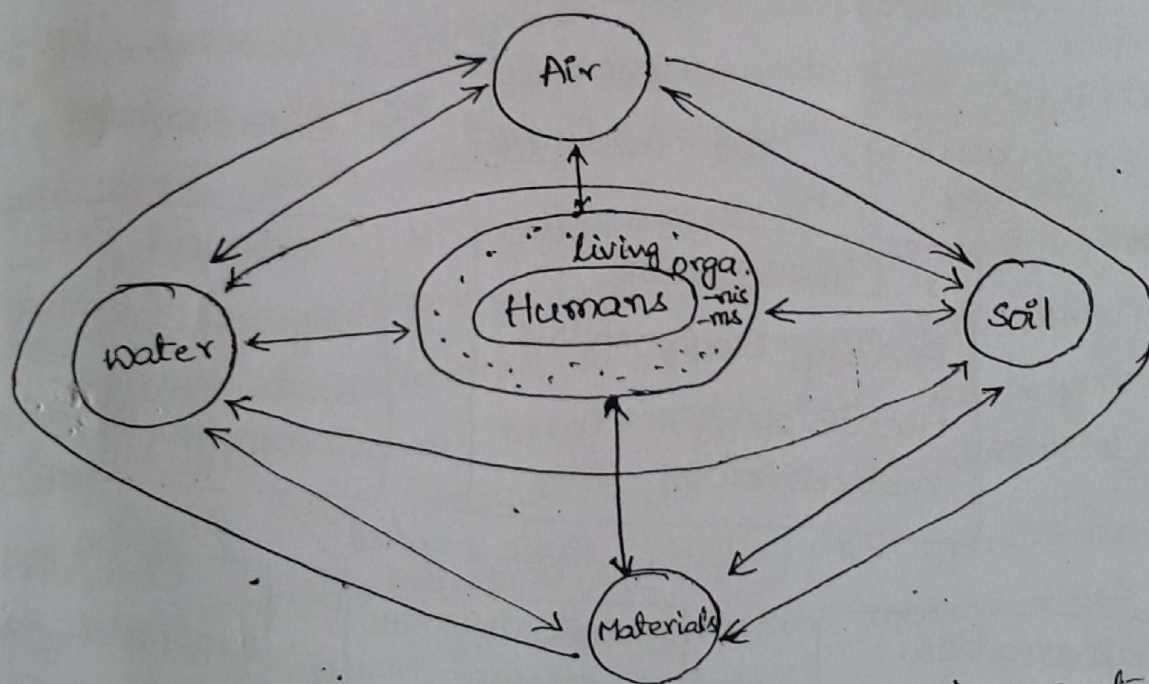


## - A Multidisciplinary Subject

\* 'Environment' is derived from the French word 'Environner' means to encircle or surround

\* Definition:- The sum total of water, air and land and the inter-relationships that exist among them and with the human beings, other living organisms and materials.

\* the concept of Environment can be clearly understood from the following figure.



The above figure depicts the environment of human beings. Air, water, land surrounding us constitute our environment, and influence us directly. At the same we too have an influence on our environment by overuse or over-exploitation

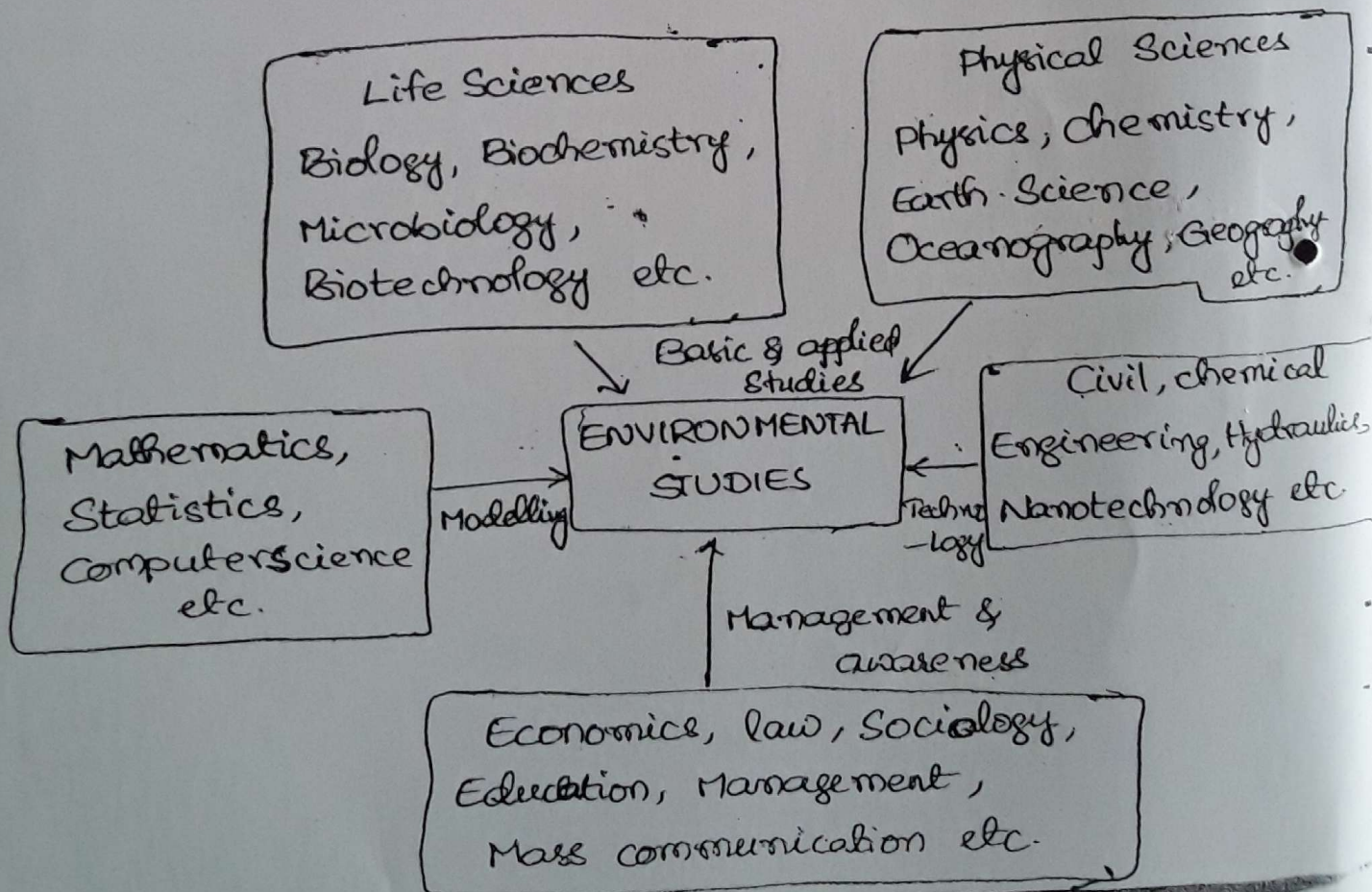


air, water and land.

Urban environment is somewhat different from rural environment. In urban environment we can see profound influence of human beings. Urban air, water and soil are loaded with various types of chemicals & wastes.

### \* MULTI DISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES:-

Keeping in view the complex nature of environment, knowledge inputs from various disciplines of Science, Social Science, law and Engineering are included in Environmental Studies.





→ Life Sciences including Botany, zoology, microbiology,<sup>2</sup> genetics and Biochemistry help in understanding the biotic components and their interactions.

Genetics and Biotechnology are emerging as useful tools for finding solutions to environmental problems.

→ Physics, Chemistry, Geology, atmospheric science, Oceanography and geography help in understanding the physical and chemical structure of abiotic components of environment along with mass and energy transfers.

→ Mathematics, Statistics and Computer science likewise serve as effective tools in environmental modelling.

→ Economics, management and sociology provide the inputs for dealing with the socio-economic aspects associated with various development activities.

→ A Synthesis of Civil Engineering, hydraulics, Chemical Engineering and Nanotechnology provide the technical solutions to environmental pollution control and waste treatment that are extremely important for protection of the environment.

→ Environmental laws provide the guidelines and legal measures for effective management and protection of the environment.

→ Environmental education and mass communication are too important subjects that are instrumental in disseminating environmental awareness.

Therefore, ES is a multidisciplinary subject where we deal with different aspects using a holistic approach.



Environmental studies has a wide scope.

The basic aspects of environmental studies are,

- Natural Resources - their conservation and management.
- Ecology and Biodiversity.
- Environmental pollution and control.
- Social issues related to development & Environment.
- Human population and Environment.

Environmental studies highly concentrating on more technical aspects like Environmental Science, Environmental Engineering & Environmental management.

Because of this scope, now we have several career options, that are broadly categorized as,

i) Research & Development (R&D) in Environment:-

→ There is a need for trained manpower at every level to deal with environmental issues, like: safe & clean drinking water, (Healthy) Hygienic living conditions, clean & free air, Fertile land, healthy food and sustainable development.

→ Because of strict pollution control laws, industries need Environmental experts to control pollution and waste disposals.

→ Environmental experts are now in great demand in Industries for adopting green technologies to reduce pollution.



(i) Green Advocacy :- For implementing various acts

and laws related to Environment, need for Environmental lawyers, who should be able to plead the cases related to water and air pollution, Forest, wild-life etc.,

(ii) Green Marketing :- We can recognize the quality of the product with ISO mark. Now-a-days we are considering quality and Environmental friendly nature of the product. Such products have ecomark or ISO 14000 certification.

(iv) Green Media :- Environmental awareness can be spread among the public through mass media like T.V., Radio, news paper, magazines, boardings, advertisements etc.,

(v) Environment Consultancy :- Many Government, non-government organizations (NGO), industries are engaging environmental consultants for systematically studying and tackling ~~the~~ environment related problems.

### \* IMPORTANCE OF ENVIRONMENTAL SCIENCE :-

- Environmental science is a branch of philosophy that deals with the aspects of the nature.
- Man used his intelligence and conveniently classified his surroundings into several branches of science such as Botany, zoology etc.
- For his existence, comfort, Expansion & development man started doing Experiments on Nature.



Due to his damage caused by his experiments to the Nature, man felt necessary to understand the Environment.

→ For the study of Environment he introduced a new branch of Science "Environmental Science".

### \* Necessity to study the Environmental Science:-

→ It helps the society for the basic understanding of Environment, identifying and solving associated problems.

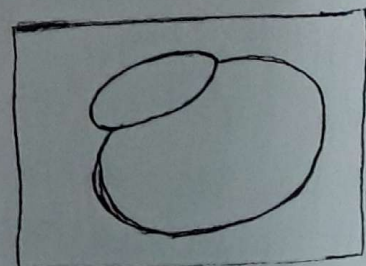
→ It helps for self-development which helps in maintenance of healthy life.

→ It helps us for understanding the Environment and hazardous leading to pollution of air, water and soil.

### Concept of Ecomark:-

In order to increase consumer awareness about environment, the GOI has introduced a scheme of eco-labelling of consumer products as 'Ecomark' in 1991. It is an 'earthen-pitcher' a symbol of eco-friendliness and our traditional heritage. A product that is made, used & disposed off in a harmless manner is called ecofriendly and is awarded this eco-mark.

ECOMARK of  
INDIA.





**Environmental Awareness:**

It is absolutely essential to create awareness because:

- Environment belongs to all and participation of masses is a must for successful implementations of environmental protection plans.
- Environmental awareness is needed to change the mindset of modern society.
- Public must be made aware of serious health impacts of environmental pollution and their right to live in a clean and healthy environment.
- There is an urgent need to create awareness amongst people that we have no other option but to follow sustainability principles.

**1.4 Sustainability:**

There is a need for discussion to evolve strategies for environmental issues for sustainable development. So heads of nations or their representatives meet at a common platform for discussion and sign agreements reach at unanimously. Such meetings are called by various names like International agreements, protocols, covenants or conventions.

**Stockholm Conference, 1972:**

The United Nations Conference on the Human Environment was held at Stockholm from 5-16 June 1972, considering a need for common principles to guide the people of the world for the preservation and enhancement of the environment. The conference declaration contained 26 principles concerning the environment and development. Few of the important ones are given below;

- Natural resources must be safeguarded.
- Wildlife must be safeguarded.
- Non renewable resources must be shared and not exhausted.
- Pollution must not exceed the environment's capacity to clean itself.
- Damaging oceanic pollution must be prevented.
- Integrated development planning is needed.
- Environmental education is essential.



The Earth Summit (Rio Summit), 1992:

It also called the United Nations Conference on Environment and Development (UNCED) which took place on 3-14 June 1992 in Rio de Janeiro, Brazil. Nearly 180 heads of states or their representatives and about 30,000 delegates participated in the conference. The Earth Summit focused on:

- An Earth Charter aiming at development and protection of environment.
- Agenda-21, the global action plan for sustainable development.
- Substantial development in new funding from developed countries to aid in the sustainable development in the south.

There was disagreement on two issues:

1. Reduction of green house gas emission by 20% by 2000.
2. Conservation and management of biodiversity.

1.6 Global Environmental Challenges

While some environmental issues are of local nature, there are some which are of global concern. Issues like global warming and climate change, ozone layer depletion, acid rains and population growth are of major concern for the entire world.

Global Warming

Troposphere, the lowermost layer of atmosphere, traps heat by a natural process due to the presence of certain gases. This effect is called 'Green House Effect'. It is similar to the warming effect observed in the horticultural green house made of glass. The major green house gases are carbon dioxide, ozone, nitrous oxide, chlorofluorocarbons (CFCs) and water vapour. The average global temperature is  $15^{\circ}\text{C}$ . In the absence of green house gases this temperature would have been  $-18^{\circ}\text{C}$ . Therefore green house effect contributes a temperature rise to the tune of  $33^{\circ}\text{C}$ . Heat trapped by these gases in the atmosphere keep the earth warm enough to allow us and other species to exist.

Due to anthropogenic activities there is an increase in the concentration of the green house gases in the air that absorb infrared light containing heat. Therefore these gases are trapping more heat and thereby increasing the average surface temperature beyond  $15^{\circ}\text{C}$ . This phenomenon is referred to as 'Enhanced Green House Effect' to distinguish its effect from the one that has been operating naturally for millennia.



Carbon dioxide

- ❖ Contributes 55% to global warming due to human activity
- ❖ Main sources: Fossil fuel burning, deforestation
- ❖ It stays in the atmosphere for 500 y
- ❖ In 1990 its concentration in the atmosphere is 355 ppm, and it is increasing at the rate of 1.5 ppm/y.

Chlorofluorocarbons (CFC)

- ❖ Contributes 24% to global warming due to human activity
- ❖ Main sources: leaking AC, fridge, evaporation of industrial solvents, aerosols, propellants
- ❖ It depletes ozone in stratosphere
- ❖ It generally traps 1500-1700 times more heat per molecule than  $\text{CO}_2$  while they are in troposphere
- ❖ It stays in the atmosphere for 65-110 y
- ❖ Atmospheric Concentration of CFC is 0.00225 ppm, and it is increasing at the rate of 0.5% annually

Methane ( $\text{CH}_4$ )

- ❖ Contributes 18% to enhanced Green House Gases
- ❖ Main sources: when bacteria break down dead organic matter in moist places, production and use of natural gas, incomplete burning of organic material
- ❖ It stays in the atmosphere for 7-10 y
- ❖ It generally traps 25 times as much heat as  $\text{CO}_2$  molecule
- ❖ Atmospheric Concentration of  $\text{CH}_4$  is 1.675 ppm, and it is increasing at the rate of 1% annually

Nitrous Oxide ( $\text{N}_2\text{O}$ )

- ❖ Contributes 6% to global warming due to human activity
- ❖ Main sources: burning of biomass, nitrogen rich fuels (coal), break down of Nitrogen fertilizers in soil, live stock wastes and nitrate contaminated ground water
- ❖ It stays in the troposphere for 140-190 y



- ❖ It depletes ozone in stratosphere
- ❖ Atmospheric Concentration of  $N_2O$  is 0.3 ppm, and it is increasing at the rate of 0.2% annually
- ❖ It traps 230 times as much heat per molecule as  $CO_2$

### Impacts of enhanced green house effect

#### 1. Global temperature rise:

It is estimated that the earth's mean temperature will rise between  $1.5-5.5^\circ C$  by 2050 if the input of green house gases continues at the present rate. Even at the lower value earth would be warmer than it has been for 10,000 years.

#### 2. Rise in sea level:

Increase in global temperature will melt the polar ice caps and glaciers resulting in rise in sea level. Current models indicate that an increase in  $3^\circ C$  of temperature would cause the sea level to rise 0.2-1.5 m over the next 50-100 years. One meter rise in sea level will submerge low lying areas of cities like Shanghai, Bangkok, Venice as well as agricultural low lands and deltas in Bangladesh, India and China and affect their productivity.

#### 3. Effects on human health:

The global warming will lead to changes in the rainfall pattern in many areas, thereby affecting the distribution of vector borne diseases like malaria, filariasis etc. Warmer temperature and water stagnation would favour the breeding of mosquitoes, snails and some insects, which are the vectors of such diseases. High temperature and humidity will increase respiratory and skin diseases.

