extends upon the state Punjab. In this area ground water and surface water are very less, fauna. Very few bamboo bushes, ferns and other plants are seen.

5. ***Eastern Ghats:*** The Eastern Ghats have tropical dry deciduous thorny forests. A small northern area, bordering Orissa, Possesses moist deciduous forests. These regions are also is important for wildlife.

6. ***Western Ghats:*** It represents the mountainous Western Zone of South India which is rich in flora and fauna with tropical rain forest extended from Maharashtra to Kerala. Kerala is also known as Malabar Coast of the Sea. Our banana, mango, citrus, black pepper is found abundantly here.

7. ***Deccan plateau:*** Deccan plateau represents in the states of Madhya Pradesh, Maharashtra, Andhra Pradesh, Orissa, Tamilnadu, Karnataka and Kerala. It is rich in flora and fauna and availability of medicinal plants like Ranwolffia, serpentine, Cinchona that gives quinine which cures malaria, vinca rosea (catharanthas) which gives vincristine and viniblastin that is used for the treatment of cardiovascular ailments, pilocarpus – eye ailments, black mulberry and moreton bay chestnut – act against AIDS Virus, Ephedra – respiratory troubles.

8. ***Indo-Gangetic plain:*** This is a very fertile land Zone of the centre of North India through which mighty rivers like Indus and Ganges along with their tributaries flow well enriching that land Zone. This region consists of tropical moist deciduous forests and tropical dry deciduous forests. Littoral and mangrove forests are also found.

9. ***North East India Zone:*** This zone is of 7 small sisters which are mountain states like Assam, Arunachal Pradesh, Meghalaya, Mizoram, Nagaland, Tripura and Manipur. All these having rich culture and resources. The vegetation of these regions consists of tropical west evergreen forests, tropical semi – ever green forests, sub tropical broad – leaved hill forests. These regions have one of the finest bamboo forests in our country. These regions represent high diversity of orchids, bamboo, tree ferns, etc.

10. ***Coastal Zone:*** This part of South India is having rich continuous Western Ghats and not so rich Eastern Ghats which are discontinuous and not very rich in flora and fauna like Western Ghats because of shortage of rainfall.

11. ***Islands around the mainland:*** Andaman and Nicobar islands are a chunk of South India and having undisturbed dense forest of different types in the Bay of Bengal.

    Lakshadweep Island is in the Arabian Sea. They have Indian and African affects resembling that of Madagascar of African Zone and Kerala state of India. These islands have many species of mammals and marine animals.

Because of such diversities, India is called a 'Mega-diversity Zone'

7. HOT SPOTS OF BIO-DIVERSITY:

Places in the world especially forest that contain different varieties of species that are present in a dense manner are generally called **Hot Spots** of diversity. Some areas have greater concentration of living creatures than others. Such areas are under great threat as they are being destroyed by human invasions. Hence they are called bio-diversity hot spots.

Hot Spots are rich in flora and fauna and mostly located in tropical areas. Most of them are present in developing countries. These have endangered and endemic species which add up about 85% of plants and animals found in Madagascar forests.

8. THREATS OF BIO-DIVERSITY:

There are various kinds of animals and plants present on the earth and these form the rich bio-diversity of the planet. The wide variety of plants and lush green plants and other living organisms not only add beauty of the planet but also help in maintaining eco-system.

1. ***Unplanned development and habitat destruction:*** human activities such as cutting trees, filling wet lands, ploughing grasslands or burning down forests may change or completely destroy the natural habitat of a species. Large scale development projects like industrial plants or hydro-electric projects have contributed substantially to the loss of area which is rich in bio-diversity. Human settlement of roads, dams which increase loss of forest area which results in the loss of habitat for a large number of animal and plant species in the area.

2. ***Poaching or over exploitation for commercial gain:*** Many plant and animal species have been over exploited by humans, sometimes to the point of extinction. Many species such as tigers and elephants are killed or poached for their skins, tusks, claws etc., which have high commercial value, and some species of snakes, birds are smuggled out for

their value for collectors. Some medicinal plants and timber trees are over exploited and the population of species is decreased.

3. ***Environmental Pollution:*** Soil, water and air [pollution disturb the functioning of eco-system and may reduce or eliminate sensitive species. Over use of fertilizers, pesticides also affect the environment. The contamination of water by effluents from irrigation, industrial wastes destroy aquatic life and resources of marine like coral reefs.

4. ***Global Climatic Change:*** It is expected that in few years global climatic change will adversely affect bio-diversity of the planet. As the temperature is increased world widely, the climate is changed. The change in climate leads to a change in habitat of living organisms. The species which cannot adjust to the higher temperature may become extinct. Some islands and coastal system are affected by floods. Hence there is a loss in bio-diversity.

5. ***Invasion by introduced species:*** The deliberate or accidental introduction of non-native species has become a major threat to bio-diversity worldwide. For example Cantan Camara which was originated in Brazil is spreading rapidly in Indian forest and the dominance of this species is affecting other species like herbs, shrubs. Some water plants like hyacinth is increasing and causing several problems such as clogging of rivers and lakes etc.

6. ***Nature of legal system:*** In planning legal enforcements, a perfect combination of ecological and economic realities and involvement of people is required. Protection of wild life and animals is neglected and hunting in national parks and sanctuaries is not reduced which is a threat for bio-diversity of animals and plants.

7. ***Mining:*** Mining activities involve digging up tonnes of earth in order to get the ore. This process leads to deforestation and soil erosion which causes pollution of land, water and air. It affects the bio-diversity of flora and fauna.

8. ***Waste disposal:*** Dumping of nuclear, radio-active materials and domestic wastes on land or water kills the plants, animals and aquatic life which lead to the extinction of species.

9. ***Exploitation of water resources:*** Over exploitation of water resources leads to the decrease in water level and absence of rainfall decreases the water level which is a

major threat for animals and aquatic organisms as all of them need water for their survival.

10. ***Eutrophication:*** Nutrients settlement is increased in water bodies i.e. if inorganic compounds enter the water bodies in the form of floods or contamination. The nutrients increase the growth of algae and lower the production of oxygen. It leads to the death of fishes and other aquatic animals.

9. MAN-WILDLIFE CONFLICTS:

Man-wildlife conflicts are also one of the causes for loss of biodiversity. The man-wildlife conflict started with the evolution of man. It intensified and increased due to the activities of modern man. Conflict between man and wildlife has become an issue of survival for both wildlife and man. With the increase in human activities by modern man, and the encroachment of the natural habitats of wildlife by man, the natural habitat of wildlife, i.e., forest, has shrunk. The shrinkage of forest cover has compelled the wild animals to move outside the forests and enter villages and towns around the forests, and attack the agricultural fields, domestic animals, and sometimes, even human beings. This has made the people i.e., the villagers kill the wild animals that have strayed into their villages. The result is loss of wild animals. Anthropogenic activities like developmental pressure, encroachment, over - exploitation, faulty management of forests and wildlife, etc. have also increased the man-wild life conflict and led to loss of wildlife and biodiversity.

10. ENDANGERED SPECIES OF INDIA:

Endangered species are those whose numbers are reduced to the point that is in danger of becoming extinct.

A. Characteristics of endangered species:

- → Small range
- → Large territory
- → Low reproductive rate
- → Low population
- → Narrow habitat requirements

B. Some of the important endangered species of animals of India are:

1. Reptiles – Gharial, green sea turtle, tortoise and python.
2. Birds – Great Indian bustard, peacock, pelican, Great Indian hornbill, Siberian white crane, and pink-headed duck.

3. Carnivores – Indian Wolf, Red Fox, Sloth Bear, Red Panda, Tiger, Leopard, Striped Hyena, Indian Lion, Golden Cat, Desert Cat, Dugong
4. Primates – Hoolock Gibbon, Lion-tailed Macaque, Nilgiri Langur Capped Monkey, Golden Monkey.

11. ENDEMIC SPECIES OF INDIA:

A group of living organisms that are strictly confined to any specific area in the world are generally called ***Endemics***. The phenomenon by which groups of living organisms are confined to a specific area is called ***Endemism.***

A. Characteristics of Endemic Species:

→ They are confined to a specific area in any art of the world.
→ They have become endemics due to some geographical or ecological barriers that exist in that area.
→ They have no capacity of mutability.
→ They are generally confined to mountains, hills and valleys.

1. ***Progressive Endemics***: They are formed during Progressive Evolution. Eg; Potentilla
2. ***Conservative Endemics***: The plants which are previously distributed widely but due to ecological conditions they became endemics. Eg: Taxodium
3. ***Neo-Endemics***: These plants are evolved during recent times and became endemics. Eg: Piper nigrum.
4. ***Local Endemics***: These are endemics which are confined to a very small local area. Eg: Taxus.
5. ***Pseudo Endemics***: These are plants that look like endemics but may disappear later on.
6. ***Micro Endemics***: These are also neo-endemics of lower group of recent origin.

B. Some of the endemic species of India are

- The Eastern Ghats – Potentilla, Metasequoia, Pimpinella etc.
- The Western Ghats – amphibians (frogs, toads, etc.)

  Reptiles (lizards, crocodiles, etc) lizards (varanus), reticulated python and Salamander, Lion-tailed Macaque, brown palm civet; Nilgiri, Thar, etc. are some important endemic species of India.
- Flora of India includes orchids and species like sapria himalayana, uvalia lurida, Nephenthes, Khasiana, Pedicularis Perrater, etc.

12. CONVERSION OF BIO-DIVERSITY:

Conversion in a broad sense can be defined as 'a method to stop the unplanned development that breaks ecological as well as human laws by careless use of natural resources.' Bio-diversity conversation refers to scientific management at an optimum level where sustainable benefit can be derived for both present and future.

There are two types of conversations:

1. Insitu conservation (On Site)
2. Exsitu Conservation (Off Site)

1. Insitu Conservation:

This approach is mainly intended to wild species of crop plants, forest varieties, animals, grass-land species etc.

Insitu means 'in the natural or original place'. Protecting species against environmental pollution at the habitat places is called insitu conservation. This conservation is carried out in areas such as national park, wild life sanctuaries.

1. ***Establishment of Natural Park***: A part of national importance representing biodiversity can be established. It should include plants and animals belonging to different species. The selective species such as endangered, endemic, and rare species are kept at national parks and they are protected.

2. ***Wild life sanctuaries:*** Sanctuary is a very well protected area at which plants and animals are not exposed to any type of danger either internal or external danger. The animals are protected from hunters and they are cured if they get infected.

3. ***Habitat maintenance:*** Habitat is the place of natural living of animals and plants. We have to maintain these places like providing green houses, artificial caves, pools etc., for animals and birds in their dwelling place. This should be done by government.

4. ***Methods of increasing population:*** Methods and new techniques should be introduced to protect the endangered, endemic and rare species so that the population of species is maintained. They can lead a better life and also they will be protected from being extinct or vanish from surface of Earth.

5. ***Bio – reservoirs:*** Bio – reserve is a special area in which extraneous activities that can harm the plants and animals is curbed by law. They differ from national parks and sanctuaries. They help in protecting bio-diversity for some time.

   A. ***Limitations of its conservation***: Although there are numerous benefits of insitu conservation, it also has the following limitations:

- These ecosystems may not be fully protected against environmental pollution.

   B. ***Advantages of Insitu Conservation***:

- It ensures long term protection of the area.
- These provide a good opportunity for conservation as well as evolution
- In-Situ conservation is a cheap method of conserving biological diversity.
- It helps in protecting species in their natural habitat.

2. ***Exsitu Conservation***:

It is the chief mode of preserving of genetic resources. In this technique, plant and animal species are conserved outside their natural habitats. This can be done through establishment of gene banks, botanical gardens, tissue culture technique etc.

1. ***Gene banks***: Gene banks are also known as germ plasma banks, seeds, pollen grains and other parts of vegetative propagating preserved in different conditions and by applying different techniques. E.g.: Vegetables, seeds, oil seeds, pulses are stored for several years in liquid nitrogen.

2. ***Botanical gardens***: Botanical gardens are used for the conservation of rare and endangered plant species for study and research of specific plant characters and for scientific information and experiences to promote development.

3. ***Aquaria***: This is mainly used for the captive propagation of threatened or endangered fresh water species. It also plays an important role in educational facilities.

4. ***Tissue Culture Technique***: Tissue Culture Technique helps in preventing endangered animals and plants. A very small piece of root or apex part of leaf is taken and cells from those parts are collected n a test tube and cultivated in petri dishes or test tubes. The culture medium contains a gel with proper nutrients which cause plant to grow rapidly. In these species no seeds or seeds in fruit will be less in number.

5. ***DNA Technology***: The DNA technology helps in preventing endangered animals or plants. Through interchange in the DNA of species we can get a new hybrid species with good nutrients. We can also get ideal food species through this technology.

A. Advantages of Exsitu Conservation:

- It ensures long term conservation of the species.
- Due to controlled supervision and assured food, shelter and security provided in exsitu conservation, they can survive longer and may breed more than usual i.e. they can increase their population.
- By exsitu conservation hybrid species are possible.
- The quality of off springs or new born species can be improved.

B. Limitations of Exsitu Conservation:

- It is a specific method that can be adopted for only a few kinds of species.
- Over protection of species in exsitu conservation may result in loss of naturality.

13. STEPS TO PRESERVE BIO-DIVERSITY:

- Restricting the conversion of forest lands to industries.
- Genes of existing species should be collected.
- High yield of agriculture system should be developed.
- Measures should be taken to prevent pollution.
- Effective measures must be taken for the conservation of bio-diversity

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UNIT IV – ENIVIRONMENT POLLUTION

Contents: • Environmental Pollution: Definition, Cause, effects and control measures of •Air pollution, •Water pollution, •Soil pollution, •Noise pollution, •Nuclear hazards. •Role of an individual in prevention of pollution. - Pollution case studies. **•Solid Waste Management:** Sources, classification, effects and control measures of urban and industrial solid wastes. •Consumerism and waste products.

INTRODUCTION:

According to ODUM (1971), Pollution is *"an undesirablechange in the characteristics of air, water and land that harmfully affectthe life and also create health hazards for all living organisms on the globe"*.

According to SOUTHWICK (1976), Pollution can be defined as *"the unfavorable (or) alteration of environment caused by human activities and causing harm to human beings".*
Basically the Pollution is of two types viz.,

1. Natural Pollution: This type of pollution is limited in its occurrence generally from natural hazards like volcanic eruptions, emissions of natural gas, soil erosion, ultraviolet rays, cosmic rays etc and

2. Man made Pollution: Human activites such as urbanisation, industrialisation, modern agriculture methods and other activites are causing pollution.

Most of the pollution is man made only. However, Pollution is usually categorized as Air Pollution; Water Pollution; Thermal Pollution; Noise Pollution; Land & soil Pollution; Radio Active Pollution and Marine Pollution.

1. AIR POLLUTION

1. ATMOSPHERE:

Commonly air constitutes of 80% of man's daily intake of materials by weight. We breathe 22,000 times a day on the average inhaling 16kg of air. The earth's atmosphere is an envelope of gases extending from surface to a height of more than 200km. Atmosphere constitutes a protective gas which helps in survival of human beings. Earth's atmosphere is a mixture of gases and consists of several layers which are as follows.

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

1. ***Troposphere: -*** It is the first layer of atmosphere which is present close to the ground level. It is present 10 to 15 kms above the ground level. It shows active and strong movement of air clouds formation. This is called as the seat of weather. The top layers of this sphere show

a temperature of 80^0C. The next zone adjacent to troposphere is called tropopause which is an intermediate zone present between the troposphere and the next zone i.e., stratosphere.

2. ***Stratosphere: -*** This layer of atmosphere is present next to troposphere. It ranges from 15 to 50 kms above the surface of the earth. Ozone gas is present between 13 to 23 kms, because of that this layer is generally named as "OZONOSPHERE." It has a capability of absorbing ultraviolet portion of solar radiation and protects all living organismson earth from getting exposed to ultraviolet part of solar radiation. Upper layer of stratosphere is called stropopause which is nearly 50 kms above the earth's surface and has a maximum temperature of 0^0C temperature. This stropopause is an imaginary line which separates stratosphere and mesosphere.

3. ***Mesosphere: -*** This is the 3^{rd} layer of atmosphere and ranges from 50 to 80 kms above the earth's surface and called as middle sphere of atmosphere. In this zone the temperature decreases upto -80^0C.The upper layer consists of 1000^0C and it is called mesopause which is intermediate zone of Mesosphere and Ionosphere.

4. ***Heterosphere or (Ionosphere): -*** This is the layer extended upto 300 kms above the surface of the earth. In this layer many gases like oxygen are present in ionic form. As the gases are present in ionic form, this layer is called Ionosphere. Above 125 miles above the surface of the earth there is another layer called Thermosphere which regulates the temperature. In this layer N_2 and o_2 are present in 1:1 ratio. Thermopause is the intermediate zone of Thermo pause and Exosphere.

5. ***Exosphere: -*** This is called the highest zone in the atmosphere. It is generally present above 1000 km from the surface of earth. The dominant element is Hydrogen. It may be present in molecular form or ionic form. In this zone temperature ranges from 200^0C to 1000^0F. This increase in temperature is mainly because of solar radiation. Helium is abundant in this zone. The lower part where helium is abundant is described as Helium zone.

2. AIR POLLTION:

One of the formal definitions of air pollution is as follows – The presence of one or more contaminants in the atmosphere in such quality and for such duration as it is injurious, or tends to be injurious to human health or welfare, animal life or plant life.

Air pollutants are mainly present in troposphere. These air pollutants are mainly of two types:

1. Primary Air Pollutants
2. Secondary Air Pollutants

1. Primary Air Pollutants:-The primary air pollutants are those which are directly released from sources to atmosphere or air.

Eg: CO, CO2, SO2, NO, NO2, Hydrocarbons, supended particles etc…

2. Secondary Air Pollutants:-The secondary air pollutants are those pollutants which are formed after the interaction or reaction with primary pollutants.

Eg:SO_3,HNO_3,H_2SO_4,H_2O_2,O_3,NO_3,salts of SO_X,NO_X,PAN etc…

2.1. SOURCES OF AIR POLLUTION:

a) ***Natural Causes:-*** Natural disasters such as cyclones, volcanic eruption earthquakes cause suspension of dust particles and ash in air and cause air pollution. Forest fires, pollen grains, microbes, methane gas and other gases released from air is mainly due to decay of organic matter. Radon gas is released due to radio active decay with in the earth's crust.

b) ***Man made causes:*** Human beings are the major contributors to air pollution. some of the man made air pollutions are:-

1. Industrial wastes:- The increase in number of industries contributes heavily to air pollution. Different industries produce air pollution in different manners depending upon the process. Petroleum refineries emit large amounts of hydrocarbons &particulate matter. Iron, steel, paper mills, chemical plants emit vast amounts of particles into the atmosphere.