#### 4. Effects on agriculture:

Tropical and subtropical regions will be more affected since the average temperature in these regions is already on the higher side. Soil moisture will decrease and evapo-transpiration will increase, which may dramatically affect the wheat and maize production. Increase in temperature and humidity will increase the pest growth and they will adapt to such changes better than crops.



**Measures to check global warming**

- 1) Reduction of green house gas emission
- 2) Cut down the current rate of use of CFC's and fossil fuels.
- 3) Increasing plantation
- 4) Stabilize population growth
- 5) Shift to renewable energy resources
- 6) Adopt sustainable agriculture
- 7) Efficiently remove carbon dioxide by utilizing photosynthetic algae

**Climate change:**

Climate is the average weather of an area. It is the weather conditions, seasonal variations and extremes of weather over a long period, at least 30 years. We had a relatively stable climate for 10,000 years and the mean average temperature fluctuated by 0.5-1.0 °C. **Climate change** refers to the changes in the average weather conditions due to anthropogenic (man-made) activities which are upsetting the delicate balance of various components of the environment. Human activities like industrialization, energy production and urbanization are the main causes of global climate change.

**Acid Rain:**

**Definition:** Rain, snow or precipitation containing a high amount of acidity is called acid rain.

When fossil fuels such as coal, petroleum and natural gas are burned, chemicals like sulphur dioxide ( $\text{SO}_2$ ) and nitrogen oxides ( $\text{NO}_x$ ) are produced. These chemicals react with water in the air to form sulphuric acid ( $\text{H}_2\text{SO}_4$ ) and nitric acid ( $\text{HNO}_3$ ). These acids increase the acidity of the rain water, thus causing acid rain. In normal rain water the pH is about 5.6, which is slightly acidic due to the dissolution of carbon dioxide. However in the acid rain the pH falls well below 5.6 causing acidity. Acid rain was first discovered in 1800's in Great Britain. Acid rain deposition occurs in two ways;

- 1) **Wet deposition:** Wet deposition of acid occurs when any form of precipitation removes acids from the atmosphere and delivers it to the earth's surface.

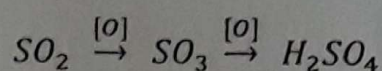


Generally sulphuric acid forms a major fraction of acid rain followed by nitric acid and a very small fraction of other acids.

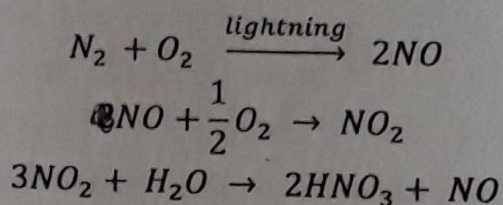
- 2) Dry deposition: Acid deposition also occurs via dry deposition in the absence of precipitation. This occurs when particles and gases stick to the ground, plants or other surfaces. On moist surfaces these gases can dissolve and form acids.

#### Mechanism of formation of acids

- 1) Sulphuric acid:



- 2) Nitric acid:



#### Sulphur dioxide (SO<sub>2</sub>):

- ❖ Natural source: volcanic eruptions and decomposition of organic materials.
- ❖ Man made sources: combustion of coal from thermal power plants, oil refineries and natural gas wells.

#### Nitrogen oxides (NO<sub>x</sub>):

- ❖ Natural source: Bacterial action in soil and chemical reactions in the atmosphere.
- ❖ Man made sources: burning of fossil fuels at high temperatures, from supersonic jet planes.

#### Effects of Acid rain:

Acid rain has a number of harmful effects below pH 5.1. The effects are visible in the aquatic system even at pH less than 5.5.



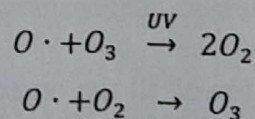
- 1) It causes deterioration of buildings especially made of marble. Crystals of calcium and magnesium sulphate are formed as a result of corrosion.
- 2) It damages metals and car finishes.
- 3) Aquatic life is badly affected by Lake Acidification.
- 4) It damages foliage and weakens trees.
- 5) It affects the plant photosynthesis.
- 6) It also affects wildlife and it disrupts the food chain.
- 7) Acid pollutants cause respiratory problems in humans.

#### Control Of Acid Rain:

- 1) Emission of SO<sub>2</sub> and NO<sub>2</sub> from industries should be reduced by using pollution control equipment.
- 2) Coal with low sulphur content is desirable for use in thermal plants.
- 3) Liming of lakes and soils should be done to correct the adverse effects of acid rain.
- 4) A coating of protective layer of inert polymer should be given in the interior of water pipes for drinking water.

#### Ozone layer depletion

Ozone is a colourless gas which is found in the stratosphere of our atmosphere. The ozone layer plays an important role in protecting us from harmful UV radiation from Sun. The ozone layer absorbs these harmful UV radiations and thus prevents these rays from entering the earth's atmosphere. The UV radiation causes photo dissociation of ozone in to oxygen molecule (O<sub>2</sub>) and radical (O<sup>•</sup>) in the stratosphere, but they quickly recombine to form ozone. So ozone is constantly got created and destroyed by Chapman cycle, which is a natural process.



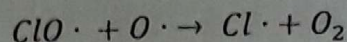
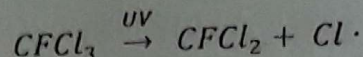
Ozone layer thickness in the stratosphere is measured in Dobson units (DU). If the thickness of the ozone layer is less than 220 DU, then it is referred to as an ozone hole is formed. A number of pollutants entering into the stratosphere deplete



the ozone layer. The pollutants are chlorofluorocarbons (CFC's), methane (CH<sub>4</sub>) and nitrogen oxides (NO<sub>x</sub>).

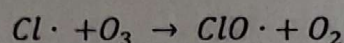
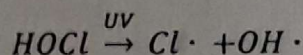
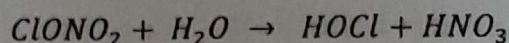
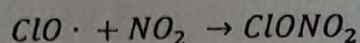
#### Mechanism of ozone layer depletion

By CFC:



The chlorine free radical formed will again attack the ozone molecule and the process continues repeatedly depleting ozone layer.

By NO<sub>2</sub>



#### Effects of ozone layer depletion

- 1) Ozone layer depletion increases the amount of UV radiation reaching the earth's surface. The UV radiation affects DNA and the photosynthetic chemicals.
- 2) Easy absorption of UV rays by the lens and cornea of eye will cause cataracts.
- 3) Yields of vital crops like wheat, corn etc. will decrease.
- 4) Degradation of paints, plastics and other polymer material will result in economic loss due to effects of UV radiation.
- 5) It also causes global warming.

#### Population Growth:

A population is the summation of all the organisms of the same group or species, which live in a particular geographical area. There is dramatic increase in global human population in the last few centuries. It took about 39,000 years of human



history to reach 1 billion, 130 years to reach two billion, 45 years to reach four billion and the next doubling is likely within a span of few decades.

With scientific and technological advancement, life expectancy of humans has improved. People started living in definite settlements leading a more stable life with better sanitation, food and medical facilities. Victory over famine related deaths and infant mortality became instrumental for a rapid increase in population size.

#### Population explosion and its effects

The unprecedented growth of human population at an alarming rate is referred to as population explosion. There has been a dramatic reduction in the doubling time of the global human population. In 2011, the world population reached 7 billion and it is predicted to grow four times in the next 100 years. Population explosion is causing severe resource depletion and environmental degradation. Our resources like land, water and fossil fuels are limited and over exploitation leads to exhaustion. So, the governments are introducing birth control programs to shrink the population. There are two important views on population growth which are discussed below;

1) Malthusian theory: According to Malthus human populations tend to grow at an exponential rate whereas food production increases very slowly or remains stable. Therefore starvation, poverty, disease, crime and misery are invariably associated with population growth. He believes preventive checks like birth control need to stabilize population growth.

2) Marxian theory: According to Karl Marx, population growth is a symptom rather than cause of poverty, resource depletion, pollution and social ills. He believed that social exploitation and oppression of the less privileged people leads to poverty, overcrowding, unemployment degradation that in turn causes over population.

A compromise between the two views is required because all these factors seem to be interrelated and interdependent.



### Role of Information Technology in Environment and Human health

IT has tremendous potential in the field of environmental education and health as in any other field like business, economics etc. Development of internet facilities and information through satellites has generated a wealth of up to date information on various aspects of environment and health.

Database is the collection of inter related data on various subjects. In computer the information of database is arranged in a systematic manner that is easily manageable and can be very quickly retrieved. Some of the important information systems are discussed below:

#### 1) Environmental Information System (ENVIS)

The ministry of Environment and Forests has established an Environmental Information System (ENVIS) as a plan program in 1982. The focus of ENVIS is on providing environmental information to decision makers, policy planners, scientists and engineers all over the country. ENVIS has a network of several participating institutions organizations known as ENVIS centres. The ENVIS centres work for generating a network of database in areas like pollution control, clean technologies, remote sensing, coastal ecology, etc.

The major objectives of ENVIS are:

- To build up a repository and disseminating centre in Environmental science and engineering.
- To gear up the modern technologies of acquiring, processing, storage, retrieval and dissemination of information of environmental nature.
- To support and promote research, development and innovation in environmental information technology.
- To provide national environmental information service relevant to present needs and capable to development to meet the future needs.

#### 2) National Management Information System (NMIS)

It is set up Department of Science and Technology (DST) and has compiled a database on Research and Development projects along with the information about research scientists and personnel involved.



### 3) Geographical Information System (GIS)

Satellites imageries provide us actual information about various physical and biological resources in a digital form through remote sensing. We are able to gather digital information on environmental aspects like water logging, desertification, deforestation, and so on. GIS has proved to be a very effective tool in environmental management. GIS is technique of superimposing various thematic maps using digital data on a large number of inter related aspects. Several useful softwares have been developed for working in the field of GIS.

#### Applications of GIS:

- GIS is very useful for future land planning.
- Interpretations of polluted zones, degraded lands or diseased cropland etc. can be made based on GIS.
- Planning for locating suitable areas for industrial growth is now being done using by preparing Zoning Atlas.
- GIS serves to check unplanned growth and related environmental problems.
- Satellite data also helps in providing correct, reliable and verifiable information about forest cover, success of conservation efforts etc.
- GIS also provides information of atmospheric phenomena like approach of monsoon, ozone layer depletion, smog etc.
- It can explore and discover new reserves of oil, minerals etc. with the help of information generated by remote sensing satellites.
- It also helps in identifying several disease infected areas which are prone to some vector borne diseases.

Thus GIS plays a key role in resource mapping, environmental conservation, management, planning and environmental impact assessment.



### 3. ECOSYSTEMS

An Ecosystem is a group of biotic community of species, interacting with one another and with their non-living environment exchanging energy and matter.

→ we have various kinds of life supporting systems (Ecosystems) like the forests, grasslands, oceans, lakes, rivers, deserts.

✶ "The study of Ecosystems is defined as Ecology"

→ The term Ecology was coined by Ernst Haeckel. It is derived from the Greek words:

$\text{oikos} = \text{home} + \text{logos} = \text{study}$ .

"So Ecology deals with the study of organisms in their natural home, interacting with their surroundings."

— Ecosystem characteristics:- All Ecosystems are characterized by certain basic structural and functional features which are common.

#### \* STRUCTURAL FEATURES:-

Composition and organization of biological communities and abiotic components constitute the structure of an Ecosystem.

(I) Biotic structure:- The plants, animals and micro-organisms present in an Ecosystem form the biotic component. These are divided as producers or consumers, based on how do they get their food.



(a) Producers:- They are mainly the green plants, which can synthesize their food themselves by making use of  $\text{CO}_2$  present in the air and water in the presence of sunlight by using chlorophyll, the green pigment present in the leaves, by the process of photosynthesis. They are also known as photoautotrophs [photo-light, auto-self, troph-food]

There are some micro-organisms which can produce organic matter by the oxidation of some chemicals in the absence of sunlight. They are known as chemo-autotrophs.

(b) Consumers:- Organisms which get their organic food by feeding upon other organisms are called Consumers.

These are in following types:-

(1) Herbivores (plant eaters) : They feed directly on producers and hence also known as "primary Consumers".

Ex: rabbit, insects, grasshopper.

(2) Carnivores (meat eaters) :- They feed on ~~herbivores~~ or other Consumers.

→ If they feed on herbivores they are called Secondary Consumers.

Ex: frog, ~~to~~ small fish

Primary Carnivores

→ If they feed on other Carnivores, they are known as tertiary Consumers or Secondary Carnivores.

Ex: Snakes, big fish

(3) Omnivores:- They feed on both plants and animals.

Ex: Humans, rat, fox, many birds.



(4) Detritivores [ Dead organism feeders ]:- They feed on the parts of dead organisms, wastes of living organisms, their partially decomposed matter.

Eg: Beetles, termites, ants, crabs, earthworms etc.

(c) Decomposers:- They derive their nutrition by breaking down the complex organic molecules to simpler organic compounds and ultimately into inorganic nutrients

Dead organism  $\xrightarrow{\text{Decomposers}}$  Cellulose  $\xrightarrow{\text{Decomposers}}$   $\text{CO}_2$ , methane--

Ex: Bacteria and fungi are decomposers.

I. Abiotic structure:- The physical and chemical components of an ecosystem consider as its abiotic structure. It includes climatic factors, soil factors, geographical factors, Energy, nutrients and toxic substances.

(a) physical factors:- The sunlight and shade, duration of sun, average temperature, maximum-minimum temperature, annual rain, wind, soil type, water availability etc are some of the important physical factors which have a strong influence on the ecosystem. We can clearly see the difference in temperature and precipitation (rainfall, snow etc), pattern in a desert ecosystem, in tropical rainforest and in tundra ecosystem.

(b) chemical factors:- Availability of major essential nutrients like Carbon (C), phosphorus (P), potassium (K), Hydrogen ( $\text{H}_2$ ), Nitrogen ( $\text{N}_2$ ), Oxygen ( $\text{O}_2$ ) and Sulphur (S), levels of toxic substances, salts, salinity and many organic substances present in the soil or water largely influence the functioning of the ecosystem.



(3)

Energy Flow:- The functioning of ecosystem depends on the flow of Energy. Energy enters the ecosystem from the solar radiations and is converted into chemical form by the producers. From there the Energy passes from one trophic level to the next through food.

The flow of Energy, in the Ecosystem is governed by two basic laws of thermodynamics. i.e

- (1) Energy can neither be created nor destroyed, but can be transformed from one state to another, or transferred from one component to another.
- (2) Every transformation or transfer of Energy is accompanied by its dispersion. Therefore, one hundred percent transformation of Energy from one form to the other or transfer from one organism to the other is not possible. It is always accompanied by some dispersion or loss of Energy in the form of heat.

There are two aspects with respect to energy flow in Ecosystem.

- (1) There is unidirectional or one way flow of Energy in the Ecosystem i.e from producers through herbivores to Carnivores. The Energy cannot be transferred in the reverse direction. i.e the Energy captured by the autotrophs does not revert back to solar input, or the Energy which passes to the herbivores does not pass back to the autotrophs.

The amount of Energy flow decreases with successive trophic levels.

Producers capture only a small fraction of solar Energy, and the unutilized Energy dispersed mostly as heat. Part of Energy captured in gross primary



Production (Gpp) is used for maintenance of their respiration and for providing food to herbivores. The unutilized net primary production (Npp) is ultimately converted to detritus, which serves as energy source to decomposers. Thus Energy actually used by the herbivore trophic level is only a small fraction of the Energy Captured at the producer level.

+ [The Energy Consumed by the herbivores is used in respiration and a fraction of consumed Energy is transferred to decomposers. The herbivore level of Energy either utilized by the Carnivores or gets transferred to decomposers after the death of herbivores. In this way, again only a small fraction (i.e. about 1% of herbivore productivity) is used to support Carnivore productivity. In the same way, the Energy available at Carnivore trophic level is again divided, leaving a very small fraction to support the next trophic level i.e. top Carnivore.]

With increasing trophic levels, the respiration cost also increases sharply. On an average, Producers consume about 20% of their gross productivity in respiration. The herbivores consume about 30% of consumed Energy in respiration. In Carnivores, the proportion of transferred Energy consumed in respiration rises to about 60%. Thus, there is a tremendous loss of Energy at successive higher trophic levels.



Graphic representation of trophic structure and function of an Ecosystem, starting with producers at the base and successive trophic levels forming the pyramid apex is known as "Ecological pyramid".

In a pyramid, various steps of food chain are represented sequence wise, with producers at the base, herbivores above them followed by Carnivores and so on, with top Carnivores at the top. An Ecological pyramid can be upright or inverted.

Ecological pyramids are of 3 types.

### ✓ Pyramid of Numbers:-

A graphic representation of number of individuals per unit area of various trophic levels, stepwise with producers forming the base and top Carnivores at the tip is called Pyramid of numbers.

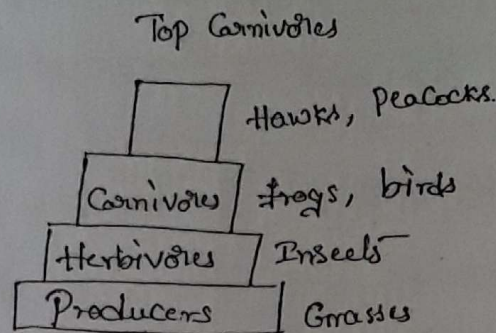
It represents the number of individual organisms at each trophic level. We may have upright or inverted pyramid of numbers, depending upon the type of Ecosystem and food chain.

For Example:- In a grassland, a large number of grass or herbs are the producers. These are small in size and very large in number. So, the producers form a broad base.



The herbivores in a grassland are insects, grasshoppers etc, are less in number. These are feed by fewer number of frogs, and the frogs still feed by fewer number of snakes. These are feed by very few peacocks or eagles, hence the pyramid apex becomes gradually narrower forming an upright pyramid.

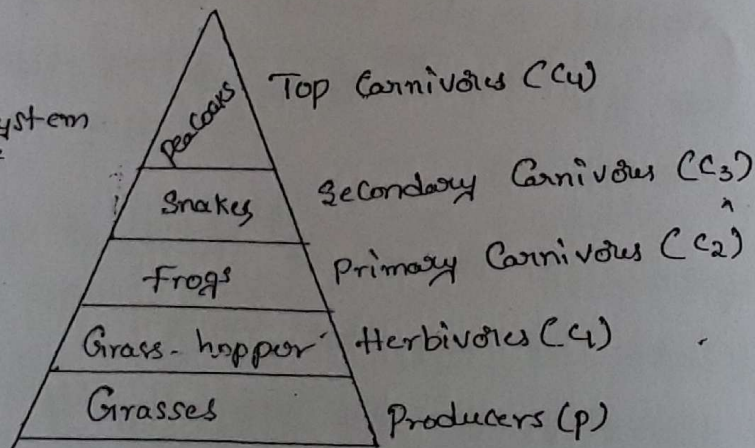
### Pyramid of Numbers — Grassland.



upright pyramids  
of Numbers.

(or)

### Grassland Ecosystem

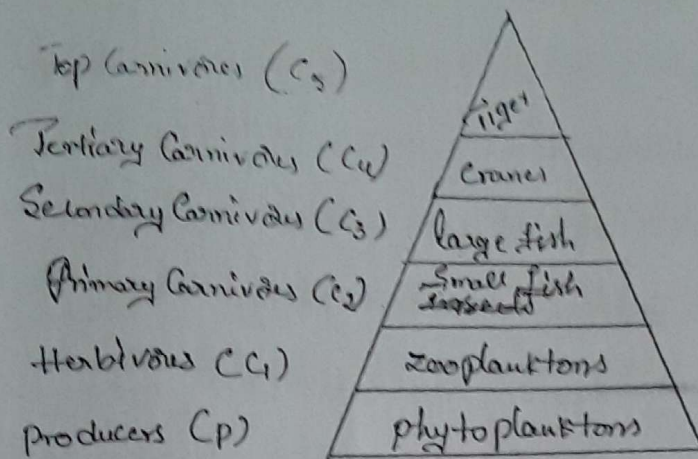


Pond Ecosystem :- The producers in the ponds are phytoplanktons, which are smaller in size and very large in number. So, the producers form a broad base. Herbivores, Carnivores and top Carnivores in pond decrease in number at higher trophic levels.

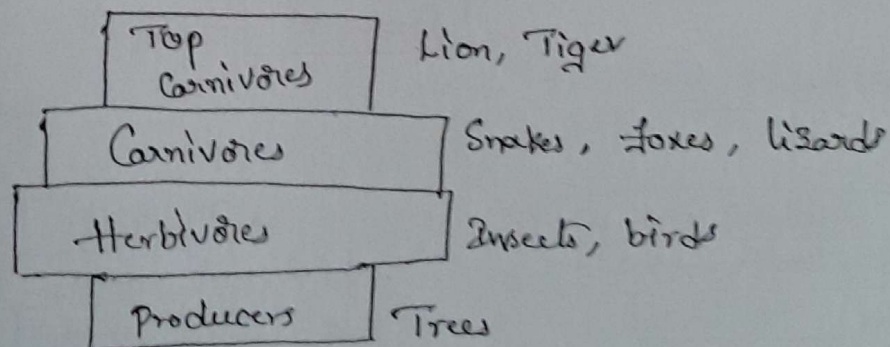


## Pond - Ecosystem

Notes



Forest Ecosystem:- In a forest Ecosystem, big trees are the Producers, which are less in number and hence form a narrow base. A large number of herbivores including birds, insects and several species of animals feed upon the trees and form a much broader middle level. The Secondary Consumers like fox, snakes, lizards etc are less in number than herbivores, while top Carnivores like lion, tiger etc are still smaller in number. So the pyramid is narrow on both sides and broader in the middle.



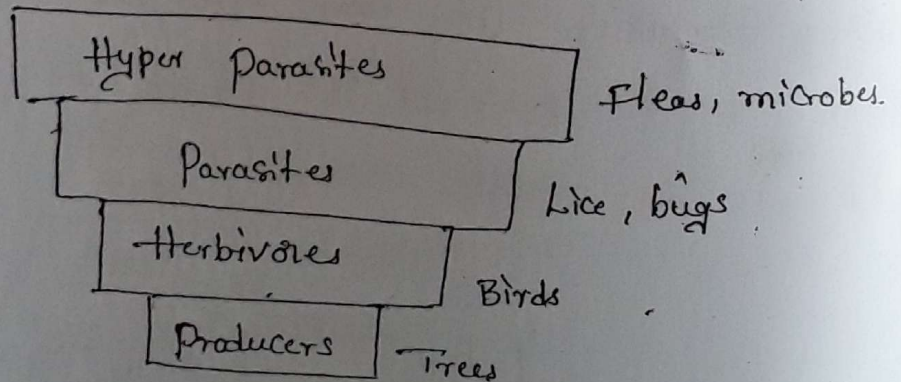
Forest Ecosystem



### Parasitic food chain:-

Parasitic food chain shows an inverted pyramid of numbers. The producers like trees which are less in number. Herbivores or fruit eating birds acting like herbivores which are larger in number. A much higher number of lice, bugs etc grow as parasites on these birds, while a still greater number of hyperparasites like fleas and microbes feed upon them. Thus making an inverted pyramid.

### Parasitic food chain





Pyramid of biomass :- It is based upon the total biomass at each trophic level in a food chain. The amount of living organic matter present in a particular environment is called biomass. It is measured both as fresh and dry weight.

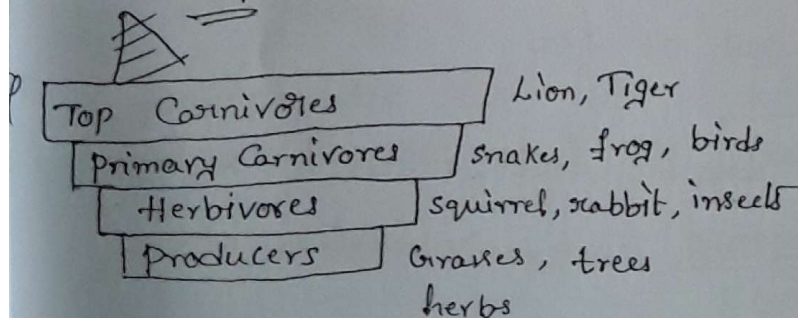
"A graphic representation of biomass present sequentially per unit area of different trophic levels, with producers at the base and top carnivores at the tip, is called pyramid of biomass."

• In a terrestrial ecosystem, the maximum biomass occurs in producers and there is progressive decrease in biomass from lower to higher trophic level. The pyramid of biomass can also be upright or inverted.

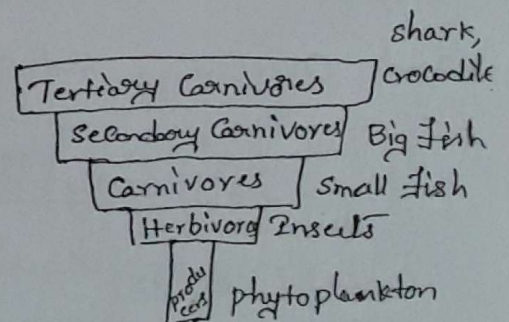
The pyramid of biomass in a forest is upright in contrast to its pyramid of numbers. This is because the producers (trees) contain a huge biomass while the consumers (total biomass feeding on them) decreases at higher trophic levels, resulting in broad base and narrow top.

### Pyramid of biomass

(a) Forest / Grassland



(b) Pond Ecosystem





The pond Ecosystem shows an inverted Pyramid of biomass. The total biomass of producers (phytoplanktons) is much less. Compared to herbivores (zooplanktons), Carnivores (small fish), Secondary Carnivores (big fish) & tertiary Carnivores (Crocodiles). Thus the Pyramid takes an inverted shape with narrow base and broad apex.

Pyramid of Energy:- A graphic representation of the amount of Energy trapped per unit time and area in different trophic levels of a food chain with producers forming the base and the top Carnivores at the tip, is called Pyramid of Energy.

The amount of Energy present at each trophic level considered for this type of pyramid. Pyramid of Energy gives the best representation of the trophic relationships and it is always upright. The Energy Content is generally expressed as  $\text{Kcal/m}^2/\text{yr}$  or  $\text{KJ/m}^2/\text{yr}$ . Maximum Energy Content is present in the Producers. The Energy Content decreases as it passes into higher trophic levels, because of its utilization for several life activities and Overcoming Entropy as well as heat.

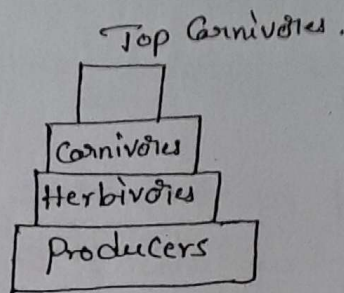
At every successive trophic level, there is a huge loss of Energy in the form of heat, respiration etc.



Thus, at each next higher level only 10% of the Energy passes on. Hence, there is a sharp decrease in Energy level of each successive trophic level as we move from producers to Carnivores. Therefore, the Pyramid of Energy is always upright.

Pyramid of Energy:-

Forest Ecosystem

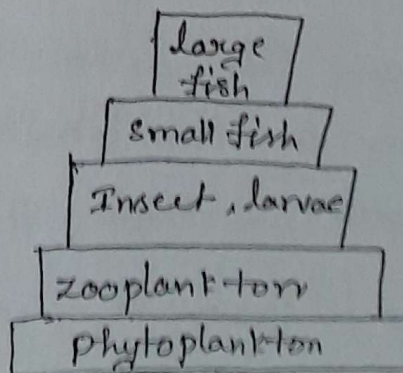


⇒ According to Odum, in a pond Ecosystem, phytoplanktons trap huge amount of solar Energy. The Zooplanktons and other herbivores, which feed upon the Phytoplankton possess less amount of Energy. They feed by primary Carnivores (insects, larvae, and small fishes) with a very ~~smaller~~ less Energy Content. They feed by secondary Carnivores (large fishes), which have still less Energy Content.

Pyramid of Energy

in a pond/aquatic

Ecosystem:-





Every Ecosystem performs some functions, under natural conditions in a systematic way.

→ It receives Energy from the sun and passes it on through various biotic components.

→ In fact all life depends upon this flow of Energy.

→ Besides Energy, various nutrients and water are also required for life.

→ which are exchanged by the biotic components with in themselves and with their abiotic components.

⇒ The major functional attributes of an Ecosystems are as follows

(1) Food chain, Food web and trophic structure.

(2) Energy flow

(3) Cycling of nutrients

(4) Primary and Secondary production

(5) Ecosystem development and regulation.

#### (1) Trophic Structure

The structure and functions of Ecosystems are very closely related and influence each other.

→ The producers and Consumers are arranged in the Ecosystem in a definite manner and their interaction along with population size are expressed together as trophic structure.

→ Each food level is known as trophic level.



## Food chain :-

In the Ecosystem various trophic levels are Connected through food chain.

→ The transfer of Energy from one trophic level (Eg. producers) to the next trophic level (Eg. Consumers) is called food chain.

→ All types of Ecosystems possess two types of food chain :

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

1. Grazing food chain :- It extends from producers through herbivores to Carnivores.

● Producers are auto-trophic organisms, which synthesise organic food from simple inorganic raw materials through photosynthesis utilizing solar Energy.

→ A part of the food synthesised by the producers is used for their body growth, while the rest is utilized in providing Energy for various life activities.

→ A The animals that feed on other organisms are called Consumers.

→ The Consumers which directly take their food from plants are called herbivores or first order Consumers (or Primary Consumers.)

Ex: Zooplankton, small fish, grass-hopper, field-mouse, rabbit, deer, goat, elephant etc.

A part of the food Eaten by herbivores is used in growth, while major part is utilized in production of Energy for various life activities.



⇒ The herbivores are eaten by Second order Consumers or Primary Carnivores.

Ex: frog, some birds, fishes, wild cat, fox etc.

A part of food obtained from herbivores is used in body growth by the primary Consumers, while the rest is used in production of Energy for various life activities.

⇒ The Carnivores which feed on Second order Consumers are called Third order Consumers or Secondary Carnivores.

Ex: Snake (prey upon frog), wolf (prey upon fox).

⇒ The last order Consumers are not preyed upon by other animals. They are called top Carnivores.

Ex: shark, Crocodile, tiger, Lion etc

Some Common food chains are given below :-

Terrestrial food chains: [forest, grassland, Desert] ^

- (1) Grass → Grass-hopper → Shrew → Hawk
- (2) Vegetation → Rabbit → fox → wolf → Tiger
- (3) Grass → Insects → frog → Snake → Peacock.
- (4) plant → Butterfly → frog → Snake → Hawk

Aquatic food chain :-

- (1) Phytoplankton → zooplankton → Small Crustaceans → Predator in  

↓  
 Small fish

← large fish ←  
 Crocodile



- (2) phytoplankton  $\rightarrow$  zooplankton  $\rightarrow$  small fish  $\rightarrow$  large fish  $\rightarrow$  shark.  
 (3) phytoplankton  $\rightarrow$  zooplankton  $\rightarrow$  fish  $\rightarrow$  Crane  $\rightarrow$  Hawk.

### Detritus Food chain :-

It starts with dead organic matter and passes through detritivores and their predators.

- \* These depends mainly on dead organic matter.
- \* A much <sup>larger</sup> fraction of Energy flows through the detritus food chain.
- \* A good Example of a detritus food chain based on mangrove leaves is described below:

Mangrove leaves  $\rightarrow$  Detritivores  $\rightarrow$  micro-organisms  $\rightarrow$  Crabs  
 $\rightarrow$  small fishes  $\rightarrow$  large fishes  $\rightarrow$  shark

Food WEB :- In nature the food chains are not isolated sequences but are interconnected with one another.

A network of food chains which are interconnected at various trophic levels, so as to form a number of feeding connections amongst different organisms of a biotic community is called food web.

- $\rightarrow$  A food web opens several alternate pathways for the flow of food energy.
- $\rightarrow$  It also allows an organism to obtain its food from more than one type of organisms of the lower trophic level.



- Food webs give greater stability to the Ecosystem.
- In a food web, there are a number of options available at each trophic level (food level). so if one species is affected, it does not affect other trophic levels so seriously.
- Thus a field mouse may be eaten by a wild cat, a snake or an owl.
- Similarly, wild cat eats number of herbivores like birds, mice, squirrels etc.
- Generally a food web operates according to taste and food availability of the organisms at each trophic level.
- for example, Tigers normally do not eat fish or crabs, but in Sunderbans, they are forced to feed on them in absence of their natural prey.