2. Automobiles:- These help in easy transportation but cause major air pollution by emitting dangerous pollutants such as CO, CO_2, SO_2, NO_X, hydrocarbons, Pb.CFC'S etc…

3. Thermal power plants:- To meet the increase in demand for electricity the large number of thermal stations has been setup. Most thermal stations use coal as main fuel and coal ash is generated as waste product. The other pollutants are fly ash, SO_2, hydrocarbons and other gases etc.

4. Nuclear plants:- The nuclear explosions cause major air pollution. It releases huge amounts of pollutants including hazardous chemicals; dust particles. Nuclear power plants generate radioactive pollutants that effect the environment majorly.

5. Agriculture activities:- The excessive use of fertilizers, pesticides, insecticides help in increasing productivity of crops but cause pollution. The chemicals cause air pollution when sprayed & also travel large distances via air and affect the living organisms.

6. Disposal of garbage:- All the Biodegradable and Non-biodegradable elements present in the waste materials cause air pollution. When these waste materials are burnt toxic gases are released which affects the health of the living organisms and surroundings.

2.2. EFFECTS: Some of the air pollutants can seriously and adversely affect the health of the population and the environment.

1. ***Sulphur oxides:-*** Sulphur dioxide is the major air pollutant and it remains in air for 2 to 4 days and travels a distance of 1000 km before it is deposited on ground. It reacts with other inorganic substances & forms SO_3 and H_2SO_4 & salts of sulphuric acid.

Sources:-

- Sulphur oxides are released into air by
- Power plants
- Industrial boilers
- Diesel generator
- Combusion of fuel's
- Biological decomposition
- Something of sulphide contained ores
- Effluents from motor vehicles & air crafts
- Volcanic eruptions etc…

Effects:-

- Human beings:-Paralysis, damage of lungs, lowering the resistance of diseases such as pneumonia and influenza,lung&heart diseases ,asthma leaking of fluid plasma from blood, swelling of air sags, cancer.
- Plants:-Death of living tissues, decreased growth and yield of plants &co
- Materials:-Damage to materials, corrosion.

2. ***Oxides of Nitrogen:-*** NO_x are major composition of atmosphere, and NO&NO_2 are the major pollutants.

Sources:-

- Power generators
- Vehicles
- Forest fires
- Combusion of fuels, oil
- Textile industries

Effects:-

- Human beings:-It affects lungs, inflammation of lung tissues, pulmonary edema, head ache, coughing, chest tightness, in extreme cases death.
- Plants:-Stunted growth, collapse plant leaves.
- Materials:-Damage to materials and corrosion.

3. ***CO: -*** Carbon monoxide is a colourless, odourless, tasteless gas which is present in small concentration.

Emission sources:-

- Agricultural burning
- Forest fires
- Air crafts &Automobiles
- Burning of coal, oil
- Iron, steel, paper industries.

Effects:-

- Human beings:-The CO combines with haemoglobin and forms carboxy hemoglobin which reduces the O_2 carrying capacity. The less carrying of O_2 affects the brain function and increases the rate of heart beat and breathing control which increases physiological stress, dizziness, and head ache.
- Plants:-Inhibition of nitrogen fixation, premature ageing, inhibition of cellular respiration, initiation of roots etc…

4. ***Hydro carbons: -***These affect human beings very severely.

Effects:-

- Human beings:-Carcinogenic effect on lungs, irritate mucus membrane irritation to eyes, nose, throat and respiratory distress, cancer.
- Plants:-Damage plants, light flecks or stipples on upper leaf, damages growth of plants.
- Materials:-Material becomes less elastic & more brittle.

5. ***H_2S: -*** It has odour of rotten egg and a major pollutant.
   - Human being: - Respiratory failure, paralysis, breathing problem, head ache, eye irritation, nausea, lung damage, water accumulation, respiratory failure followed by death.

6. ***NH_3: -*** It has a pungent smell.
   - Human beings;-Chemical burns to throat, irritation to eyes, throat, increase in blood stream.

7. ***CO_2: -*** It is a colorless gas.
   - Human beings:-respiratory problems and effects human beings severly.It leads to global warming and imbalance livelihood of all living organisms.

8. ***Arsenic: -*** It is an industrial pollutant.
   - Humans:-Damage red blood cells, kidneys&cause jaundice.

9. ***Lead: -*** Lead is present in organic, inorganic form in the air.
   - Human beings:-Toxic to nervous &blood functioning system, mild anemia, fatigue, head ache, irritability, encephalopathy, coma, cadiorespiratory arrest&death, paralysis, abdominal pain, disturbs metabolism of vitamin D.

10. ***Radon: -*** It is colorless, gas soluble in water. There are 27 isotopes of Radon.
   - Human beings:-Causes damage to lungs and effect bronchi and eventually cause lung cancer.

11. ***Ozone O3: -*** It is a colorless gas. It is secondary air pollutant.
   - Human beings:-respiratory irritant, aggravates impairs lung functioning, other lung and heart diseases, eye irritant.
   - Plant:-It affects the plants as it is toxic plants.
   - Material:-It corrodes material.

12. ***SPM: -*** Particulate matter.
   - Human beings:-Respiratory damage and effects functioning of lungs.

13. ***PAN (Para acetyl nitrate): -***
   - Human beings:-Irritation to eyes and other human sense organs blisters on skin. Green house effect which leads to global warming and imbalances eco system of living organisms.

2.3. OUTDOOR AIR POLLUTION

a) Smog:- Smog is a type of large scale outdoor pollution. It is caused by chemical reactions between pollutants derived from different sources primary automobile exhaust and industrial emissions. Depending on the geographical location, temperature, wind and weather factors, pollution is dispersed differently. A temperature inversion occurs when air close to the earth is cooler than the air above it. Under these conditions the pollution cannot rise and be dispersed.

b) Acid rain:- When a pollutant such as sulphuric acid combines with droplets of water in the air, the water (or snow) can become acidified. The effects of acid rain on the environment can be very serious. It damage plants by destroying their lives, it poisons the soil and it changes the chemistry of lakes and streams. Damage due to acid rains kills trees and harms animals, fishes&other wild and aquatic life.

c) ***Green House effect:-*** It is also referred to as global warming.CO_2 is produced when fuels are burned. Plants convert CO_2 back to O_2, but the release of CO_2 from human activities is higher than the world's plants can process. The situation is made worse since many of the earth's forests are being removed and plant life is being damaged. This is increasing CO_2 build up like a blanket and traps heat close to the surface of our earth, changes the temperature which increases the melting of the ice cops which increases the level of water in ocean and seas and imbalances the hydrological cycle and effects living organisms.

d) ***Ozone Depletion:-*** It is an another result of air pollution. The chemicals released from coolants and refrigerators enter into atmosphere and reaches stratosphere. There the chemicals namely CFC's(chloroflouro carbons) reacts with ozone gas and decreases the level of ozone layer and creates holes leading to open up in this layer which allows radiation to reach the ultraviolet radiation is known to cause skin cancer and damages plants and wild life. Thus ozone depletion is the major cause which affects the environment severely.

2.4. PREVENTIVE STEPS FOR AIR POLLUTION:

Control of air pollution is required to prevent further damage. Air pollution prevention and control technologies should be developed for industries, electric power plants, indoor environments etc. The following are some of the measures that need to be followed to control air pollution.

1. The industrial gaseous wastes should be treated before being discharged into the atmosphere.
2. The hazardous chemicals should be converted into less harmful substances.
3. Instead of using low grade and conventional fuels, environment friendly fuels such as gobar gas, LPG and natural gas must be generated and used.
4. Increasing of green belts must be promoted as the quality of air can be improved and maintained.
5. Using mass transport system, bicycles etc for near by distance
6. Shifting to less polluting fuels
7. Using non conventional source of energy
8. Using biological filters and bio scrubbers
9. Planting more trees
10. Reduction of pollution at source

2. WATER POLLUTION

INTRODUCTION:

Water is the main constituent of hydrosphere and is renewable resource. It is the second essential component of biosphere. The distribution of water resources is not uniform over the earth's surface. About 97% of it is salt water in the seas and oceans, 2.6% is trapped in polar ice caps and glaciers. Only 0.4% is available as fresh water.

1. *CHEMICAL EXAMINATION OF WATER (TESTS):*

The pH; Biological Oxygen Demand, Dissolved Oxygen; Chemical Oxygen Demand etc are some of the chemical tests to find the stage of pollution of water.

1. **pH**: The value of pH gives the degree of acidity or alkalinity of polluted water. Determination of pH is important in calculating the coagulant (thick or thin) dose.
2. **Biological Oxygen Demand (BOD)**: It is defined as the quantity of oxygen utilized by micro organisms at a temperature of 20oC, generally measured for 5 days. When water is polluted by unwanted materials, naturally the O2 content gets reduced and that water become not fit for consumption either by human beings or animals or plants. Living organisms require water with some quantity of sustainable oxygen in it. That oxygen is necessary for living organisms is generally called ***BOD***. If there is reduction in oxygen content of water, it becomes unfit for biological consumption because there is change in BOD.
3. **Dissolved Oxygen**: The amount of oxygen in dissolved form in water at a particular temperature and atmospheric pressure is known as dissolved Oxygen. In polluted waters, dissolved oxygen is the factor which determines whether the biological changes are carried by aerobic (needing oxygen) or by anaerobic (oxygen not required) micro-organisms. Eg: 5 to 8 mg/L of dissolved oxygen is required for most of the species and fishes.

2. MARINE POLLUTION:

A number of commercial and industrial activities are responsible for polluting marine ecosystems. The discharge of waste materials from industries and other sectors into oceans as this helps in minimising soil polllution and also does not spread many diseases.