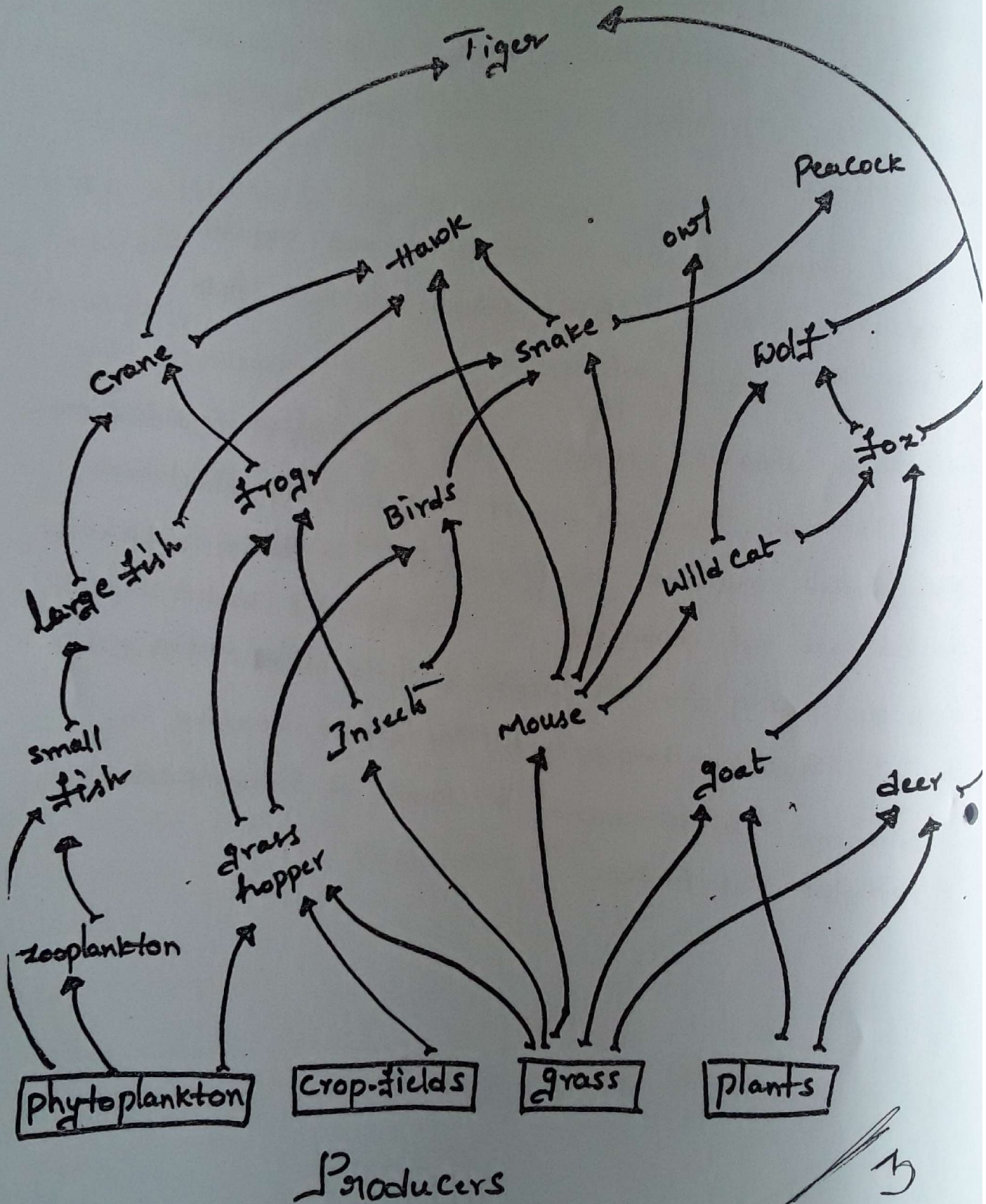
" Draw food web "



### Significance of food chains and food webs:-

- (1) Food chains and food webs play a very significant role in the Ecosystem because the two most important functions of Energy flow and nutrient cycling take place through them.
- (2) The food chains also help in maintaining and regulating the population size of different animals and thus, help maintain the Ecological balance.
- (3) Food chains show a unique property of biological magnification of some chemicals. There are several pesticides, heavy metals and other chemicals which are non-biodegradable in nature. Such chemicals are not decomposed by micro-organisms and they keep on passing from one trophic level to another. And, at each successive trophic level, they keep on increasing in concentration. This phenomenon is known as biomagnification or biological magnification.







### Major Ecosystem Types

#### 1) Forest Ecosystem

These are the ecosystems having a predominance of trees that are interspersed with a large number of species of herbs, shrubs, climbers and a variety of wild animals and birds. Depending upon the prevailing climatic conditions, forests can be of various types.

- a) Tropical rain forests
- b) Tropical deciduous forests
- c) Tropical scrub forests
- d) Temperate rain forests
- e) Temperate deciduous forests
- f) Evergreen coniferous forests (Boreal forests)

#### Tropical rain forests:

- ❖ These are evergreen broadleaf forests found near the equator.
- ❖ They are characterized by high temperature, high humidity and high rainfall.
- ❖ All through the year the climate remains more or less uniform.
- ❖ They are the richest in biodiversity.
- ❖ There are different types and layers of plants and animals in the tropical rain forest.
- ❖ The Emergent layer is the top most layer of the tallest broad leaf evergreen trees, below which lies the canopy where top branches of shorter trees form an umbrella like cover. Below this is present the understory of still smaller trees.
- ❖ Some woody climbers are found to grow which are known as Lianas. There are some other plants like orchids which are epiphytes attached to the trunks of big trees capturing water and nutrients falling from above.
- ❖ The understory trees receive very dim sunlight. They usually develop dark green leaves with high chlorophyll content so that they can use the diffused light for photosynthesis.
- ❖ The shrub layer receives even less sunlight and the forest floor receives almost no sunlight and is a dark layer.



- ❖ Interestingly flowers of the forest are very large, colourful, fragrant and attractive. The Silent Valley in Kerala is the only tropical lying in India which is the natural habitat for wide variety of species.
- ❖ These forests provide us timber, fuel wood, resins, gums, drugs etc.

#### Tropical Deciduous forests:

- ❖ They are found little away from the equator.
- ❖ They have a warm climate throughout the year and rain occurs only during monsoon.
- ❖ A large part of the year remains dry and therefore different types of deciduous trees are found to lose their leaves during the dry season.

#### Tropical Scrub forests:

- ❖ They are found in areas where the dry season is even longer.
- ❖ Here there are small deciduous trees and shrubs.

#### Temperate Rain forests:

- ❖ They are found in temperate areas with adequate rainfall.
- ❖ They are dominated by coniferous trees like pines, firs, redwood etc.
- ❖ They also consist of some evergreen broad leaf trees.

#### Temperate Deciduous forests:

- ❖ They are found in areas with moderate temperatures.
- ❖ They have long summers, cold but not too severe winters and abundant rainfall throughout the year.
- ❖ The major trees include broad leaf deciduous trees like oak, hickory, poplar etc.

#### Evergreen coniferous forests (Boreal forests):

- ❖ They are found just south of arctic tundra.
- ❖ Here the winters are long, cold and dry; sunlight is available only for few hours.



- ❖ The major trees include pines, spruce, fir, cedar etc. which have needle shaped leaves having a waxy coating so that they can withstand severe cold and drought.
- ❖ The soil is found to get frozen during winter where few species can survive.
- ❖ Species diversity is rather low in these forests.

## 2) Grassland Ecosystem

Grasslands are dominated by grass species but sometimes allow the growth of a few trees and shrubs. Three types of grasslands are found to occur in different climatic regions:

### a) Tropical grasslands

- ❖ They occur near the borders of tropical rain forests in regions of high average temperature and low to moderate rainfall.
- ❖ In Africa, these are typically known as Savannas, which have tall grasses with scattered shrubs and shunted trees.
- ❖ The Savannas have a wide diversity of animals like zebra, giraffe, antelope etc.
- ❖ During dry season, forest fires are quite common.
- ❖ Deliberate burning of these grasslands can release huge quantities of carbon dioxide responsible for global warming.

### b) Temperate grasslands

- ❖ They are usually found on flat, gentle sloped hills.
- ❖ Here winters are very cold but summers are hot and dry.
- ❖ Intense grazing and summer fires do not allow shrubs or trees to grow.
- ❖ In United States these grasslands are known as Prairies, in South America as Pampas, in Africa as Velds and in central Europe and Asia they are known as Steppes.
- ❖ The soils are quite fertile and therefore very often these grasslands are cleared for agriculture.



c) Polar grasslands (Arctic Tundra)

- ❖ They are found in Arctic polar region
- ❖ The climate is severely cold and strong, frigid winds keep blowing.
- ❖ The climate is too harsh for trees to grow.
- ❖ In summers the sun shines almost round the clock and hence several annual plants grow in summer.
- ❖ The animals include arctic wolf, weasel, arctic fox, reindeer etc.
- ❖ A thick layer of ice remains frozen under the soil surface throughout the year and is known as permafrost.

3) Desert Ecosystem

- These ecosystems occur in regions where evaporation exceeds precipitation.
- The precipitation is less than 25cm per year.
- About 1/3 of our world's land area is covered by deserts.
- They have little species diversity and consist of drought resistant plants.
- The atmosphere is very dry and hence it is a poor insulator. So, it gets cooled up very quickly making the nights cool.
- Deserts are of three major types, based on climatic conditions.

a) Tropical deserts

- ❖ Sahara and Namibia in Africa and Thar desert in India are tropical deserts.
- ❖ These deserts are driest of all with only a few species.
- ❖ Windblown sand dunes are very common.

b) Temperate deserts

- ❖ Mojave in southern California
- ❖ Here the day time temperatures are very hot in summer but cool in winters.

c) Cold deserts

- ❖ Gobi desert in China
- ❖ Here the winters are cold and summers are warm.



- Desert plants and animals are having most typical adaptations for conservation of water.
- Many desert plants are found to have reduced scaly leaves so as to cut down loss of water due transpiration or have succulent leaves to store water.
- Some plants have deep roots to tap ground water.
- Many plants have a waxy, thick cuticle over the leaf to reduce loss of water through transpiration.
- Desert animals have thick outer coverings to minimize loss of water. They live inside burrows where humidity is better and heat is less.
- Desert soil is rich in nutrients but deficient in water.

#### 4) Aquatic Ecosystem

It deals with water bodies and the biotic communities present in them. Some important aquatic ecosystems are discussed below.

##### a) Pond ecosystem

- ❖ It is a small fresh water aquatic ecosystem where water is stagnant.
- ❖ Ponds may be seasonal i.e. receiving enough water during rainy season.
- ❖ Ponds are very shallow water bodies which play a very important role in villages.
- ❖ They contain several types of algae, fishes, insects and birds.
- ❖ They are used for washing, bathing, drinking etc and therefore get polluted.

##### b) Lake ecosystem

- ❖ Lakes are usually big fresh water bodies with standing water.  
They have different zones
- ❖ They have a shallow water zone called Littoral zone.
- ❖ An open water zone where effective penetration of solar light takes place, called Limnetic zone.
- ❖ A deep bottom area where light penetration is negligible, known as Profunda zone.



There are several types of organisms in lakes:

- a. Planktons: that float on the surface of waters e.g., phytoplanktons
- b. Nektons: that swim e.g., fishes
- c. Neustons: that rest or swim on surface
- d. Benthos: that are attached to bottom sediments
- e. Periphytons: that are attached or clinging to other plants or surface e.g., crustaceans

#### Stratification:

The lakes show stratification or zonation based on temperature differences. During summer, the top waters become warmer than the bottom waters. The top layer circulates without mixing with the cold layer thus forming a distinct zonation.

- a. Epilimnion: warm, lighter, circulating surface.
- b. Thermocline: middle layer, the region of sharp drop in temperature.
- c. Hypolimnion: cold, viscous, non circulating bottom layer.

#### Types of lakes:

- a) Oligotrophic lakes: which have low nutrient concentration
- b) Eutrophic lakes: they are over nourished by nutrients like nitrogen and phosphorous usually as result of agricultural runoff or municipal sewage discharge. They are covered with algal blooms, e.g. Dal lake.
- c) Dystrophic lakes: that have low pH, high humic acid content and brown waters e.g. bog lakes
- d) Endemic lakes: that are very ancient, deep and have endemic fauna which are restricted only to that lake e.g. lake Baikal in Russia
- e) Desert lakes: occur in arid regions and have developed high salt concentrations as a result of high evaporation. e.g. Great salt lake-Utah, Sambar lake in Rajasthan.
- f) Volcanic lakes: that receive water after volcanic eruptions e.g. many lakes Japan.
- g) Meromictic lakes: that are rich in salts and are permanently stratified. E.g. lake Nevada.



- h) Artificial lakes or impoundments: that are created due to construction of dams.  
E.g. Govindsagar lake at Bhakra-Nangal

### Streams

- ❖ These are fresh water aquatic ecosystems where water current is a major controlling factor.
- ❖ The oxygen and nutrient in the water is more uniform.
- ❖ Their dissolved oxygen levels is higher than of ponds even though the green plants are much less in number.
- ❖ The stream animals have usually has a narrow range of tolerance to oxygen.
- ❖ So aquatic animals get affected easily if the water is polluted, as it depletes the dissolved oxygen level.
- ❖ The streams are the worst victims of industrial development.

### River ecosystem

- ❖ They are large streams that flow downward from mountain highlands and flowing through the plains fall in to the sea. So, the river ecosystem shows a series of different conditions.
- ❖ Mountain highland: this part has cold, clear waters rushing down as waterfalls with large amounts of dissolved oxygen. The plants are attached to rocks (periphytons) and fishes are cold water, high oxygen requiring fish like trouts.
- ❖ In the second phase: on the gentle slopes, the waters are warmer and support a luxuriant growth of plants and less oxygen requiring fishes.
- ❖ In the third phase, the river waters are very rich in biotic diversity. Moving down the hills, river shapes the land. They bring with them lots of silt rich in nutrients which are deposited in the plains and in the delta before reaching the ocean.



### Oceans

They are gigantic reservoirs of water covering more than 70% of our earth's surface and play a key role in the survival of marine species. They provide us iron, phosphorous, magnesium, oil, natural gas, sand and gravel. They act as the major sink for carbon dioxide and play an important role in maintaining biogeochemical cycles and hydrological cycles, thereby regulating the earth's climate.

Oceans have two major life zones:

- 1) Coastal zone with relatively warm water, nutrient rich shallow water. Due to high nutrients and ample sunlight this is the zone of high primary productivity.
- 2) Open sea: It is the deeper part of the ocean. It is vertically divided into three zones.
  - a) Euphotic zone which receives abundant sunlight and shows high photosynthetic activity.
  - b) Bathyal zone receives dim light and is usually geologically active
  - c) Abyssal zone is the dark zone, 2000-5000 m deep. It has no primary source of energy i.e. solar energy. It is the world's largest ecological unit.

### Estuary

- ❖ An estuary is a partially enclosed area at the mouth of a river where fresh water and salty sea water meet.
- ❖ Constant mixing of water stirs up the silt which makes the nutrients available for the primary producers.
- ❖ The organisms present in estuaries show a wide range of tolerance to temperature and salinity, such organisms are known as eurythermal and euryhaline
- ❖ Coastal bays and tidal marshes are examples of estuaries.
- ❖ They have a rich biodiversity and many of the species are endemic.
- ❖ They are many migratory species of fishes like eel and salmons; they spend half of their life in fresh water and half in salty water.
- ❖ Estuaries are of much use to human beings due to their high food potential.



## NATURAL RESOURCES

**INTRODUCTION** :- The word "resource" means a source of supply & is generally held in reserve.

The nature resources are the materials, which living organisms can take from nature for their substance their life.

[A natural resource can be substance, an energy unit (or) a natural process (or) phenomenon]

Ex: land, soil, water, forest.

The natural resources are important components of life supporting system.

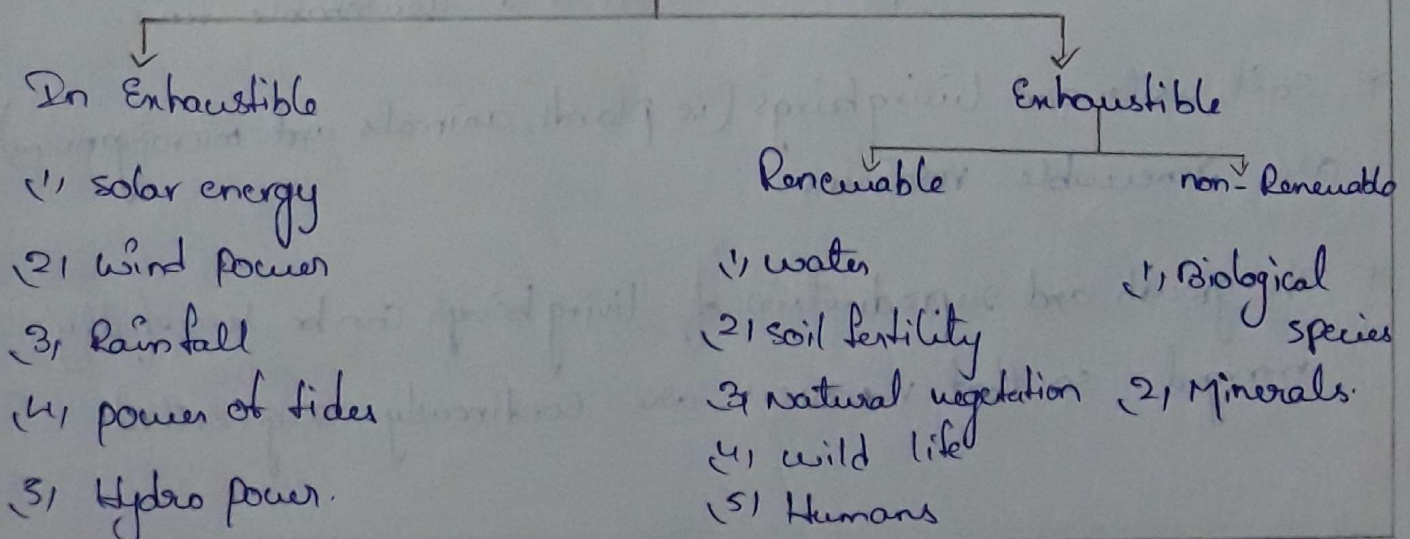
### Classification of natural Resources

Depending upon the availability and abundance, natural resources are two types.

1) Ren Exhaustible

(2) Ren Exhaustible

#### Natural Resources





used are called Non Exhaustible resources. These resources are present in unlimited quantity in the nature. Some nonexhaustible resources unaffected by human activities, while many others may show some change in their quality.

Ex: solar energy, wind power, rainfall and atomic energy.

\* Some resources may sometimes affected by human activities

Ex: The quality of air is changed due to pollution.

2, Exhaustible Resources: The resources which will decrease on use are called Exhaustible resources. These resources have limited supply on the earth.

\* Exhaustible Resources are two types

(1) Renewable Resources (2) Non-Renewable Resources.

(1) Renewable Resources: The resources have the capacity to reappear again their original quantities by quick recycling, reproduction and replacement within a reasonable time.

\* Soil, water and living beings (i.e plants, animals and microorganisms) are renewable resources.

\* The growth and reproduction of living beings can be successfully managed so that resources are continuously regenerated.



\* However, if the consumption of these resources continues to their rate of renewal, not only their quality effected, they eventually exhausted.

(2) Non-Renewable resources The resources which do not regain original qualities, once used up are non-Renewable resources. These resources lack the ability of recycling and replacement.

- \* Many abiotic components are non-renewable.
- \* The fossil fuels (Coal, petroleum & natural gas) crude metal once extracted cannot be regenerated at the place of extract.
- \* A biological species which becomes extinct from the earth can't be created again.

### Forest Resources

Forests are the one of the most important natural resources on earth. Approximately one third of the earth's total land area covered by forest. Forests are the valuable wealth of a. They are store houses of biodiversity and provide important and environmental services to mankind.

Uses of Forests:- The forests not only produce 'non-renewable' material goods, but also provide several environmental services which are essential for life.



(1) Commercial uses:- Forests provide us a large number of commercial goods which include timber, firewood, pulpwood, food items, gum rubber, fibers, medicine, drugs and many more items.

Half of the wood used as fuel for heating and cooking one third of the timber is used for building materials, plywood and chip one sixth of wood harvest is converted into pulp and used for paper industry.

(2) Ecological uses:- The ecological services provided by our forests may be summed up as follows:-

\* production of oxygen:- The trees produce oxygen by photosynthesis which is so vital for life on the earth. they are rightly called as earth lungs.

\* Reducing global warming:- The main greenhouse gas Carbon dioxide ( $\text{CO}_2$ ) absorbed the forests as a raw material for photosynthesis. These act as a sink for  $\text{CO}_2$ , thereby reducing the problem of global warming caused by greenhouse gas  $\text{CO}_2$ .

\* Wild life habitat:- Forests are the homes of millions of wild animals and plants. about 7 million species are found in the tropical forests.

\* Regulation of hydrological cycle:- Forested watersheds act like giant sponges absorbing the rainfall and slowly releasing the water for seepage of springs, which helps in bringing rains.

\* Soil conservation:- Forests bind the soil particles tightly in them and prevent soil erosion. They also act as wind-breaks.



\* Pollution moderators: Forests can absorb many toxic gases and can help in keeping the air pure. They have also been reported to absorb noise and thus help in preventing air and noise pollution.

### Major Causes of deforestation

- 1) Shifting cultivation: The jhum (a) shifting cultivation is a traditional agro-forestry system, widely practiced in the north eastern region of our country. It involves felling and burning of forests followed by cultivation. This type of cultivation is always meant to fulfil local needs but this method causes extreme damage to forest.
- 2) Fuel Requirements: Increasing demands for fuel wood by the growing population in India, wood used as fuel for heating and cooking process.
- 3) Raw materials: For Industrial use, wood for making boxes, furniture, railway sleepers, plywood, match-boxes, pulp for paper industry etc. Plywood is in great demand for packing tea for tea industry of Assam while fire tree wood is used for packing apples in Jammu.
- 4) Development projects: Massive destructions of forests occur for various development projects like hydroelectric projects, big dams, road construction, mining etc.
- 5) Growing Food needs: In developing countries this is the main reason for deforestation. To meet the demands of rapidly growing population agriculture lands and settlements are created by clearing forests.



(6) over grazing: The poor in the process mainly for wood as a source of fuel leading to loss of tree cover and cleared lands are turned into grazing lands. overgrazing by the cattle leads to further degradation of these lands.

(7) Forest fires: There may be natural or man made and cause huge forest loss.

## Water Resources

### Water - a unique Resource

- 1) It exists as a liquid over a wide range of temperature i.e. from  $0^{\circ}\text{C}$  to  $100^{\circ}\text{C}$ .
- 2) It has the highest specific heat, due to which it warms up and cools down very slowly without causing shocks of temperature to the aquatic life.
- 3) It has a high latent heat of vaporisation. Hence it takes a huge amount of energy for getting vaporized. That's why it produces a cooling effect as it vaporizes.
- 4) It is an excellent solvent for several nutrients. Thus as a very good carrier of nutrients, including oxygen, which are essential for life.

### Hydrological cycle

The water we use keeps on cycling endlessly through the environment, which we call as hydrological cycle.



The water from various moist surfaces evaporates and falls on the earth in the form of rain (or) snow and passes through living organisms and ultimately returns to the oceans. Solar energy drives the water cycle by evaporating it. Forms water bodies, which subsequently returns through rainfall (or) snow. Plants too play a very important role by absorbing the ground water from the soil and releasing it into the atmosphere by the process of transpiration.

Global distribution of water resources is quite uneven depending upon several geographic factors. Tropical rain forest area receive maximum rainfall, while the major world deserts occur in dry and receive very little rainfall.

#### Ground water:

About 9.86% of the total fresh water resources in the form of ground water and it is about 25-50 times that of surface water. Ground water was considered to be very pure.

A layer of sediment or rock that is highly permeable and contains water is called aquifer. Layer of sand and gravel are good aquifers. They may be of two types:

1) Unconfined aquifers: These are covered by permeable earth materials and recharged by seeping down of water from rain and snow melt.



Confined aquifers:- These are present between two impermeable layers of rock & sediments and are recharged only in those areas where the aquifer meets the land surface. Sometimes the recharged area is hundreds of kilometers away from the location of the well. Ground water is static, it moves through at a very slow rate of about a meter for 50 in a years.

### Effects of groundwater usage:

- (1) Subsidence:- when ground water withdrawal is more than its recharge rate, the sediments in the aquifer get compacted a phenomenon known as ground subsidence. Huge economic losses may occur due to this phenomenon because it results in the sinking of underlying land surface. The common problems associated with this include structural damage in buildings fractures in pipes reversing the flow of sewers and canals and tidal flooding.
- (2) Lowering of water table:- Mining of ground water is done for irrigation crop fields. However excessive mining caused a sharp decline in future agricultural production, due to lowering of water table.
- (3) Water logging:- when excessive irrigation is done with ground water it raises the water table gradually leading to water logging and salinity problems.



## Big Dams - Benefits And Problems

Big dams are often regarded as a symbol of national development. They have multi-purpose use and have been referred to as 'Temples of modern India'. However there are several other issues and problems related to them.

Benefits: The dams like Bhakra-Nag, Nagarjuna Sagar and Damodar have played a significant role in India's social and economic progress. Dams store precious rain water to irrigate crop fields, generate electricity supply drinking water and save land from floods and droughts.

The various benefits of dams are:

- 1) Hydroelectricity generation and reduce water and power shortage
- 2) Ensuring the year-round water supply.
- 3) Transfer of water from of excess to areas of deficit-deficiency using canals.
- 4) Flood Control and Soil protection
- 5) Irrigation during dry periods.
- 6) Multipurpose river valley projects also provide for inland water navigation and be used to develop fish hatcheries and nurseries.

Problems:

Big dams submerge forest displace local people, cause water logging and siltation and may result in earthquakes.



Thousands of people displaced by such projects.

Some of the disadvantages/problems of dams are as follows:

- 1) Submergence of large areas of land that might include fertile fields and settlements.
- 2) Resettlement and rehabilitation of displaced people.
- 3) A number of water related diseases casually used with the creation of reservoirs. Ex: Malaria.
- 4) Some dams lose enormous water through evaporation and seepage into porous rock beds that they waste more water than, what becomes available.
- 5) Salt left behind by evaporation increases the salinity of the river and make it unusable when it reaches the downstream cities.
- 6) Dam projects can also lead to lowered nutritional status when highly productive fields are flooded.
- 7) Displacement of tribal people.
- 8) Loss of forests, flora and fauna.
- 9) Changes in fisheries and the spawning ground.
- 10) Loss of non-forest land.
- 11) Growth of aquatic weeds.
- 12) Climatic changes.

This although dams are built to serve the society with multiple uses but it has several serious side effects. That is why now there is a shift towards construction of small dams or mini hydro projects.



## Mineral Resources

Minerals are Exhaustible, non-renewable resources found in the earth's crust. They are essential to our industrialized social and daily life. Due to rapid Expansion of industries, the consumption of minerals has increased tremendously all over the world.

Minerals can be metallic eg iron, copper, gold etc or non-metallic eg: sand, stone, salt, phosphates etc. man use a number of minerals in industries production of Consumers goods, agriculture inputs, hospital and defence or research experiments.

Mining: The term "mining" refers to the process of taking out minerals or their ore from the earth.

There are two methods of mining:

Surface mining: This method of mining is utilized when mineral deposits occur near the surface of earth.

sub-surface mining: This method is used when the mineral deposits deep beneath the earth's surface. big holes are dug in the earth surface to extract out ore from the horizontal ore bodies.

## Effects of mining

The mining processing and disposal of minerals have negative effects of environment.



The main harms caused by mining are as follows:

The top soil is removed from the mining area to get access to the deposit. It disturbs and damages the land and results in defacing the landscape. Such a land is called mine spoil.

Mining often causes of building cracks in house, bulging of roads, bending of rail tracks and leaking of gas from cracked power lines leading to serious disasters.

Mining disturbs the natural hydrological process and also pollute ground water as well as surface water. Sometimes radioactive substances like uranium also contaminate the water bodies through mine wastes.

Extraction and processing of ores emits large quantities of air pollutants such as soot, metal particles etc leading to serious mental hazards.

Miners often suffer from serious respiratory and skin diseases like asbestosis, silicosis, black lung disease etc. due to constant exposure to the suspended particulate matter and toxic substances.

### Remedial measures:

- The degraded lands can be reclaimed or restored to a semi-natural condition by revegetation, restoration of flora.
- The adverse impact of mining can be minimised by adopting eco-friendly mining technology.



## 2. Natural Resources

### RENEWABLE AND NON-RENEWABLE ENERGY SOURCES

A source of energy is one that can provide large amount of energy in a usable form over a long period of time. It aims at human welfare covering household, agriculture, transport and industrial complex like other natural resources. Energy resources are also non-renewable as well as renewable.

1) Renewable resources :- Renewable resources which can be generated continuously in nature and are inexhaustible.

eg: wood, solar energy, wind energy, tidal energy, hydropower, biomass energy, biofuels, geo-thermal energy and hydrogen.

\* There are also known as non-conventional sources of energy and they can be used again and again in an endless manner.

2) Non-Renewable resources :- Non-renewable resources which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted.

eg: coal, petroleum, natural gas and nuclear fuels like uranium and thorium.

### Renewable Energy Resources :-

(a) Solar energy :- Sun is an inexhaustible and pollution-free source of energy. Solar energy can be used for human welfare in two ways directly and indirectly. The nucleus fusion reactions occurring inside the sun release unlimited quantities of energy in the form of heat and light.



- ① Solar heat collections: These can be passive & active in nature.
- \* Passive solar heat collectors are natural materials like stones, bricks, etc. & material like glass which absorb heat during the day time and release it slowly at night.
  - \* Active solar collectors pump a heat absorbing medium through a small collector which is normally placed on the top of the building.

2) Solar cells: They are also known as photovoltaic cells & PV cells. Solar cells are made of thin wafers of semi conductor material like silicon and gallium. When solar radiation falls on them, a potential difference is produced which causes flow of electrons and produces electricity.

\* Solar cells are widely used in calculators, electronic watches, street lighting, traffic signals, water pumps. Solar cells are used for running radio and television also.

③ Solar cookers: Solar cookers make use of solar heat by reflection. The solar radiation using a mirror directly on to a glass sheet which covers the black insulated box within which the raw food is kept.

The food cooked in solar cookers is more nutritious due to slow heating. However, it has the limitation that it cannot be used at night & on cloudy days.

(4) Solar water heater: In this cold water gets heated and flows out into a storage tank. The hot water from the storage tank is taken on the roof & then supplied through pipes into buildings like hotels and hospitals.



## Food RESOURCES

The main sources of human food are plants and animals. We consume most all parts of the plant in the form of cereals, pulses, vegetables, fruits and species. A number of animal products such as milk, butter, egg and meat also supplement our food requirement.

### Changes caused by overgrazing and Agriculture in crop production:

The major sources of our food are crops. The cropping pattern is determined mainly by natural factors like rainfall, climate and soil conditions. Overgrazing, traditional agriculture and modern agriculture have also affected the crop production.

Impacts of overgrazing: Overgrazing refers to the condition when the living beings grazing exceed the carrying capacity of a land. The carrying capacity of any system is the maximum population that can be supported by it on a sustainable basis.

Overgrazing removes the vegetal cover of the soil, and makes it compact. It reduces the humus content due to decrease in organic cycling and infiltration capacity of the soil. As a result the soil loses its fertility.

Due to the loss of vegetal cover the soil becomes susceptible to the action of wind and water and gets eroded.

Overgrazing adversely affects the composition of plant population and their regeneration capacity because of overgrazing vast areas. In North and East states of our country are getting invaded by weeds and bushes of low fodder value.

Impact of Traditional Agriculture: About half of the global population practices traditional agriculture. The main impacts of this type of agriculture on crop production are as follows:



③ shifting cultivation practised in many tribal areas results in deforestation.

Loss of forest cover exposes the soil to wind, rain, and storms, thus by resulting in soil erosion.

④ slash and burn cultivation destroys the organic matter and makes the soil nutrient poor within a short period.

Impact of modern Agriculture: Modern agriculture is largely, based upon technological factors like the use of improved seeds, chemical fertilizers, synthetic pesticides and extensive irrigation.

Though technological factors have proved a boon to our modern agriculture and have increased the crop yield, they have created a number of problems. Some major problems related with modern agriculture are given below:

1. Intensive farming have reduced the fertility and productivity of the soil, and one can't think of crop yield without the use of chemical fertilizers.

2. Irrigation use of chemical fertilizers to boost up to crop yield. The presence of excess nitrate in drinking water is dangerous for human health.

3. The excessive use of NPK fertilizers causes micronutrient imbalances and which is affecting the productivity of crops.

4. Excessive NPK fertilizers are often washed off with rain water to water bodies and lakes causing eutrophication.

5. The chemical pesticides are non-degradable and enter the food chain and become hazardous to human life.



change in Concave reflectors, all of which collect the Solar heat and produce as high a temperature as  $3000^{\circ}\text{C}$ .

6) Solar power plant & Solar Energy collected by using Concave reflectors which cause boiling of water to produce steam. The steam turbine drives a generator to produce electricity.

\* WIND POWER & It has been used for centuries to run the wind-mills for grinding grains and pump water in certain area. But the wind does not blow with regulated intensity all the year round and in all areas. Therefore, wind power can be used in certain areas and on certain days.

\* GED thermal Energy & In some places, the heated water comes to the Earth surface as hot springs. It can be used for generating of electricity.

\* Tidal Energy & Tidal waves of the sea can be used to turn turbine and generate electricity. The Tidal Energy can be harnessed by constructing a tidal barrage we can generate electricity by using the high tide and the low tide.

\* Hydro-power & Hydro electric Energy is produced from the kinetic Energy of water falling from a height. Hilly and high land areas are suitable for this purpose, to generate electricity. It is cheaper than the electricity produced by thermal power plants. However building a dam to hold water leads to several environmental problems like disturbance of animal habitats, submergence of vegetation, displacement of people and Earth quake.

Non-Renewable Energy Resources & These include various fossil fuels and nuclear Energy. The fossil fuels include Coal, petroleum



products and natural gas from the nuclear fission of the uranium. And these are limited in nature so these resources are exhausted resources.

\* Fossil fuels : Fossil fuels are found inside Earth's crust where they have been formed through heat and compression on plants and other organic matter.

\* Fossil fuels are three types :

- Solid (Eg. Coal, peat)
- Liquid (Eg. petroleum) and
- gaseous (Eg. Natural gas, LPG, CNG, LNG).

\* Coal : Is the most abundant fossil fuel in the world. It contains Carbon, water, Sulphur and nitrogen. Coal is used for cooking heating in industries and thermal power plants.

\* petroleum : It is employed for transport, agriculture and some industries.

\* Natural gas : Natural gas is used both in cooking and in industries. It is the cleanest fossil fuel. It burns without any smoke.