A. *SOURCES*

1. ***Oil and petroleum spillages***: Leakage of oil from oil tankers as they are accidental discharge into the sea. Oil spillage is a major cause of concern around the coastal regions.
2. ***Toxic chemicals:*** Industrial wastes containing toxic chemicals and heavy metals pollute marine ecosystems. Apart from heavy metals, substances such as petrol, Grease oil, pesticides herbicides and solvents such as paint strippers also damage marine ecosystem.
3. ***Hazardous wastes:*** Wastes discharged through nuclear testing, nuclear power plants, defense explosions, etc. when such radioactive wastes are disposed in oceans, they pose

a great hazard to the living organisms in the marine ecosytem. These substances poison the ecosytem and cause a serious from of marine pollution.

4. ***Raw sewage***: Oceans receive huge amount of sewage from coastal cities all over the world. Effllluents from industries and discharge of domestic sewage cause major pollution.
5. ***Thermal polllution***: In many industries, water is used as a coolant and it becomes hot in the process. This warm water is then discharge into water bodies which increase the water temperature; this is known as thermal pollution. The aquatic animals suffer a lot as they cannnot survive under such conditions.
6. ***Plastics:*** Fishing nets, cargo, wastage from cruise ships and plastic industries, all these plastic materials enters into the oceans and causing marine pollution. Fishes consumes plastic as they mistaken plastic as food and they die as these plasstics contain toxic elements.
7. ***Noise pollution:*** Noise of high intensity can be heard for thousands of kilometers away under waer and may stress and disrupt marine life.

→ Some of the sea shores where large amount of marine pollution is causing are as follows – Mumbai, Chennai, Vishakhapatanam, Goa, and puri beach (Orissa).

B. *EFFECTS:*

1. Excessive nutrients in water bodies promote plant growth which leads to a drop in water quality.
2. Disruption of the natural ecosystem E.g. lack of oxygen for shellfish and marine life (causing a drop in their population).
3. Decrease in the recreational and aesthetic value of water bodies.
4. Coral reef population is declined due to pollution.
5. Decrease in biodiversity due to pollution as it effects the quality of water.
6. Changes in species composition and dominance.
7. Toxic phytoplankton species population is increased due to presence of impurities.
8. Decreases in water transparency (increased turbidity), Colour, smell, and water treatment problems.
9. Dissolved oxygen is depletion due to presence of impurities which may affect the existance of fauna.
10. Loss of desirable fish species in marine bodies.

C. *CONTROL STEPS*

1. Oil pollution can be controlled by using oleic and stearic acids which help in concentrating and removing oil pollutants.
2. The bacterium Pseudomonas putida also known as super bug effectively eliminates oil spills.
3. The disposal of hot water into water bodies should be prohibited.

4. Solid wastes such as plastic, glass, metal, papers, etc. should be recycled for different purposes instead of being discarded as wastes.
5. Sewage and industrial wastes should be treated before being released into sea water.
6. Strategies such as establishment of marine protected areas, adoption of bioregional management approach.
7. Disposal of poisonous substance in the sea must be stopped by enforcing strict laws.

3. FRESH WATER POLLUTION:

The effects of water pollution are varied depending on the toxicity of the chemicals that are dumped and on the location of the site of disoposal. Urban areas are highly polluted and cause several diseases in hunman beings and destroy aquatic ecosytems.

A. EFFECTS

1. Effect on human health:-

The consumption of polluted waqter may lead to various diseases of the central nervous system and may cause damage to liver, brain, and kidneys. Some of the adverse effects of water pollution on human health are shown below.

TYPE OF ORGANISM	*DISEASE*	*SYMPTOMS*
Bacterial	♦ Typhoid	♦ Diarrhea, Severe vomiting, enlarge spleen, inflamed intestine.
	♦ Cholera	♦ Diarrhea, severe vomiting, dehyration.
	♦ Bacterial dysentery	♦ Diarrhea, fatal in infants without proper treatment.
	♦ Enteritis	♦ Severe stomach pain nausea, vomiting, rarely fatal.
Viruses	♦ Infectious hepatitis	♦ Fever, severe headache, loss of appetite, abdominal pain, jaundice, enlarge liver, rarely fatal but may cause permanaet liver damage.
Parasitic protozoa	♦ Amoebic dysentery	♦ Severe diarrhea, head ache, abdominal pain, chills, fevers, if not treated may cause liver abscess, bowel perforation and death.
	♦ Giardia	♦ Diarrhea, abdominal cramps, flatulence, bleaching, Fatigue.
Parasitic worms	♦ Schistosomiasis	♦ Abdominal pain, skin rash, anemia, chronic fatigue and chronic general ill health.

2. *Effects on plants:*

Nitrate and phosphate fertilizers that are use of increasethe nitrogen and phosphate content of soil act as pollutants in may areas. The high concentration of heavy metals which may be toxic for plants and hence may hamper or affect the growth of the plant.

Eutrophication:

The excessive use of fertilizers on crops may cause some amount to be retained in the soil; this excess amount is washed away during rains and reaches the nearby water bodies. The presence of excess amount of nitrates and phosphates in water increase the growth of certain plants on the surface of the water body, this phenomenon is known as Euthophication. The excess growht of plants results in reduces the oxygen supply to aquatic plants and other living organisms.

3. *Effects on animals:*

The organisms that live in aquatic habitats are directly affected by water pollution the presence of harmful chemicals and pollutants in water make the survival of aquatic organism's extremly difficult. Large number of known and unknwon aquatic plant and animal species has become extint. Drinking polluted water causes the toxins present in the water to enter the body of the organisms this poising may lead to serous health disorder and may even cause death.

B. *CONTROL STEPS*

In order to preserve the available water resources of the planet, it is important to reduce the wastage of water and to control water pollution.

1. Industrial wastes and effluents should be treated in order to reduce their toxicity.
2. Proper waste disposal systems should be put in p[lace to prevent contamination of water boides.
3. Non – biodegradable waste material such as plastics hsould bot be dumped in water bodies.
4. Human activites such as bathing and washing in the river, ponds and lakes must be prohibited.
5. Washing animals, throwing wastes, half burnt dead bodies must be completely stopped.
6. Immersing idols which are made up of plaster of paris must be completely stopped.
7. The use of pesticides and fertilizers should be minimized so that the excess amount is not washed into rivers during rains.
8. Separate drainage of sewage and rain water should be provided to prevent over flow of sewage with reain water.
9. Planning trees would reduce pollution by sediments and will also prevent soil erosion.

C. *CASE STUDY:*

1. ***Fluorosis:*** People suffer from a disease called fluorosis after consuming water containing fluorine for sufficiently a long time. Quantity of fluoride in water is only 1 ppm. Diseases caused by fluorosis are:
    - ♦ Back pain and cannot easily bend.
    - ♦ Joints get stiffened as so movement of joints is impaired.
    - ♦ Teeth are the worst effected and a brown coating appears on the enamel of teeth giving bad appearance.
    - ♦ Persons with fluorosis cannot erect freely.

2. ***Minimita disease:*** Minamata disease was first discovered in Minamata city in Japan in 1956. It was caused by the release of methyl mercury from, the Chisso Corporation's chemical factory. This highly toxic chemical bio- accumulated in shellfish and fish in Minamata Bay which when eaten by the local populace resulted in mercury poisoning.
   Symptoms include ataxia, numbness in the hands and feet, general muscle weakness, narrowing of the field of vision and damage to hearing and speech. In extreme cases, insanity, paralysis, coma, and death follow within weeks of the onset of symptoms.

3. ***Itai Itai disease:*** In Japan the cadmium was released into rivers by mining companies in the mountains. Due to the cadmium poisoning, the fish in the river started to die, as the cadmium and other heavy metals accumulate at the bottom of the river and in the water of the river. This water was then used to irrigate the rice fields. The rice absorbed heavy metals, especially the cadmium. The cadmium accumulated in the rice. People who intake the contaminated food were affected with this disease. The symptoms of this disease are as follows – Softening of the bones, severe pain and kidney failure.

4. ***Blue baby syndrome:*** Blue baby syndrome mainly is seen in infants. The patient appears blue, due to Deoxygenated blood by passing the lungs and entering the systemic circulation. Blue baby syndrome can also be caused by Methemoglobinemia. It is belived to be caused by high nitrate contamination in ground water resulting in decreased oxygen carrying capacity of hemoglobin in babies leading to death. The ground water is thought to be contaminated by nitrate generated from fertilizer used in agricultural lands and waste dumps. It may also be related to some pesticides(DDT, PCB etc.) which cause ecotoxicological problems in the food chains of living organisms which kills aquatic animals.

3. SOIL POLLUTION

INTRODUCTION:

Land is one of the most important components of our natural environment. Land provides food security for living organisms. Any change in the physical, chemical and biological properties of soil due to natural or human activities is known as soil pollution.

A. CAUSE OF SOIL POLLUTION: -

The causes of soil pollution may be classified into the following two categories:

1. ***Natural causes: -***

   Some of the natural causes of soil pollution are earthquakes, landslides, hurricanes and floods. Such natural disaster cause severe damage to the composition of soil.

2. ***Manmade causes: -***

- ***Industrial waste: -*** Industrial wastes contain different kinds of toxic, inflammable and non biodegradable substances that may stick within the soil for a long time.
- ***Urbanization: -*** Construction of dams, houses, factories, etc., converts the land which is adjacent to those areas, unfit for agriculture hence leading to soil pollution.
- ***Mining: -*** Non-renewable substance and valuable minerals are extracted from earth is called mining. Mining leads to change in the structure and composition of the soil and hence causes soil pollution.
- ***Agricultural waste and chemicals: -*** Biodegradable wastes such as straw, dry twigs, leaches, seeds, grasses, etc., increases soil fertility but excessive use of chemical and non degradable pollutants may degrade soil quality and cause soil pollution.
- ***Domestic wastes and garbage: -*** Wastes from kitchen food, paper, cloth etc., and non-biodegradable wastes such as glasses, plastic material, metal cans etc. Improper disposal of hazardous domestic wastes such as batteries, plants, medicine, glass bulbs, spray cans etc., contribute greatly to soil pollution
- ***Radioactive wastes: -*** Nuclear power plants, nuclear testing and explosions, etc add large amount of radioactive materials to soil.

B. EFFECTS OF SOIL POLLUTION: -

The following are some of the adverse effect of soil pollution:-

- The disposal of industrial wastes on fertile lands degrades the quality of the soil and make the land unfit for use in the long run.
- Urban wastes consist mainly of non biodegradable substances they retain in the soil for a long time and slowly poison the land damaging its fertility.
- Soil pollution causes the fertile lands to become barren
- Continuous soil erosion destroys the aesthetic value of the land.
- Radioactive elements that are present in the polluted soil enter the food chain through plants.

C. CONTROL OF SOIL POLLUTION: -

In order to meet these growing food demands of the rapidly increasing population, it is important that the available land resources are conserved.

- Pesticides and fungicides are essential for the plant growth but their overuse has led to soil pollution hence reduce using of chemicals.
- Bio-fertilization and manures should be used instead of their chemical alternatives. Bio-fertilization is a process in which certain microorganisms are used to increase the fertility and growth capacity of soil.
- Recycling is another way to reduce and control soil pollution. Recycling paper, plastics and other materials reduces the soil pollution.
- Deforestation, the cutting down of trees, causes erosion, pollution and loss of fertility in the top soil. Planting trees or deforestation helps prevent soil erosion and pollution.
- Proper solid waste management will help in minimizing soil pollution.

4. NOISE POLLUTION

INTRODUCTION:

The word noise is derived from the Latin word naussea meaning seasickness. It refers to a lound sound that may cause sickness. Noise pollution refers to loud sounds created by humans or machines that may bdistrub the environment and hamper the normal living of organisms.

A. SOURCES

Noise polllution is increasingly becoming a major cause of concern. It has several disadvantageous effects on the organisms that are subjected to high levels of noise and may cause hearing defects, stress and stress – related diseases.

The natural phenomena which cause noise pollution is as follows.

Source	noise intensity in Decibels (dB)
Normal conversation	55-60
Automobiles	90
Train whistle	110
Loud stereo	100 – 115
Jet craft	100 – 110
Jet craft launching	150
Rocket engine	180 – 195

B. CAUSES

Human activities contribute the most to the rising levels of noise pollution. Some of the sources of noise ppollution caused due to human activites are discussed as follows

1. ***Domestic appliances:*** the excesive use of domestic appliances, such as mixers, washing machines, telephones, etc., that were inveted for the ease of human beings but causing noise pollution.
2. ***Industries:*** various industries such as textile mills, printing press, engineering units stone crushers, etc., these machines cause a lot of noise while carrying out these activities.
3. ***Transportation:*** the increasing number of automobiles on the road in cities contributes greatly to noise pollution. Motor vehicles, trains, ships, and air crafts also genereate ear

splitting noise, people living close to railway statins shipping ports and air ports are constantly sujected to high – intensity noise.

4. ***Entertainment:*** Electronic devices such as radio, television, etc., also produce considerable amount of noise leading to no;ise polution inside homes.

C. EFFECTS OF NOISE POLLUTION:

Noise pollution does not only affect the hearing capability of human beings, it also causes other health disorfers. The effects are classifed into the following two categories;

a. ***Auditory effects:*** A loud sound of particular fequency (ofa high intensity) even for a short duration can result in temporary deafness. Hearing loss occurs due to damage of trauma to the cochlea which is an important fluid – filled structure of the inner ear.

b. Non – auditory effects: the various non auditory effects of noise pollution are described as follows

1. ***Effects on human health***: Noise pollution causes the following adverse effects in human beings

- Physiological disorder: Anxiety, insomnia, high blood pressure, fatigue, etc., occures as a consequence of over exposure to noise.
- Loss of working efficiency: Excessive noise leads to poor concentration and reduces the ability to think.
- Annoyance: Neurotic people are more sensitive to noise than normal people. Regurlar exposrue to loud noises may cause speech and reading disabilities in young children.

2. ***Effects on wild life***: Noise pollution has various effects on wild life. Loud noises increase the trate of mortality of animals as they increase fear stresss in animals. Many animals become dull and inactive and their health deteriorates due to continued exposure to high – intensity noises which leads to death and may species of animals, such as whales and dolphins, use sounds for communication and navigation loud noises affedct their normal lives.

Animals and birds prefer to avoid nosy habitats; a decline in the number of migratory birds to a particular habitat is observed when it becomes noisy.

D. CONTROL STEPS:

Noise pollution is emerging as mahor threat to the sociesty. It is important to spread awareness among people for its control. The following are a few control measures that may be utilized to curb noise pollution.

1. Air craft nose may be reduced by desingning engines that make less noise.
2. Industrial bose may be reducing by redesigning the machines. They should also be service are regular intervals.

3. Public awareness regarding different modes of noise pollution should be genereted in people.
4. Playing music abnove a certain permissoble level during marriages and other social and religious functions should be prohibited.
5. Bursting cracker that genreate a lot of noise should be banned.
6. More and more trees shold be planted since trees act as sound absorbers and hence contribute to minimizing noise pollution.

5. THERMAL POLLUTION

INTRODUCTION:

Thermal pollution is common and widespread form o water pollution. A large number of lakes streams and rivers are affected by thermal pollution.

A. CAUSES:

The major causess of thermal pollutin are electric power plants and industries. They contribute to thermal pollution in the following types.

1. In most electric power plants a large amount of heat energy is released when coal, oil, or natural gas is burned or nucelar fuel undergo fission.
2. In facgtoreis and in nuclear power plants. A large quantity of water is required. This ate is pumped from near by water sources which is resulting in increasing temperature of water bodies and causing thermal pollution.
3. Another major cause of thermal pollutin is deforestation resulting in global warming.
4. Removal of growing crops and construct buildings, roads, and other structures warms the water by as much as 10^{o}C.
5. Soil erosion and contamination of water also contributing to thermal pollution.

B. EFFECTS

The following are some adverse effects of thermal polluton

1. The mixing of wast hot water into water bodies raises the average temperature of the water which affects the aquatic life.
2. The thermal pllution also affects the concetration of dissoved oxygen. Warm water contains lower concentrations of dissolved oxygen compare to cold water this low concetration of DO affects thesruvival of aquatic flora and fauna.
3. The incrase in wate temperature activates certain pthogenic micro organisms to accelerate that is increae its population. There may be changes in microbial population which affects the qualiyt of water and productivity of aquatic ecosystems.
4. The heated industrial effluents may contain toxic polutants such as cadmium, copper and arsenci may make the water unsuitable for any purpose.

5. Thermal pollution may result in changes in the physical and chemical properties of water.

C. CONTROL STEPS

Thermal pollution should be control as it destroys the physical, chemial, and biological nature of water resources

1. Instead of discharging hot water directly into waste bodies, it should be passed through cooling tower or cooling ponds so that it gets cooled by the process of evaporation.
2. Special ponds should be contructed in such industries to collect the hot water.
3. Cold water or air showers may be used in the industries to check hot gases at the source.
4. The excess heat energy that is produced in the genration of electricity may be utilized in another industry where this energy may be required the process is called cogeneration.

6. RADIOACTIVE POLLUTION

INTRODUCTION:

Radiation refers to the energy emitted by an atom while transforming from a high energy state to low energy state, this energy may be emitted in form of waves or moving subatomic particles. In nuclear reactors, radioactive elements such as uranium, plutonium,etc., are used as fuels. The products of the reaction may also be radioactive in nature and form nuclear wastes. These wastes are not disposed properly; they may cause serious poisoning of the environment. This is known as radioactive pollution or radioactive pollution.

A. CAUSES:

Some causes of radiating pollution are discussed as follows:

- ***Natural source: -*** High energy protons and electrons released from the sun are contained in cosmic rays; prolonged exposure to these rays may cause skin cancer in human and animals.
- ***Radioactive waste from nuclear power plants: -*** there is no trustworthy method of storing radioactive waste generated from powerplants.The leaked nuclear waste may cause severe effect to biosphere,.
- ***Nuclear explosions: -*** Atomic explosions release a large amount of radiation. The radioactive elements are passed onto humans via the food chain.
- ***Medical user: -*** Most of the man made radiations come from the use of X-rays for examination of teeth, bones, lungs and other organs. Diagonstic X-rays in pregnant women may increase the risk of cancer in the unborn child.
- ***Radiation from other sources: -*** Radiation from luminous watches, clock dials, cell phones, microwave ovens,etc., constitute smaller sources of exposure.

B. EFFECTS

The effects of radiation pollution fall under the following two categories:

1. ***Somatic Effects:*** - Different parts of body have different levels of sensitivity. Tissues of intestine, bone cancer, premature ageing, cardiovascular disorders, etc., and may hence reduce life span.
2. ***Genetic effects: -*** Radiations emitted both from natural and anthropogenic sources can lead to changes in the genetic frame work of an individual and cause certain effects.Such effects are caused mainly because of changes in the DNA.,which may lead to an increase in the number of children born with abnormalities and may also cause increased infant mortality.