\* Nuclear Energy : It is obtained through fission or fusion reaction of selected radioactive materials, which yields large amount of heat energy.

a) In Nuclear fission : In this process, the nucleus of certain isotopes (Eg. Uranium-235) with large mass numbers are split into lighter nuclei on bombardment by neutrons. It releases a large amount of energy through chain reaction.

b) Nuclear fusion : In nuclear fusion, two isotopes of a light element are forced together at extremely high temperatures,



until they fuse to form a heavier nucleus releasing a large amount of energy.

\* The burning of fossil fuels and nuclear energy are causing a number of negative environmental consequences such as global warming, acid rain, air pollution and oil spills during transportation. Therefore, we have to minimise the use of fossil fuels and replace them with ecofriendly renewable resources.

### ROLE OF INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES:-

Conservation of resources means the management of human use of the resources to give maximum benefit to present generation and to meet the requirement of the future generations. Environment belongs to each one of us and all of us have a responsibility to contribute towards its conservation and protection.

#### \* Conservation of water :-

- 1) Continuous running of water taps should be avoided while brushing, shaving, washing or bathing.
- 2) Wastage of water can be avoided by installing water saving toilets.
- 3) While using washing machines, fill the machine with water only the level required for your clothes.
- 4) Water leakage in pipes and toilets, should be stopped promptly.
- 5) Watering of plants in kitchen gardens and lawns should be done only in the evening.
- 6) Drip Irrigation and Sprinkling may be practised to improve irrigation efficiency and reduce evaporation.



- 1) Water of washing from clothes may be used for watering off Courtyards, drive ways etc.
- 8) Rain water harvesting System should be installed in the houses for future use.

### Conservation of Energy

- 1) Solar Cooker may be used for cooking food on sunny days to cut down LPG Consumption.
- 2) Make a habit of switching off lights, fans and other appliances when not in use.
- 3) One can save petrol or diesel by using public transportation when not in.
- 4) Avoid using car or scooter for short distance and cover such distances by walking or riding bicycle.
- 5) Build your house with provision for sunspace to keep the house well light and to save electricity.
- 6) Grow Recycle and reuse glass, metals and paper.
- 7) Grow trees and climbers at proper places outside your home to cut off intense heat of summers and get a cool breeze and shade.

### Conservation of Soil

- 1) Grow different types of ornamental plants, herbs and trees gender. Grow grass in the open areas which will bind the soil and prevent its erosion.
- 2) Make Compost from your kitchen waste and use it for your kitchen - garden or flower pots.



- 3) Avoid strong flow of water to irrigate lawn and plants, use sprinkling irrigation to prevent washing off the soil.
- 4) Avoid over irrigation of agriculture fields to prevent water logging and salination.
- 5) In agricultural fields crop rotation and mixed cropping may be practised to maintain soil fertility and to prevent the depletion of certain soil nutrients.
- 6) crop residue should be incorporated in the soil by ploughing instead of burning it in the field.
- 7) Green manure and mulch may be used in the field to maintain soil fertility and protection of the soil against erosion.

### Floods

Inundation of a large area with water for several days in continuation is called flood. Floods has been regular features of some parts of India and Bangladesh causing huge loss of agriculture, life and property. In India the most affected states are Assam, West Bengal, Bihar Orissa and eastern Uttar Pradesh. Due to floods, the plains become silted with mud thus reducing the cultivable land areas.

During the last few decades there has been sharp rise in the incidence of floods. floods are caused by both natural as, well as human factors. Among natural factors, the important are prolonged downpour, blocking of free flow of the rivers due to siltation and landslide. the human activities such as



deforestation, overgrazing construction activities, channel manipulation through diversion of river courses etc. are contributing largely to the sharp rise in the incidence of floods.

### Droughts

The condition of dryness for prolonged period is called drought. It results when the average rainfall for an area drops below the normal. Droughts cause famine and starvation of human and animal population of the region concerned. Prolonged drought conditions in a region change the biotic components of the ecosystem due to death of several plant and animal species.

Human activities like deforestation, overgrazing, mining etc are largely responsible for spreading of deserts, thereby converting more areas to drought affected area.

The problem of drought can be controlled by afforestation programmes, which increase the content of air moisture the resource of precipitation and the rate of rain water. Dry farming techniques and water conservation scheme also prove quite effective to fight the problem of drought.

### Conflict over water

Water is a essential natural resources for sustaining life and environment. The available water resources are under great pressure due to the increased demands. According to a report of UN some 80 nations including India and 40% of the world's population are already the problem of "water stress".



Conflict over sharing of rivers and water between neighbouring countries & different states of a country have now become quite common because of shortage of water. out of India's 18 major rivers, 7 are shared between different states.

Some major water conflicts are discussed below:

1) Water Conflict in the middle East: In the middle east, countries share river basins namely the Jordan, the Tigris-Euphrates and Nile have the shared water resources.

→ There is a severe battle for the water among Jordan, Syria and Israel for the share of Jordan river water.

→ Turkey has abundant water and plans to build a chain of dams of Tigris-Euphrates for hydroelectric power generation and plans to transport and sell water to other middle east countries, which may create war like situation in these countries.

2) The Cauvery water dispute: The Cauvery water is a matter of conflict between Tamil Nadu and Karnataka and fighting is almost hundred years old. The river water is almost fully utilized and both the states have increasing demands due to complex cropping pattern and some cash crops demanding intensive water. thus aggravating the water crisis.



### 3) The Satley Yamuna link (SYL) Canal dispute

The issue of sharing the Ravi-Beas waters and SYL issue between Punjab and Haryana is a case of dispute between two states. The Supreme Court on January 15, 2002 directed Punjab to complete the work of SYL within a year. But till date neither the SYL has been completed nor the conflict over sharing of Ravi-Beas water is resolved.

### Conservation and management of water

- 1) Increase in irrigation efficiency in agriculture fields by reducing wastage.
- 2) Recycling of used water in industries so as to reduce water wastage.
- 3) Reduction of used water in domestic water wastage of constructing waste water treatment plants and recycling the treated water.
- 4) Harvesting of rain water by storing of rain water and recharging ground water.
- 5) Protection of water sheds and afforestation to improve water economy.

### Management approaches

- 1) Construction of dams and water reservoirs to control floods ensure year round supply of water and generation of electricity.
- 2) Diversion of water bodies through canals to increase water supply in arid areas.
- 3) Regular distillation of rivers, streams and other water bodies.



## Land Degradation

A number of factors are responsible for the degradation of land. These include soil erosion, water energy, salination, shifting cultivation, desertification and various development activities.

Soil Erosion: Removal of top fertile layer of the soil by water or wind is called soil erosion. Erosion of soil by water generally occurs near hills, where high speed wind and flooding removes top soil.

### Depletion of soil fertility

The growing population and advancing technology have forced human beings to clear large areas of natural vegetation to develop agricultural lands, residential areas and industrial establishments. When natural vegetation is removed, the nutrients stored in vegetation are removed and lost. The nutrients and organic matters accumulated in the soil. Water logging and application of non-degradable chemicals also leads to the loss of soil fertility.

### Soil Conservation

Soil conservation refers to the measures and practices which protect the soil against loss and help in maintaining fertility with a view to establish sustainable agriculture. The conservation is based on following basic principles:

- (i) protection of soil from impact of rain drops
- (ii) To slow down the water from down the slope in a narrow path
- (iii) To slow down the water movement, along the slope.



- (iv) To encourage more water to enter the soil.
- (v) To increase the size of soil particle.
- (vi) Reduction in the wind velocity near the ground by growing vegetation cover and.
- (vii) To grow the strips of stubble or other vegetation cover which might catch and hold the moving particles of soil.

### Conservation of erosion-affected soils:

The conservation of erosion affected soils include steps:-

- (i) soil stabilization: Soil stabilization is achieved by seeding the bare grounds with plants that can survive large harsh conditions ~~and~~ growing drought resistant grasses.
- (ii) Restoration of soil fertility: The soil fertility can be restored by increasing the amount of detritus to the soil. It increases nutrients and also improves the moisture level of the soil. The restoration of soil fertility to its original level is a slow process.

shifting cultivation: It consists of cutting trees and setting them on fire and raising the crops on the resulting ash. This practice is called "Jhuming" in north-eastern India. It is not harmful if the 'Jhuming' cycles are longer, when 'Jhuming' is done in 5 or 10 years of cycle. It destroys forest and depletes the soil.



## BIODIVERSITY AND ITS CONSERVATION

Biodiversity is the sum of the variety of all living organism, in general biodiversity is a measure of the relative diversity among organisms present in diff ecosystems.

→ Diversity includes with in species, among species and competitive diversity among ecosystems.

Definition: The totality of genes, species and ecosystems of a region.

● Why should we learn about biodiversity:- causes are

→ The human Population depends on biodiversity for food and other necessities

→ The increasing human population is depleting natural resources and causing pollution

As a result, the biologically rich and unique habitat are being destroyed.

→ At present, biodiversity loss is one of the world's most pressing crisis

→ The biological diversity identified into 3 levels

1. Genetic diversity
2. Species diversity
3. Community & Ecosystem diversity
4. organismal diversity.

### Genetic Diversity:

→ Genetic diversity refers to the variation of genes with in species.

→ Tremendous amount of genetic diversity exists with individual species.



- The genetic variability is responsible for the different characters in species
- Genetic diversity is the raw material, from which new species arise through evolution
- we can understand each and every individual species variation through mechanism
  - 1) Diversity within different population
  - 2) Diversity between variety - population
  - 3) Diversity within species

### Species Diversity:

- Species diversity refers to the variety of species within a region
- It includes, Animals, plants and micro organisms
- Species diversity is a function of both species richness and evenness.

Species richness: It refers to the number of species per unit area. As number of species increases, species diversity increases

Species evenness: Indicates the evenness in the number of individuals of species. The evenness of species represents higher species diversity in the region

- Species diversity measures the number of species in a given region. also distribution of each species within the region.

### Ecosystem Biodiversity:

- Ecosystem diversity refers to the variations in the biological communities in which species live.



→ Life exists in soil, air, water and other such habitats. Communities are controlled by environmental variables.

- Ecosystem include not only the plants, animals and microbes, that coexists in which way they interact with each other and how they adapt their physical environment
- Living organisms and physical environment interact with each other in an ecosystem.

### ORGANISMAL DIVERSITY

- The living organisms on earth is estimated to be between 13 to 14 millions
- Around 1.5 million of species provide the substance of biodiversity.
- It may be a group of species varieties and individuals species have distinct population.
- Group such as plants, birds, Mammals, fishes.
- Account for only 3% of the estimated total area and fauna.

### Hot Spots:-

- Hot spots are such geographic areas that are usually rich species, most of which are endemic and these are in a constant threat of being over exploited.
- Among the 18 hot spots in the world, two are found in India.
- 18 hot spots contain app. 49,955 endemic plant species besides many animal species.



### Eastern Himalayas:

→ Photogeographically the area comprises Nepal, Bhutan, and neighbouring states of North India. This area lies north of the Tropic of Cancer. There are an estimated 9000 plant species, in which 3500 are being endemic on Indian side.

Eastern Himalayas has been considered as a rich centre of primitive flowering plants and also a cradle of speciation of several families of monocotyledons; In this area Gymnosperms and pteridophytes are also well represented.

The Eastern Himalayas are also rich in wild which have high economic value. This is also regarded as the centre of origin. Since ancient times tea plant has been cultivated in Northeast India.

The total yielding plant is sparsely distributed in the region. 63% movements are from Eastern Himalayas and than 60% of the Indian birds are recorded in the Eastern Himalayas. Huge wealth of the plants, fungi, insects and birds have found in the region.

### Benefits of biodiversity:

→ Biodiversity has contributed in many ways to the development of human culture. And human communities have played a major role in shaping the diversity of nature at the genetic, species, ecological levels.



⇒ Research show that the more diverse of an Ecosystem provide more strength to maintain itself and to recover from damage.

⇒ The loss of a species, decreases the ability of the Ecosystem.

b] Economical biodiversity role:-

For all humans biodiversity is first a resource for a daily life such "crop diversity" is also called agro-biodiversity.

⇒ Biodiversity is a reservoir of resources to be drawn upon for the manufacture of food, pharmaceutical and cosmetic production.

⇒ Some of the important economic uses, that biodiversity supplies to human kind are:-

Bio-diversity is providing food:- Crops, livestock, forestry

⇒ Bio-diversity has a role in medicinal wild plant species have been used for medicinal purposes.

for example:- cinchona tree, poppy plants.

According to the national cancer Institute, over 70% of the promising anti-cancer drugs come from the tropical rain forest.



- Biodiversity may be a source of energy for the industrial are oils, lubricants, Perfumes, poisons etc. can be from various Plant species.
  - Supplies from animal origin are wool, milk, leather, meat. Animals may also be used as a mode of transportation.
- Tourism and Recreation

Biodiversity is a source of economical wealth for many areas such as many parks and forests where wild nature and animals are a source of beauty and joy for many people.

● Ecotourism growing a outdoor recreation activity.

Ethical role of biodiversity:

- finally the role of biodiversity is to be a mirror of our relationships with the other living species.
- An ethical view- It tells about rights and duties of human beings for the protection of biodiversity.
- Biodiversity is also a part of many cultural and spiritual heritage.

Scientific role of bio-diversity

- Biodiversity is important because each species can give their characteristic information.
- Scientists can understand how life evolved and how it will to evolve on earth.
- In addition, biodiversity helps scientists to understand how life functions and the role of each species present in ecosystem.



### a) ecological role of biodiversity

- All species provide some kind of function to an ecosystem
- They capture and store energy, produce organic material decompose organic material, help to distribute water and nutrients throughout the ecosystem.
- ecosystem also provide us various supports and services such as purification of air and water, stabilisation and moderation of the climate, decrease of flooding, drought and other environment disasters
- These functions are important to an ecosystem and to human.

### b) Economical biodiversity role

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### Biodiversity in food: crops, livestock, forestry & fish

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EX - SITU CONSERVATIONS :

Ex-Situ Conservation means that the flora and fauna are preserved outside natural habitats.

- flora and fauna are preserved as herbarium specimens, seed storage at low temperatures, as botanical gardens, zoos, deer parks, safari parks.
- Central state governments together managing 33 botanical gardens universities too have their botanical gardens
- There are 2,75,300 plant species available in India.
- The Indian government focused on wetland, mangroves and coals management.
- In 1998-1999 an amount of Rs 140 Lakhs were released to the state government for the preparation of action plans for managing. Pongon in Himachal Pradesh, Wullur in Kashmir, Loktak in Manipur, Rudrasagar in Tripura and Kolleru in A.P.
- Conservation and management of mangroves and coral reefs has been recommended in 1998.

IN - SITU CONSERVATIONS :

1. Conservation or protection of flora and fauna within natural habitat called in-situ conservation. Around 4.2% of the total geographical area of the country has been used for in-situ conservation of habitats ecosystem.
- 2) In this protected area we have 85 national parks and 448 wild sanctuaries have been created. Biosphere reserve programme is being implemented throughout India.



3. The Tera Range in Gora hills of Meghalaya we have a gene Sanctuary, for preserving the rich nature diversity of wild citrus species.
4. Sancturries of Rhododendraus and orchids have been Established in Sikkim Implemented many steps for the protection of larger mammals.
5. Project Tiger is an example of highly endangered Species in the indian
6. Project Elephant was lanched in 1992 for free ranging population of wild eleplants.
7. Lions & have been given special attention in Selected Sancturries and natural parks in North East and North West India.

In-Situ Conservation includes legal protection of endangered Species the preparation and implementation of Species management of recovery plant and the established of protected areas to conserve individual species and habitats.

It is necessary to implement the following steps:-

1. Expansion of the protected area network.
2. Population Survery and data base Creation.
3. Mapping of forest types, protected areas and Natural forest.
4. Improved protection efforts and landscape for Conservation.
5. In-situ Conservation.



THREATS TO BIODIVERSITY

Human activities are the major threat to biodiversity. Important factors leading to loss of biodiversity are described below:

1. Destruction of Habitats: Destruction of natural habitats is the prime threat to the biodiversity. Natural habitats, which protect natural flora and fauna are being converted to human settlements, harbours, dams, reservoirs, crop-lands, grazing grounds and mining sites.

- \* Deforestation decreases animals shelter and food. It reduces reproductive capacity of certain wild animals due to reduction of their free movement area. This decreases the population of many species.

- \* Migratory animals are also affected by deforestation because of the disturbance in their routes.

- \* Some of the dams are blocking migration of fishes by changing the physical environment.

2. Habitat Fragmentation: Habitats that formerly occupied wide areas are now divided into pieces by roads, fields, towns, canals, powerlines etc.

- \* Habitat fragmentation is the process where a large, continuous area of habitat is divided into two or more fragments.

- \* It decreases interaction and reproduction of animals.

- \* This reduces population of species.



Industries:- For example fibres for clothing, wood for shelter and as fuel.

Biodiversity may be a source of energy for the industrial production.

Western Ghats:- It is one of the most important biogeographic zone of India. It is also a rich centre of endemism and also represented by active zones of speciation.

It has 490 species of arboreal taxa, around 1500 endemic dicotyledonous plant species are reported from Western Ghats, which includes orchids and approximately 315 species of Vertebra have become Endemic including amphibians and reptiles, Nilgiri langur, flying squirrel are the rare animals.