C. Control Measures Of Radioactive Pollution:-

The following measures should be taken in order to control the adverse effects of radioactive pollution.

- Amount of radiations can be reduced by plantation of dense trees around the Atomic power plants.
- Proper management of radioactive waste should be ensured.
- Suitable waste disposal methods for nuclear power plants should be developed
- Diagonositic procedure involving X – rays examination should be avoided as much as possible.
- For setting up nuclear power plants various efforts including the process of site selection, its design construction, operation and short and long term effects should be seriously considered to control radiation.

D. Safety measures to be followed in nuclear power plants:

- Control of radio activity by regulating the neutron flux.
- Maintainace of core by cooling which is done by using coolants.
- Maintainace of barriers that prevent the release of radiation that is by constructing a series of physical barriers between the radioactive core and the environment.
- The handling of the equipment via remote and the core of the reactor.
- Physical shielding should be there.
- Worker should spend limited time in the areas as they are with significant radiation levels.
- Monitoring of individuals at the work environment.

7. SOLID WASTE MANAGEMENT

INTRODUCTION

An increase in the population may lead to increase in consumption of resources and the combination of industrialization and urbanization has greatly increased the generation of solid wastes. Solid wastes are responsible for land polluting in urban and industrial areas.

A. SOURCES

- ***Domestic wastes:-*** domestic garbage refer to house hold wastes and includes paper, plastic, glass pieces, metal objects, leather etc., which are generated by domestic activities.
- ***Industrial wastes:-*** Wastes discharged from paper and pulp industries, metal smelter, oil refineries, chemical industries,etc., are the major types of industrial wastes.
- ***Commercial wastes:-*** It includes paper fibers,plastic,packaging material,etc., that generated as wastes in almost all industries
- ***Mining wastes:-***Mining activities result in generation of a lot of waste materials,such as substance that are removed to get to the useful minerals,e.g., topsoil, rocks, and heavy metals,that may be released into environment and cause harm to the environment.
- ***Radioactive wastes:-*** Nuclear explosions, nuclear testing, use of radio active substances in medical and scientific research etc., generate great amounts of radioactive wastes.
- ***Agricultural wastes:-***These waste products from farms and livestock yards and may include paddy husk, biogases from sugarcane, tobacco and corn residues,etc.,
- ***Hospital wastes:-*** hospital waste includes disposable needles, syringes, blades, blood soaked bandages, human flesh, tissues and many more such items that may cause contagious diseases.
- ***Hospital waste: -*** Hospital wastes may lead to highly infectious diseases in those people coming in direct contact. Therefore the disposal of such wastes needs to be managed in a safe and scientific manner.

B. EFFECTS:-

- Urban and industrial solid wastes in the population leads to increase of disease causing organism such as mosquitoes, flies, etc.
- The solid waste migrate from one place to the other by using rain water and mixes with the near by water bodies causing water pollution.
- Burning of solid waste leads to air pollution.

- Radioactive substances presents in solid waste cause a number of diseases in human beings.
- Presence of large quantity of solid wastes reduces the aesthetic value of that land.
- The non-biodegradable solid wastes such as polythene, plastic, and rubber are discharged in large amounts which cause major pollution and it affects health of the human beings.

C. *CONTROL MEASURES:-*

- ***Collection of solid waste: -*** A large number of dustbins must be provided for proper collection of solid wastes. Door to door collection of domestic garbage should in practice.
- ***Transportation of solid waste***:- The next step in solid waste management is the transportation of solid wastes to the dumping ground by using tractors, trucks, etc.,
- ***Disposal of solid waste: -*** The following methods must be followed for the dumping of waste material.
  - ***Open dumping: -*** It is a common method of waste disposal where the wastage is left without being covered or protected. This method leads to the growth of flies and mosquitoes and also causes soil and air pollution.
  - ***Land fill: -*** It is another common method of waste disposal. In this the waste is covered by a thin layer of solid; but this method makes the ground water contamination and also makes that areas unfit for agriculture.
  - ***Ocean dumping: -*** Many of the industrial effluents containing poisons chemicals are dumped into the oceans. Every year approximately 38 million tons of waste is dumped in coastal and estuarine areas.
  - ***Incinerating: -*** In this method of incineration, non-biodegradable waste is burnt at a high temperature such that all the substances are reduced to ash. Using this process we can decrease 75% to 95% of waste but leads to air pollution as toxic ah is released into air.
- ***Composting: -*** Composting refers to the biochemical degradation of organic material to yield a sanitary soil supplement. This is a useful and eco-friendly technique but the drawback of this method is the necessity to separate organic materials from other wastes.
- ***Reduction of sources:*** The best possible technique for the management of waste would be reduction at source. Over consumption can be checked or reduced by following five R's
  - ***Refuse:*** Instead of buying new containers from the market make use of the ones that are in house. Refuse to buy new items.

- ***Reuse: -*** Do not throw away the soft drink cans or the bottles. Reuse them as pencil stands or flower vases.
- ***Recycle: -*** Use shopping bags made of cloth or jute which can be used again. This can be collected and taken for recycling.
- ***Reduce: -*** Reduce the generation of unnecessary waste like carry shopping bag while shopping and buying more electronic goods should be minimized.
- ***Repair: -*** The most effective technique to repair the broken goods instead of buying new ones which minimizes the pollution and waste materials.

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UNIT – V – SOCIAL ISSUES AND THE ENVIRONMENT

CONTENTS: Urban problems related to energy -Water conservation, rain water harvesting-Resettlement and rehabilitation of people; its problems and concerns. Environmental ethics: Issues and possible solutions. Environmental Protection Act -Air (Prevention and Control of Pollution) Act. –Water (Prevention and control of Pollution) Act -Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation. -Public awareness.

INTRODUCTION:

Social issues are matters that can be explained only by factors outside an individual's control and immediate social environment which affect many individuals in a society.

1. URBAN PROBLEMS RELATED TO ENERGY SOURCES

The urban population is maximum and increasing due to facilities. People can live happily in these areas when compared to villages. People require energy for day to day work. Energy sources are not only electricity but also firewood, coal, coke fuels etc.

A. EFFECTS: - The following are the problems of energy crisis

- Urban population suffers a lot due to lack of electricity as they are not able to carry their day to day activities.
- Urban areas will be polluted due to lack of energy.
- There is damage to life support system
- Effects residential and commercial lighting
- Industrials plants get affected due to lack of energy.
- Productivity of goods may decrease due to improper supply of energy
- This effects the working and functioning of hospitals

B. PREVENTIVE STEPS:-

- Use of solar energy and constructing nuclear power plants
- Use of wind energy by constructing wind mills
- Use of tidal energy near seas and oceans
- Decreasing the usage of electronic gadgets in everyday life
- Developing and constructing gobar gas tanks
- These steps will help in generating electrical energy.

2. WATER CONSERVATION:

The scarcity of fresh water has become a common problem due to increase of population and lack of rainfall not only these but also due to excessive use of ground water for agricultural, domestic and industrial sectors.

The available water resources should be used carefully. We should adopt various methods to minimize the consumption of water in various fields or sectors.

1. ***Water Conservation in Irrigation: -*** Agricultural sector is one of the prominent consumers of water. Some common methods of water conservation in agriculture are as follows.
   - ***a.*** Drip irrigation and sprinklers technique helps in decreasing consumption of water by plants and it reduces water by plants and it reduces water evaporation.
   - ***b.*** Irrigation in early morning or late evening reduces evaporation in loss of water.
   - ***c.*** Growing crop varieties with low water requirements and tolerance to saline water helps in conservation of water.
   - ***d.*** Use of organic and inorganic matter such as plant debris which help in slowing evaporation of water.
   - ***e.*** Interlinking water systems through canals helps in increasing availability of water at water deficient areas.

2. ***Water Conservation in Domestic Areas:-***
   - Closing taps when not in use.
   - Using small capacity flush in toilets.
   - Installing a low flow shower head that decreases consumption of water while taking bath.
   - Wash only a full load when using the washing machine.
   - Watering lawns early in the morning help in decreasing consumption of water.

3. ***Rain Water Harvesting: -*** The increase in urbanization, industrialization and population leads to increase in consumption of water. The water bodies are becoming highly polluted due to discharge of domestic, Agricultural and industrial wastage into them. Under these circumstances rain water harvesting is adopted which is a suitable method.

Rainwater harvesting is a technique of water conservation as this helps in recharging of ground water and helps agriculture purpose.

The rain water is stored by constructing special dug wells, pits, tanks, check dams etc...This stored water can be used for agricultural, industrial and domestic purpose.

- This helps in recharging ground water.
- It helps in reducing soil erosion.
- It helps in reducing floods.
- It fulfills the demand of water.

It is a technique developed in ancient Indian civilization. Some of the traditional water harvesting techniques are as follows

A. ***Kunds of Rajasthan:-***The rain water is collected in kunds which have a gentle slope towards center and a tank is constructed at centre.

B. ***Tanks in Gujarat:-***Understand tanks are constructed in Gujarat and this water is used for domestic purpose.

C. ***Temple ponds:-***Temple ponds in south India are used to store rain water.

D. ***Talabs:-***In north India they used to construct natural ponds which are used to store water and they use it for irrigation.

Thus rain water harvesting helps in increasing availability of water and a technique used to water conservation.

4. *WATERSHED MANAGEMENT*

Watershed is the area of land surrounding a river,lake,or pond which contributes to water entering into these water bodies. The size of watershed depends upon the geographical location.

The proper utilization of land and water resources for optimum production without damaging the natural resources is known as watershed management.