Benefits of Biological Diversity:-

Biodiversity has contributed in many ways to the development of human culture and human communities have played a major role in shaping the diversity of nature of the genetic, species and ecological levels.

(a) Ecological role of Biodiversity:- All species provide some kind of function to an ecosystem.



- ⇒ They capture and store energy, produce organic material, decompose organic material, help to distribute water and nutrients throughout the ecosystem.
- ⇒ Ecosystem also provide us various supports and services such as purification of the air and water, stabilization and moderation of the climate, decrease of flooding, drought and other environmental disturbances.

These functions are important to an ecosystem and to human.

Desertification: Transformation of fertile land into a desert by natural or man's activities is called desertification. It can result from various causes such as erosion of top soil, shifting of sand dunes by wind and organizing in lands sparsely covered by grass. Many deserts of the world have developed by the human activities.

Development Activities: Various developmental activities such as rapid urbanization, construction of dams, roads, railways, airports, industries and mining have caused excessive loss of large areas of fertile and productive croplands, wood lands and grass lands.



## Control of Land Degradation:-

The following measures can be adopted to check the land degradation.

- (1) Land degradation by soil erosion, floods and water logging can be checked by reforesting and grass covers.
- (2) Degradation of soil by shifting cultivation can be prevented by crop rotation, mixed cropping and plantation cropping. These practices would improve soil fertility.
- (3) Salinity of soil can be checked by improving drainage. Salinated lands can be reclaimed by leaching them with more water, if the ground water table is not high.
- (4) Advancement of deserts can be checked by mulching (Use of artificial protective covering) or by growing appropriate plant species and by raising trees as wind breakers.



## 4. ENVIRONMENTAL POLLUTION

INTRODUCTION:- Environmental pollution may be defined as the unfavourable alteration (change) of our surroundings, largely as a by product of man's action, through direct or indirect effects of changes in energy pattern, radiation levels, chemicals and physical constitution and abundance of organisms.

- \* pollution is mostly man made, but it can also be natural.
- \* Natural pollution is caused by volcanic eruptions, emission of natural gases, soil erosion, ultra violet (uv) rays, cosmic rays etc.

pollutants:- pollutants are the materials (or) factors, which cause adverse effect on the natural quality of any component of the environment.

- \* pollutants are the waste products (or) by-products of the material we use (or) throw away.

For example:- Smoke from industries and automobiles, chemicals from factories, radioactive substances from nuclear plants, etc., are the common pollutants.

- \* However, all pollutants are not waste materials.  $N_2$ , P are used to increase soil fertility, but their excess amount may cause water pollution.



pollutants are classified from different point of view, as follows:

- (1) Based on their natural disposal
- (2) Based on their existence
- (3) Based on their form.

1. Based on their natural disposal: Based on natural disposal system pollutants are classified into two types.

(a) Bio-degradable pollutants: They are actually waste products which are slowly degraded by microbial action. They cause pollution, when their production exceeds the capacity of the environment to degrade them.

Ex:- sewage

(b) Non-degradable pollutants: They are pollutants, which not decomposed (or) which decomposed very slowly.

Ex: plastics, glass, polythene bags etc.,

poisons:- pesticides like DDT, Hg, radioactive materials.

\* The non-biodegradable pollutants are difficult to manage and in most cases there is no treatment process to handle these pollutants in the ecosystem.

(2) Based on their existence:- Based on existence pollutants are classified into two types.

(a) Qualitative pollutants:- These are not-natural but these were added to the environment by the activities of human beings.

Ex:- pesticides and insecticides

(b) Quantitative pollutants:- These are present in the environment. they cause pollution when their concentration exceeds to the environment.



Ex:  $\text{CO}$ ,  $\text{CO}_2$  are always present in the environment, if their concentration increased, they causes pollution problems.

In case of  $\text{CO}_2$ , its effect on environment by global warming.

(3) Based on their forms: According to the form in which they exist after release into the environment, pollutants can be classified into two types.

(a) primary pollutants: These persist in the form in which they are added to the environment.

Eg: DDT, plastic.

(b) secondary pollutants: These are formed by interaction among the primary pollutants.

For example: PAN [peroxy Acetyl Nitrate]

\* PAN is formed by the reaction of two primary pollutant, namely nitrogen oxides & hydro carbons released from motor vehicles in presence of sunlight.

Conclusions: pollution may be divided into the following types depending upon their pollutant effect namely air pollution, soil pollution & noise pollution etc.,

### SOIL POLLUTION

Soil pollution can be defined "the addition of substances to the soil, which adversely affect physical, chemical & biological properties of soil and reduces its productivity".

\* soil pollutants are naturally synthetic substances that reduce the productivity of the soil, quantity of plants and ground water.



## Sources of soil pollution:

- \* Soil pollution is a extremely complicated process.
- \* It may occur directly by dumping and disposal of wastes, application of agro-chemicals or the indirect result of air pollution such as acid rains.
- \* The main soil pollutants are
  - (1) Industrial wastes (2) pesticides (3) Fertilizers & manures
  - (4) discarded wastes (5) Radioactive (6) other pollutants.

### (1) Industrial wastes:

Both solid and liquid wastes of industries are dumped over the soil. The wastes contain a number of toxic chemicals such as mercury [Hg], lead, copper, zinc, cadmium (cd), cyanides [CN], thiocyanates [SCN], acids, organic substances etc., some toxic chemicals reach the soil by mining operation also. Thermal power plants generate a large quantity of "Fly ash".

(2) pesticides: Now-a-days a number of chemicals are used to kill insect (insecticides), fungi (fungicides), weeds (weedicides) in order to improve agriculture, forestry and horticulture.

- \* They are sprayed on the plants in the form of fine mist (or) power.
- \* Most of the pesticides effect on all types of life therefore they also called "biocides".
- \* pesticides reduces the population of living organisms including micro-organisms



## I) By scientific methods:-

soil pollution can be controlled by the following Scientific methods:-

1. There should be minimum use of pesticides & fertilizers.
2. Use of bio fertilizers in the place of chemical fertilizers to reduce the soil pollution.
3. Improvement of cropping techniques to control weeds in agricultural fields. This will reduce the use of weedicides and herbicides.
4. Improvement of mining techniques and transportation of minerals so that it decreases spreading of mine dust.
5. Low lying areas should be selected for dumping & industrial wastes.
6. plantation of soil binding grasses and afforestation can decrease the soil erosion.

## II) Recycling and recover of materials:-

- 1) waste paper can be recycled, old books, magazines, news paper etc., are collected and recycled in milk.
- 2) Agricultural wastes, coconut waste, Jute waste etc, can be used in the making of paper.
- 3) House hold waste in the form peeling of fruits & vegetables etc., are used to increase humus. They are also used to produce organic acid by fermentation.
- 4) Sludge from sewage treatment can be mixed with coal to form fuel for power generation.
- 5) Recovery of Metals.



- \* Thus effect the fertility of soil
- \* Absorption of these pesticides affect the entire food chains and food webs.

(3) Fertilizers and manures:-

chemical fertilizers are added to the soil for the improving productivity of the crops but these fertilizers and manures increase the salt content of the soil which decreases the population of useful bacteria of the soil & it also reduces productivity of the soil

(4) Discarded materials:-

A large number of discarded materials are dumped on the soil by man, these include concentrate, leather, cans, plastics, glass, The addition of solid wastes is sometimes called the third pollutants.

(5) Radio active wastes:-

Radio active elements from mining and nuclear power plants enter into water and ultimately into the soil causes the soil pollution.

(6) Other pollutants:-

Many air pollutants (acid rain) and water pollutants ultimately become part of the soil.

Control of soil pollution:-

Soil pollution can be controlled by the following methods:

I) By scientific method.

II) Recycling of recovers of materials.



## AIR POLLUTION

The addition of foreign particles, gases and other pollutants into the air, which have an adverse effect on man and his environment is called "air pollution".

\* Depending upon the sources the pollutants may be different in different places. Air pollution is one of the most dangerous and common kind of environmental pollution in big cities, particularly in industrial cities.

### Causes of air pollution:-

Combustion of fossil fuels and wood in industries and kitchens, automobiles, aircrafts, railways, thermal plants, agricultural operations and industrial processing are the major sources of air pollution. When these fossil fuels burnt they produce a mixture of oxides of carbon, nitrogen and sulphur and water vapour.

- (1) Carbon monoxide [ $\text{CO}$ ]: This colourless gas is released by automobiles due to inefficient combustion of carbon fuels. This poisonous gas also released during mining operation.
- (2) Carbondioxide [ $\text{CO}_2$ ]: This is also released during combustion of fossil fuels by automobiles and industry. This is also called Green house gas. The growth rate 15% in the last 100 years due to excessive fuel burning.



3) Nitrogen oxides ( $\text{NO}_x$ ):-

Nitric oxide and nitrogen dioxide are known pollutants. These are released during burning of fossil fuels by industries and automobiles. These are also released from the decay of agricultural waste and burning of wood.

4) Sulphur dioxide ( $\text{SO}_2$ ):- This is produced during the combustion of coal (or) fuel oil. It is a poisonous gas. The thermal power plants which we use coal as fuel release most of sulphur dioxide into the atmosphere.

5) particulate matter:- This is observed as a suspension in air, mostly consisting of dust, ash and smoke. These pollutants are distributed in the atmosphere.

6) Ozone ( $\text{O}_3$ ):- The atomic oxygen combines with an oxygen molecule to form ozone.  $[\text{O} + \text{O}_2 \rightarrow \text{O}_3]$ .

\* chloroflouro carbons (CFC's), which are used in refrigeration and from industries react with ozone in the stratosphere. And depletion of ozone layer allows the harmful UV radiation present in sunlight to reach earth.

Effects of air pollution:-

Air pollutants enter our body through respiratory system. The common health problems are irritation of eyes, nose and throat and respiratory problems.



More exposure causes health and lung diseases, cancer, genetic defects and mental retardation.

Carbon monoxide and hydrogen sulphide ( $H_2S$ ) which affect haemoglobin and respiratory system.  $SO_2$  and  $NO_2$  irritate eyes and nose, smog causes slight respiratory problems and may cause cough, difficulty to breathe and long-term may develop bronchitis, lung cancer. The toxic pollutants lead [Pb] released by vehicles which use "leaded petrol" affects gastrointestinal tract and weakens the functioning of kidneys and liver.

### Control of Air pollution:-

Air pollution can be controlled effectively by the adopting following methods:

1. preventive measures:- The important preventive measures to control air pollution are:

- (i) selection of suitable fuel and its efficient utilization to reduce the level of pollutants in emissions.
- (ii) Modifications in industrial process and equipments to reduce emission.
- (iii) selection of suitable site and zoning for industrial set up to disperse pollution sources.

2. control measures:-

The most common method of eliminating (or) reducing pollutants is



- (1) minimize activities which cause pollution like transportation and energy production.
- (2) Modification of process and equipments.
- (3) Use of appropriate material.
- (4) Using low sulphur coal in industries.
- (5) Removing sulphur from coal.
- (6) Removing  $\text{NO}_x$  during the combustion process & controlling the flow of air and fuel in industrial boilers.
- (7) vehicular pollution can be checked by regular time-up of engines.
- (8) Using mass transport system, bicycles etc.,
- (9) shifting to less polluting fuels.
- (10) Using non-conventional sources of energy.
- (11) planting more trees.
- (12) Reduction of pollution at source.

### WATER POLLUTION

water pollution can be defined as alteration in physical, chemical or biological characteristics of water making it unsuitable for designated use in its natural state.



## Sources of water pollution:

pollution of water can be caused by point sources or non-point sources.

point sources: point sources are specific sites near water which directly discharge effluents into them. Major point sources of water pollution are industries, power plants, underground coal mines, oil wells etc.,

Non-point source: The discharge from non-point source is not at any particular site which individually or collectively pollute water.

Ex: overflowing small drains, rain water sweeping roads and fields.

Ground water pollution: Ground water forms about 62% of the total water available on earth and is about 30 times more than surface water.

\* Industry, mining etc are mainly responsible for ground water pollution

Surface water pollution: The major sources of water pollution are:

(1) sewage: Dumping drain with domestic sewage (or) industrial sewage causes water pollution.

(2) Industrial effluents: Industrial wastes containing toxic chemicals, acids, metallic salts, cyanides, radioactive substances etc. are sources of water pollution. They also cause thermal pollution of water.



- 3) Synthetic detergents: Synthetic detergents used in washing and cleaning produce foam and pollute water.
- 4) Agro chemicals: Agrochemicals like fertilizers and pesticides washed by rain-water and surface run-off pollute water.
- 5) Oil: oil spillage into sea water during drilling pollute it.
- 6) waste heat: waste heat from industrial discharges increases the temperature of water bodies and affects distribution and survival of sensitive species.

### Effects of water pollution:

#### 1) Oxygen demanding wastes:

- \* Dissolved oxygen (DO) is the amount of oxygen dissolved in a given quantity of water at a particular temperature and pressure this dissolved oxygen need for the respiration of animals and plants.
- oxygen need for the respiration of animals and plants
- \* Lower 'DO' may be harmful to animals especially fish population.

#### 2) Nitrogen and phosphorus compounds (nutrients):

Addition of compounds containing nitrogen and phosphorus helps in the growth of algae and other plants which when die and decay consume oxygen of water. excess growth or decomposition of plant will change the concentration of  $CO_2$ , which changes  $pH$  of water.

- 3) Pathogens: Many waste water especially sewage contain many pathogenic and non pathogenic micro org. and many viruses. typhoid, cholera etc., are spread by water contaminated with sewage.



4) Toxic compounds :- pollutants such as heavy metals, pesticides, cyanides and many other organic and inorganic compounds are harmful to aquatic organisms.

- \* Nitrate when present in excess in drinking water can produce cancer causing products in the stomach.
- \* Excess of fluoride in drinking water causes defects in teeth and bones called fluorosis.
- \* pesticides in drinking water ultimately reach humans and cause various health problems.
- \* In 1953, people in Japan suffered with the disease called "minamata disease". This is due to mercury dumped water and fish.

Control measures :- water pollution can be controlled by 2 types of measures.

### I. preventive measures :-

- 1) proper disposal of sewage.
- 2) Abuse of water must be checked.
- 3) Discharge of effluents without treatment into rivers, lakes & sea should be strictly prohibited.
- 4) oil pollution should be prevented.

### II. curative measures :-

- 1) solid wastes may be removed before water is released into river (or) any other water resources.



2) Drinking water should be purified.

3) Industrial water can be made less polluted before discharge by biological treatment.

4) It has remarkable capacity to accumulate and filter out heavy poisonous metals including radioactive substances as well as other toxic substances found in industrial waste.

Conclusion: sea water and river water is being polluted by many types of substances go out try to implement pollution control measures to prevent water pollution and to preserve water resources.

### NOISE POLLUTION (OR) SOUND POLLUTION

Sound is a normal feature of our life. It is a main mean of communication & entertainment. A loud, unwanted sound that causes discomfort is called noise.

"The release of unwanted sound in the atmosphere is called noise pollution".

The ears are provided with an organ called ear drum, which receives the sound waves and communicate to the brain. The sound level is measured in decibal units (db). Human ears can hear only 30db of sounds. Any sound i.e above 30db is named as noise.

Noise pollution causes hypertension, it even causes B.P, when one hear a big sound he get high B.P, Nervous tension.



## Sources of noise pollution:-

Noise pollution is the result of industrialized urban life. The main sources of noise are various industries such as textile mills, printing presses, defence equipment and vehicles (tanks, rocket launching, explosions, poaching firings), transport vehicles (trains, trucks, buses, cars, motor cycles, scooters, jet planes), electric home appliances (mixers, exhaust fans, coolers etc.,) entertaining equipment (radios, television sets). The operations such as blasting, bulldozing, construction work, stone crushing etc., and use of crackers on festival occasions also contribute to noise pollution.

## Effect of Noise pollution:-

Noise pollution affects the power of hearing as well as general health of man.

a) Effect on hearing ability:- Noise can cause temporary (or) permanent hearing loss. It depends on intensity and duration of sound level.

\* Ear drum may be damaged by sudden loud noise.

b) Interferes with man's communication:-

In a noisy area communication is severely affected.

c) physiological and psychological changes:-

Continuous exposure to noise affects the functioning of various systems of the body. It may result in hypertension, sleeplessness, ulcer digestive disorders, blood pressure changes, behavioural changes, emotional changes etc.,



Control of Noise pollution:-

Following measures can be adopted to control noise pollution:-

- (1) proper lubrication and maintenance of machines can reduce noise.
- (2) Noisy machines should be installed in sound-proof chambers which can reduce noise by absorbing sound.
- (3) Noise producing industries, railway stations, should be located away from human settlements.
- (4) There should be silence zones around residential areas, educational institutions and hospitals.
- (5) planting more trees having broad leaves.
- (6) occupational exposure to noise can be reduced using protective devices such as ear muffs (or) cotton plugs.
- (7) use of loud-speakers should be restricted to a fixed intensity and fixed hours of the day.
- (8) Personal protection against noise can be done by stuffing a bit of cotton in the ears (or) holding hands over ears under noisy situations.