Benefits:

Watershed management benefits human beings as well as environment in many ways

- It helps in conversation of soil and water
- It helps in reducing soil erosion
- It helps in regeneration of vegetation in some unused lands
- It helps in increasing afforestation
- It helps in fuel wood plantation
- It helps in increasing natural resources

Thus water shed management is beneficial to environment

3. *WASTE LAND RECLAMATION.*

Large area of land around villages, towns, metro cities are not suitable for plant growth or agricultural sector. As they are unproductive, badly eroded and degraded lands.Utilising waste land for agricultural purpose is known as waste land reclamation.

Wastelands are of two types:

1) ***Cultivable wasteland: -*** The waste land which can be developed for agriculture or forestation is called as cultivable waste land.

2) ***Non cultivable waste land: -*** The waste land which cannot be developed for agriculture or forestation is called non cultivable waste land.

Ex: Rocky lands, snow covered land (thick layer of snow),deserts, high mountain lands etc.,

a) ***Spading: -*** The upper layer of soil is examined to know up to how much extent the waste materials like salts, chalk, pollutants are present. Then the layer is removed manually by using spades. This is called spading. This is the easy and simple method to convert waste land into productive land.

b) ***Watering or desalination:-*** The saline land which consists of large amount of salts and some inorganic and organic pollutants are converted into productive land by constructing strong leak proof bunds and they are filled with water and allowed to stagnate. These pollutants, salts will enter into water. Thus soil gets relieved from salts and gets desalted this soil can be used for agriculture purpose.

c) ***Chemical methods: -*** If the soil is acidic in nature it can be converted to normal by using alkalis' at very low concentration. This can be used for agricultural purpose. If the soil is alkaline, it can be treated with specific weak acids at very low concentration which makes soil fertile.

d) ***Green manures, fertilizers and bio-fertilizers: -*** Plants like blue green algae are called bio fertilizers they help to convert land into fertile land. Manure or nitrogen fertilizer help to increase fertility of soil.

e) ***Using plant debris: -*** The plant debris increases the fertility of soil with the help of bacteria. They mix with soil and soil becomes fertile.

There are few methods which help in increasing the fertility of land i.e which helps in waste land reclamation.

4. RESETTLEMENT AND REHABITATION

Natural disasters like earthquakes, cyclones, landslides, floods, droughts, volcanic eruptions and manmade activities such as construction of dams, roads, etc., are affecting habitat places of human beings. They are causing large scale destruction and disruption of infrastructure and services. Hence rehabitation and resettlement is required for the people in that affected area.

The following are the effects of people who live in that disrupted areas:-

- Loss of shelter, food
- Loss of essential goods
- Loss of agricultural lands effects productivity
- Effects tribal people as they live near water and valleys

- Increases mortality rate
- Imbalances the socio-economic status of that people.

Rehabitation and resettlement should be done in a way such that it helps people regain their socio economic standards.

- Supporting them financially this is done by government.
- Some non government organizations also should support volunteers
- Individuals (volunteer) should help them by volunteer activities like converting unhygienic areas into hygienic by cleaning all the waste material in the natural disasters occurred places.
- Some individuals should support them with domestic appliances and cloths.
- Government organizations should support them to establish small scale firms.
- Proper transport communication should be established between these disrupted areas and nearer urbanized areas
- By following these steps we can help people to settlement and rehabitat and carry their day to day activities.

5. *ENVIRONMENTAL LEGISLATION*

Environmental legislation means laws which protect and regulate problems related to natural resources and biodiversity and environment. Some of the environmental laws and acts are as follows:

1. ***Environment Protection Act 1986:-***This act came into force on 19th November 1986.This act mainly deals with protection of environment and it contains 4 chapters and 26 sections.

Important Functions:-This act deals with following:

- The standards of quality of air,water or soil for various areas and purposes are verified.
- The permissible limits of various environmental pollutants in different areas.
- The procedures and safeguards for handling of hazardous substances.
- The prohibition and restriction of few operations in industrial areas.
- The procedures and safeguard steps to prevent accidents which cause environmental pollution.
- Enforces bar of jurisdiction to civil court if any one violate the law.

2. ***The Air (Prevention And Control Of)Pollution Act 1981:-***This act came into force on 16th May 1981.IIt contains 7 chapters and 54 sections.

Important Function:-This act mainly deals with following:

- The permissible limits to discharge air pollutants by industries.
- Right to inspect any place and collect sample of air pollution.

- Power to declare air pollution control areas and prohibit use of fuels and appliances in such areas.
- Provision for constitution of state boards.
- Provision of punishment for offences by companies and offences by the government department.
- Powers of state and central government to make rules.
- Offenders shall be punishable with fine or imprisonment or with both.

3. ***Water (prevention and control of pollution)Act 1947:-*** This act came into force on 23rd March 1974.It contains 8 chapters and 64 sections.

Important Function:-The important features of the act are as follows:

- Power of entry and inspection.
- Prohibition of use of wells, streams for disposal of polluting matter.
- Central and state boards to control ,check the pollution
- Emergency measures can be taken in case of pollution of stream or well.
- Whoever fails to comply with any direction issued by central or state board shall be punishable with imprisonment or fine or with both.
- Powers of the central government and state government to make rules.

4. ***The wildlife protection act 1972:-***This act came into force on 9th December 1972 except Jammu and Kashmir. It contains 7 chapters and 66 sections.

Important Functions:-The important features of the act are as follows:

- The wildlife in protected areas cannot be haunted.
- State government can declare any area of forest as a sanctuary based on its bio diversity and ecological significance.
- Declares wild animals as government property.
- Picking of specified plants is strictly prohibited, but special permission is granted for scientific research and education.
- Killing dangerous animals in self defense would not be considered as offence.
- Hunting or unlawful activities is strictly prohibited and the person shall be punished by law.

5. ***The forest conservation act 1980:-***This act came into force on 25th October 1980 except Jammu and Kashmir

Important Features:-The main aim and features of the act are as follows:

- The effective measures to control deforestation.
- Forest shall be considered as natural resources not economic resource.

- Central government approval is required to use forest land for non forest purpose.
- Permission is granted for development activities and reforestation.
- To restrict encroachment of forest lands by land less tribal people
- Whoever fails to comply with this act shall be punished.

Thus environment legislation is provided to protect and improve environment and natural resources.

6. Factors and issues involving in enforcement of environment legislation:

Environment legislation helps in protecting of environment, natural resources and biodiversity. There are many problems and issues involved which is effecting the enforcement of environment legislation.

1. Population growth: High population pressure needs large amount of money, time and man power which effects the enforcement of environmental legislation.
2. Illiteracy: Lack of knowledge effects enforcement of environmental legislation as uneducated people fail to understand the significance of environment legislation.
3. Religious customs: Religious customs and ceremonies which involve discharge of idols of God into water bodies and some activities related to public sentiments effects enforcement of environment law.
4. Ignorance: Even educated people are unaware of environmental legislation. Therefore educated people require knowledge and awareness regarding environment legislation.
5. Insufficiency of law: Although a number of constitutional provisions and acts exists but there are insufficient laws related to wildlife trade, discharge of chemicals in water bodies, mining activities etc. which is effecting proper establishment of environment legislation.

These are few factors which are effecting the enforcement of environmental legislation.

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UNIT – VI
ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

Contents: ♦Environmental Management: Impact Assessment and its significance ♦various stages of EIA, ♦preparation of EMP and EIS, ♦Environmental audit. ♦Ecotourism ♦The student should submit a report individually on any issues related to Environmental Studies course and make a power point Presentation.

1. DEFINITIONS:

1. ***Definition of Impact:*** An impact can be defined as any change in physical, chemical, biological, cultural or socio-economic environmental system as a result of activities: relating to a project OR adverse effects caused by industrial, infrastructural projects OR by the release of a substance into the environment.
2. ***Definition of Impact Assessment:*** Impact assessment is the process of identifying the future consequences (bad results) of a proposed project. Impact Assessment ensures that projects, programs and policies are economically viable; socially equitable and environmentally sustainable.
3. ***Definition of Environmental Impact Assessment:*** The United Nations of Environmental Program (UNEP) defined that EIA is a tool used to identify the environmental and economic impacts of a project prior to decision making regarding the project planning, design, adverse impacts, etc.. For all proposed and development projects, whether Government or Private, the

→ Ministry of Environment and Forests (MoEF) requires an Environmental impact assessment report related to the following parameters:

- ♦ The report must define what impact it would have on water; soil and air including flora and fauna.
- ♦ Affect on the lives of local people.
- ♦ To ensure that no way harm the environment on a short term or long term basis.

2. CLASSIFICATION OF IMPACTS:

Environment impacts arising from any development projects fall into three categories:

i. Direct impacts
ii. Indirect impacts and
iii. Cumulative impacts.

According to their nature, these three groups reveal:

a. Positive and negative impacts
b. Reversible and irreversible impacts
c. Light, moderate and severe impacts
d. Local and widespread impacts
e. Short – term and long – term impacts

3. SIGNIFICANCE OF EFFECTS:

Significant effects are likely to occur where valuable resources are subject to impacts of severity. EIA is recognized by adopting the five levels of significance as described in the draft to good practice and procedures. These five levels of significances are::

- **Severe:** Sites of national importance and unique resources (to exist in only one place) if lost, cannot be replaced or relocated.
- **Major:** These effects are to be important considerations at a regional or district scale during the decision making process..
- **Moderate:** These effects at a local scale are likely to be key decision making issues.
- **Minor:** These effects may be raised as local issues but are unimportant in the decision making process.
- **Neutral:** No effect, not significant.

4. METHODS OF BASELINE DATA ACQUISITION:

An Environmental Baseline Study (EBS) is an investigation conducted to establish the level of contaminants in the project areas and to assess the extent of contamination. The information needed to conduct an EBS can be acquired from the available sources:

Land features include topography; climatology (temperature, rainfall)
Geology & Hydrogeology (Litho logy of rock formations, drainage pattern, ground water table)
Air environment (study of SPM, SO_x; NO_x)
Water Environment (pH; TDS; F; dissolved Oxygen; BOD etc..)
Soil quality Soil analysis reflect the presence of nutrients like N, P, K, Ca, Mg, Fe, Mn and Al
Flora and Fauna of the proposed area
Socio economic study include Population density; Literacy rate; Category of workers viz., cultivators, agriculture laborers, etc); Medical facilities ; Main sources of availability of water viz., rivers, canals, hand pumps, taps etc..

5. PREDICTION OF IMPACTS AND IMPACT ASSESSMENT SYSTEMS (METHODOLOGIES)

One of the main challenges in today's society is to access to have a relevant and quality environmental data.

An impact assessment system must consist of:

- All aspects of consequence reports (especially a bad result report) about existing and future emissions to air.
- Projection of pre-situation, accidental situations etc of the site area should be mapped.
- Screening to determine the effect of impacts in a proposed project require a full or partial impact assessment study
- To identify the potential impacts to assess the alternative solutions that avoid adverse impacts on biodiversity

6. E I A METHODOLOGIES : This include

1. Adhoc methods: In this method, each environmental area such as air; water and the nature of impacts (short term or long term; reversible or irreversible) are considered. This method

serves as a preliminary assessment which helps in identifying more important areas like: **Wildlife, Endangered species; Natural vegetation; Grazing; Natural drainage; Groundwater; Air Quality; Economic values; Public facilities** etc…

2. Checklist methodologies: Checklists in general are strong in impact identification. Impact identification is the most fundamental function of an EIA. These are of 4 broad categories used in E I A system. They are:

(i) Simple Check lists: A list of parameters without guidelines provided on how to interpret.

Examples for simple checklist parameters;

- → Land Use includes → open space, Agricultural land; Residential; commercial; Industrial.
- → Water resources include →Quality, irrigation; Groundwater
- → Air Quality include → oxides (S, C, N); SPM; Odors; Gases
- → Service Systems include →Schools; Police; Fire Protection; Water & Power System.
- → Biological conditions include →Wildlife; Trees, Shrubs.
- → Aesthetics include→ Scenery; Structures.

(ii) Descriptive checklists: A list of environmental parameters with guidelines provided on how to interpret.

(iii) Scaling Checklists: Similar to descriptive checklists with additional information.

(iv) Scaling Weighing Checklists: These are decision making parameters.

3. Matrix methods: A matrix should be considered as a tool for the purposes of analysis that means the interactions between various activities and environmental parameters

4. Network Matrix: Networks generally consider only adverse impacts on the environment and hence decision making in terms of the cost and benefit of a project to a region.

5. Overlay methods: These methods involve preparation of a set of maps, which represent the spatial distribution of certain parameters. For eg: extent of forest area. Geographic Information Systems are now being used for these methods.

6. Environmental Index: Following some of the codes are considered:

L denotes Criteria
P denotes completely satisfied
N denotes criteria not satisfied

7. Cost / benefit analysis: It provides the nature of expenses and benefits of a project.

Essential steps to complete an environmental impact assessment include:

- Describe the proposed project as well as options
- Describe the existing environment
- Select the impact indicators to be used
- Predict the nature of environmental effects
- Assess the significance of the impact

6. *Environmental impact statement:*

Most development projects such as industries, roads, railways and dams affect the lives of local people. New projects are called “Green Field Projects” where no development has been done. Projects that already exist but require expansion are called “Brown Field Projects.” Projects can be classified into

(a) Mild Projects
(b) Moderate Projects
(c) Serious Projects

Some projects may have a temporary impact during the construction phase which could be later become less damaging. In other situations the impact may continue and even the affect of impact may increase (for e.g.: where toxic solid waste will be constantly generated).

Environmental Impact Statement is a

- Tool for decision making.
- Document prepared to describe the affect of proposed activity.
- Document that describes the impacts as a result of proposal action.
- Council for Environmental Quality Regulations (CEQ) provide the recommended format and environmental impact statements , generally forwarded to MoEF.

The EIS has typically four sections

1. An introduction including a statement of the purpose and the need of the proposed action.
2. A range of alternatives to the proposed action.
3. A description of the affected environment
4. An analysis of the environmental impacts of each of the possible alternatives.

Hence an Environmental Impact Statement (EIS) which is a summary of the project is kept for the public to read,

- The venue and the time of public hearing is declared.
- Once the hearing is held, opinions have been expressed both for and against the project (positive and negative ideas).
- The recorded minutes of meeting both positive and negative are sent to the MoEF.

7. *Environmental Management Plan:*

Environmental Management Plan (EMP) is aimed to maintain the existing environmental quality. The main objective of EMP is to investigate specific activities which are related to adverse impacts. The impacts can be first minimized by various planning activities.

Some more measures can be practiced to minimize the impacts on environment are as follows:

- The debris and unutilized construction material from construction site should be removed immediately.
- Vehicles employed should be checked for proper emissions.
- Construction activities shall not be allowed at night times.

- The mitigation measures shall include regular maintenance of machinery and provision of productive equipment to workers where needed.

7.1. Green Belt Development

A **green belt** is a policy and used in land use plans to retain areas of largely undeveloped land or agricultural land surrounding or neighboring urban areas. Green belt development also has a special importance in hydro electric projects as the project construction process emanates lot of dust due to excavation works, crushing of material and batching of aggregates. In addition, air pollution also takes place due to vehicular movement during construction and operation phases. In order to combat different kind of pollutions and avoid land slips from the portion of catchment area, a green belt is usually developed along project site & around the reservoir.

The objectives of green belt policy are to:

- Protect natural or semi-natural environments;
- Improve air quality within urban areas; The green belt has many benefits for people:
- Walking, camping, and biking areas close to the cities and towns.
- Contiguous habitat network for wild plants, animals and wildlife.
- Cleaner air and water
- Better land use of areas within the bordering cities.

The general consideration involved while developing the greenbelt are:

- Trees growing up to 10 m or above in height should be planted.
- Planting of trees should be undertaken in appropriate encircling rows around the project site.
- Generally fast growing plant species should be planted.

7.2. WATER CONSERVATION & RAINWATER HARVESTING METHODS

Water conservation means "*saving water for future*". Water is necessary to man for many purposes and also for metabolic activities. Due to growth of population, industrialization and expanding agriculture have pushed up the demand for water. Efforts have been made to collect water by constructing dams, reservoirs, digging wells, and by implementing water shed management methods.

Water shed management means the wet lands should not be flooded with water and water logging should be avoided. Sprinklers (or) drip methods of water supply should be used. Ground water recharging by means of harvesting rain water is also should be used. In ancient India, water conservation methods were adopted for eg:

1) Indus Valley Civilization in Western & Northern India especially at both Mohenjo-Daro and Harappa.

2) Dholavira a village in Rann of Kutch area in Gujarat where a large number of tanks were made in the rural to provide drinking water.

3) In Tamil Nadu, the ancient people stored rain water in places separately one for drinking purpose and another for bathing and the other for domestic purposes and called them as ***Ooranies.***

4) *In* south India, temples are built with a small tank at the centre which is called as Koneru. During the monsoon season, these koneru's get filled with water so that they are used for many purposes.

I. Methods for water conservation:

A. Decreasing run-off losses: Huge water loss occurs due to run-off; which can be reduced by allowing the water to infiltrate into the soil. By adopting

(1) Contour cultivation (Cultivation across the slope without much skill to the benefit of conservation water in any region)

(2) Terrace farming (Construction of a series of benches for catching the runoff water where the slope is above 15 degrees)

(3) Water spreading (Water flow is controlled by a series of diversions with vertical intervals and small depressions are dug in the area for temporary storage of water)

(4) Surface residues (Crop residues, animal residues etc help reducing run – off by allowing more time for water to penetrate into the soil).

B. Reducing evaporation losses: This is more effective in sandy soil and less effective in loamy sand soils. A chemical called "super Slurper" (starch + Acrylonitrile) absorbs water if used in sandy soils.

C. Reducing irrigation losses: Irrigation in early morning/ late evening reduces the evaporation losses. Sprinkling and drip irrigation methods conserve water by 30%. Growing hybrid crop varieties with less water requirements help conserve water. *D. Increasing block pricing*: The consumer has to pay a proportionately higher electricity bill with higher use of water. This helps in economic use of water by the consumers.

E. Preventing wastage of water: Wastage of water is to be arrested in houses, commercial buildings, public places etc.. Closing taps when not in use; repairing leakages from pipes & using small capacity flush in toilets prevent wastage of water.

F. Rainwater harvesting Methods: Rainwater harvesting means collecting rain water on the roofs of buildings and storing it underground for later use.

II. Rainwater Harvesting Methods:

Rain water harvesting means collecting rain water and storing it underground for later use. Not only this method recharging the groundwater, has it also raised the water table and help augment water supply. Town and civic authorities in many cities in India are introducing by laws making rainwater harvesting compulsory in all new structures. Rain water harvesting methods are classified as., Traditional and Modern methods.

Traditional Rainwater Harvesting is still prevalent in rural areas as surface storage bodies like lakes, ponds, tanks etc..

Modern methods of Rainwater harvesting are include Absorption pit method; absorption well method; and recharge trench method and collecting rain water on the roofs of buildings and stored in underground.

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