## Marine Pollution

### Causes of marine pollution:

The main sources of marine pollution are

- (i) Rivers, which bring pollutants from their drainage basins.
- (ii) coastline where human settlements in the form of hotels, industry, agriculture have been established, and
- (iii) oil drilling and shipment.

Most of the rivers ultimately join the ocean. The pollutants which these rivers carry from their drainage basins are finally poured into the sea. These include sewage sludge, industrial effluents, synthetic detergents, agrochemicals, solid wastes, plastics, metals and waste heat released by industry.

In the sea the pollutant get diluted. Still many pollutants remain unchanged, (or) partially decomposed are causing marine pollution. These pollutants affect fisheries and other marine life.

Another important source of marine pollution is the leaking toxic substances, radioactive wastes which are dumped in deep sea.

Tankers and other shippings, industries, automotive wastes, refineries, ship-accidents causes marine pollution.



while tankers transportation, oil from the tankers was released into the sea. oil in sea water can spread over a large area of the sea. It can cause adverse effects on marine life.

### Effects of marine pollution:-

- oil in the sea water affects sensitive flora and fauna.
- phytoplankton, zooplankton, algae, fish, birds, mammals are effected by oil pollution.
- Fishes death because of the slimy mucus of fish gills is affected with oil.
- oil affects the insulating capacity of feathers and it causes the death of birds

Some important incidents of birds death due to oil leakage:-

- leakage of oil from oiltankers near Alaska in 1989 caused death of about 390 thousand birds.
- At Brittany, France where 20 thousand birds died due to oil spillage.
- At Elbe, Germany 500-thousands birds died due to oil spillage.

### Control of marine pollution:-

- (i) Toxic pollutants from industries should not be discharged in coastal waters.
- (ii) Run off from non-point sources should be prevented to reach coastal areas.



3. sewer over-flows should be prevented by having separate sewer and rain water pipes.
4. Dumping of toxic, hazardous wastes and sewage should be banned.
5. Developing activities on coastal areas should be minimized.
6. Oil and grease from service stations should be processed for reuse.
7. Ecologically sensitive coastal areas should be protected by not allowing drilling.

### NUCLEAR HAZARDS

Radioactive substance are present in nature. They undergo natural radioactive decay in which unstable isotopes spontaneously give out fast moving particles (or) high energy radiation (or) both at a fixed rate until a new stable isotope is formed.

The isotopes release energy either in the form of gamma rays (or) ionization particles. i.e alpha particles and beta particles. The alpha particles are fast moving positive charged particles. where as beta particles are high speed negatively charged [electrons] particles.



The penetration of alpha particles can be stopped by a sheet of paper, while beta particles can be stopped by a piece of wood. The gamma rays can pass through paper and wood but can be stopped by concrete wall, lead slabs or water.

### Sources of Radioactivity:

Radioactivity sources are 2 types :

- (1) Natural sources and
  - (2) Anthropogenic (man-made) sources.
- (1) Natural sources : Sources of Natural radio-activity include, cosmic rays from outer space, soil, rocks, air, water and food, which contain one or more radioactive substances.
  - (2) Anthropogenic sources : These sources are nuclear power plants, nuclear accidents, x-rays, test laboratories etc., where radioactive substances are used.

### Effects of Radiations:

Radiations can effect living organisms by causing harmful changes in the body cells and also changes at genetic level.

- (1) Genetic damage : It is caused by radiations, which effects the DNA, thereby affecting genes and chromosomes. The damage is often transmitted up to several generations.
- (2) Somatic damage : It includes burns, eye cataract & cancer of bone, thyroid, lungs & skin. Even a small dose of radiations cause adverse effects over a period of time.



Damage caused by different types of radiations depends on the penetration power. Alpha particles lack penetration power but they have more energy than beta. they will be, dangerous. when they enter the body by respiration Alpha particles cannot penetrate the skin to reach internal organs, whereas beta particles can damage the internal organs.

Radio isotopes enter the environment during mining of uranium. The radioactivity in the earth's crust enters the crops grown there and ultimately enters the water bodies and affects human beings.

Radio active Iodine ( $I^{131}$ ) affects thyroid gland and causes cancer. Similarly strontium-90 affects the bones and causes leukemia (or) cancer of bone marrow.

### Control of Nuclear pollution

- (1) siting of nuclear power plants should be carefully done after studying long term and short term effect.
- (2) proper disposal of wastes from laboratory. because laboratory wastage contains several radioactive elements.

[P.T.O.]



## THERMAL POLLUTION

Thermal pollution can be defined as presence of waste heat in the water, which can cause undesirable changes in the natural environment.

Causes of thermal pollution: Heat producing industries i.e., thermal power plants, nuclear power plants, refineries, steel plants etc., are the major sources of thermal pollution. power plants utilize only  $\frac{1}{3}$ rd of the energy provided by fossil fuels for their operations. Remaining  $\frac{2}{3}$ rd is generally lost in the form of heat. is absorbed by water, which is used for cooling. cold water, generally, is drawn from some nearby water body passed through the plant and that hot water returned to the same water body. Excess of heat reaching such water bodies causes therm. pollution of water.

### Effects of thermal pollution:

- (1) High temp. decreases the solubility of oxygen in water so the dissolved oxygen amount of water is decreased.
- (2) High temp. prevents the penetration of oxygen into deep cold waters.
- (3) Toxicity of pesticides, detergents and chemicals in the effluents increases with increase in temp.
- (4) The composition of flora and fauna changes because of thermal shocks.



5) Metabolic activities of aquatic organisms increase of high temp. and require more oxygen, where as oxygen level decrease due to thermal pollution.

6) Discharge of heated water, can ever kill young fishes.

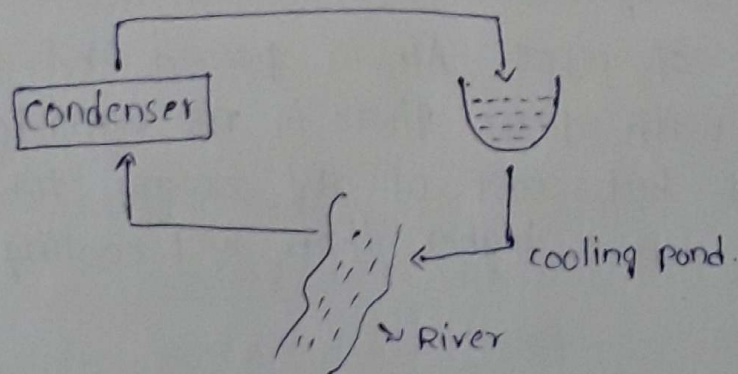
7) Fish migration is affected due to formation of variation thermal zones.

### Control of thermal pollution:-

The following methods can be used for control of thermal pollution.

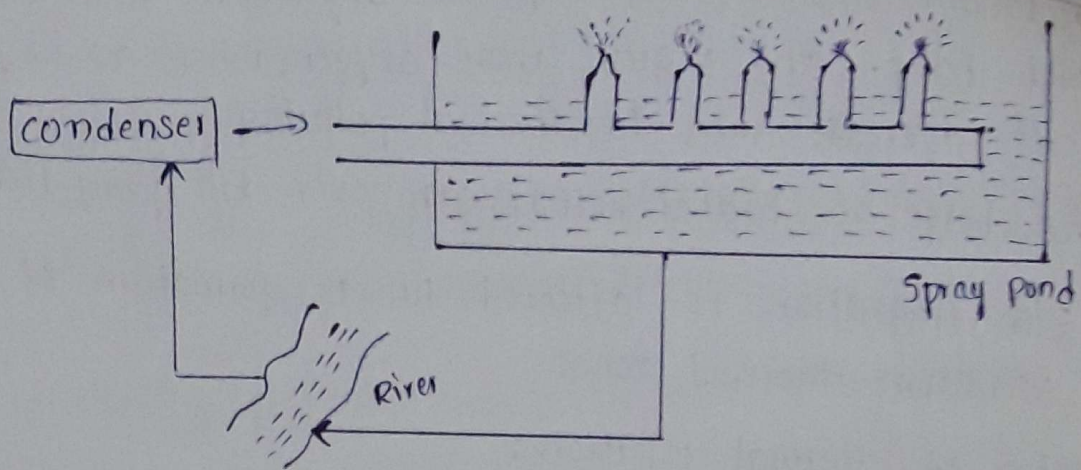
1) cooling ponds (2) spray ponds (3) cooling towers.

1) cooling ponds:- In industries hot water collected in condensers. water from condensers is stored in ponds, where natural evaporation cools the water, which can be discharged in near by water body.



(2) Spray ponds:- The water from condensers is received in spray ponds. Here the water is sprayed through nozzles, where fine droplets are formed. Heat from these fine droplets is dispersed to the atmp.





### (3) cooling towers:

(a) wet cooling tower: To cool hot water, cool air entering from sides takes away the heat and cools the water. This cool water can be discharged.

Large amount of water is lost through evaporation. Extensive fog is formed which is not good for environment and causes damage to vegetation.

(b) Dry cooling tower: The heated water flows in a system of pipes. Air is passed over these hot pipes with fans. There is no water loss in this method but cost of dry cooling tower is many times higher than wet cooling tower.



## ENVIRONMENTAL DISASTERS AND THEIR MANAGEMENT

The environmental disasters may be defined as "the extreme events either natural (or) man induced, which exceed the tolerable limits, make adjustments difficult and results in huge loss of property, income and lives.

Environmental disasters are which adversely affect human society. The environment events that cause disaster for human society include cyclones, Earthquakes, volcanic eruptions, drought and floods. The intensity of environmental disasters always viewed in terms of damages done to the human society.

Tropical cyclones : Tropical cyclones are the most powerful, destructive, dangerous and deadly atmospheric storms on the earth. The cyclones move like a spinning top at the speed of 120-100 km/hr. They are variously called in different parts of the world as Hurricanes [in the Caribbean sea], Typhoons [in north Pacific ocean], cyclones [in Bangladesh and India] and willy willy [in Australia]

Tropical cyclones become more dangerous because of their high speed, high intensity of rainfall, very low pressures.



causing unusual rise in sea level. the destructions caused by tropical cyclones include loss of human lives and property in terms of destruction of buildings, transport and communication system, agricultural crops, domestic and wild animals and so on.

mitigation of cyclones: The severity of cyclones can be minimised by taking following steps:

- (i) Tree plantation on coastal belts.
- (ii) Construction of dams and wind breaks.
- (iii) using better warning systems
- (iv) construction of proper drainage and wide roads for quick evacuation of affected people.

Management in cyclone hit areas: Following measures could be of great help in cyclone hit areas.

- (i) Identification of safe buildings in the area for providing safe shelters to the affected people.
- (ii) In coastal areas, warning should be sent to the fisherman not to venture into the sea during the course of storm.
- (iii) Listening to the weather bulletins broadcasted/telecasted/over radio/television.
- (iv) Emergency phone no. and addresses should be kept ready and remain in touch with community members.
- (v) Keep away from fallen electric poles, damaged bridges and flood water areas.



- (vi) Transportation and movements should be stopped during the course of storm.
- (vii) people who have evacuated from their places must wait for the official declaration to come back to their homes.
- (viii) Relief and rehabilitation should be immediately provided to the affected people.

### Floods

Floods simply mean inundation of extensive land area with water for several days in continuation. people conceive floods when water from heavy rains (or) sudden snow melt, overflow of rivers, submerging the surrounding land. Floods often cause huge loss of human lives and property.

Causes of floods: Floods are caused by natural as well as human activities. Among the natural factors, important are prolonged heavy rainfalls, overflow of rivers or volcanic eruptions etc.,

The human activities such as building activities, diversion of river's flow, construction of bridges and reservoirs, deforestation, changes in land use etc.,

Flood control measures: The [impact of] influence of floods can be minimised by taking series of steps such as:

- (1) By delaying the return of run-off rain water.
- (2) By diverting the flow of water.



(3) By forewarning the occurrence of floods.

(4) By constructing rain water harvesting systems.

### Mitigation of floods:

- (1) Forest; warnings and advice should be provided through media, to educate and aware people about the disaster.
- (2) Elderly people and children should be evacuated to safer places on priority basis.
- (3) valuable household items, animals and other necessary materials. Eg:- food, clothes, medicines etc) should be shifted to safer places.
- (4) Government and non-government organisations (NGOs) and help the flood affected people in the control of infectious diseases and maintaining proper sanitation.

### Droughts

The term "drought" means the condition of dryness for prolonged period. Droughts are directly related to one of the basic requirement of life, i.e. water. drought affect the human and animal population of that region prolonged drought conditions change the biotic component of natural ecosystem due to death of several plant and animal species and migration of certain animal species to other places.

### Drought control measures:

- (1) Afforestation to increase the content of air moisture, rain and hence it increases the ground water and raise of water-table.



- (2) Introduction of dry farming (dropping) techniques to reduce the dependence of on rain-water
- (3) Introduction of water conservation schemes. and
- (4) construction of water reservoirs and digging of wells etc. etc....

## \* Disaster Mangement

The natural disaster management involves the following steps:-

1. Relief measures:- Relief measures should be provided immediately to the disaster victims. the high density areas of the affected locality must be given priority in the remedial and relief measures. special rescue tools, communication equipments, heavy machines to remove debris, water pumps, cement and technicians are more important than drugs and character and not medical relief measures should be provided by foreign countries only after they are requested by the affected country because unsolicited and unwanted supplies of men and material create confusion and complicate the problems.
2. Disaster predictions:- the predictions of natural hazards may be made on the basis of past history of the area prone to a particular hazard. There should be regular monitoring of the environmental changes be caused by human activities.
3. Disaster Research:- It include the study of the contributing factors and mechanisms of natural disasters and identification



of terrain risk areas on the basis of remote the standard of constructions to escape the disasters.

4. Education: Disaster education plays a significant role in disaster reduction. It arouse awareness about the hazards of disasters, help the people to improve the standard of constructions to escape the disasters.

5. Geographic Information Systems and Aerospace surveys:

These help in natural disaster reduction and management programmes by providing maps of the problem areas, historic informations from local people, a planning frame work for local politicians and past experiences of the disasters.

### Solid waste management

Any substances that is discarded is designated as waste in any human society. bulk solid wastes are produced as by product of the normal and fundamental activities of living. The amount of wastes produced by modern industries are becoming a serious problem.

Urban wastes: comprise a complex mixture of materials discarded by urban society. these include garbage, kitchen wastes, concrete, asphalt, rugs, leather can, plastic, glass, discarded food, hospital wastes etc...



Industrial wastes :- These include blast furnace slag, coal ash including fly ash, mica wastes, metal scraps, used batteries, wastes from chemical industries such as acids, alkalis, petrochemicals, dyes etc.

### Classification of wastes :-

Wastes are classified into following categories:-

1. Biodegradable wastes :- The waste materials that can be degraded by micro organisms are called biodegradable wastes. These wastes include vegetable peelings, discarded food, tea leaves, egg shells, crop and farm residue etc.,
2. Non-biodegradable wastes :- The wastes that cannot be degraded by micro-organisms are called non-biodegradable wastes. These wastes include polythene bags, glass bottles, plastic, metal and aluminium cans, ceramics, asbestos etc.,
3. Toxic wastes :- The poisonous wastes are called toxic wastes. Such wastes include pesticides, acids, alkalis, radioactive substances etc.,
4. Non-toxic wastes :- The non-poisonous wastes are called non-toxic wastes. Such wastes include glass, ceramics, paper, leather, rubber etc.,
5. Bio-medical wastes :- These wastes are released by the hospitals and clinics and include cotton, syringe, glass and plastic bottles.



### Impact of wastes:-

Uncontrolled dumping of wastes not only gives an ugly look but also pollutes the environment. The main impacts of solid wastes

1. spoilage of Landscape:- Municipal wastes heap up on roads due to improper disposal people clean their own houses and their immediate surroundings, which affects the community including themselves. Every year, several tons of solid waste is dumped along the highways and other places, thereby spoiling the landscape.
2. pollution:- Dumping of waste on the land may pollute ground water and also the water bodies present in the vicinity. Toxic chemicals present in the wastes may mix in the ground and contaminate the ground water.
3. Health hazards:- Heaps of domestic and industrial wastes are dumped on vacant and unused land in residential areas which causes unhygienic conditions and ultimately results into out-break of diseases like cholera, gastroenteritis, malaria, dengue etc. Decomposition of organic waste produce foul smell and allows various types of insects and infectious organisms.
4. Effect on soil:- Many waste may spread on the soil and changes physico-chemical and biological characteristics of the soil. It adversely affects the fertility of the soil.



5. Effect on terrestrial and aquatic life: Urban & industrial wastes often contain a variety of toxic chemicals. Such chemicals may enter into the food chain and affect both terrestrial and aquatic organisms.

### Disposal of solid wastes:

The disposal of solid wastes can be carried out by several methods such as composting, vermiculture, recycling, land filling and incineration.

1. COMPOSTING: It involves degradation of organic wastes by micro-organisms in presence of oxygen. The organic waste is converted into compost and  $CO_2$ . The urban solid waste can also be disposed off through a biotechnology based anaerobic digestion process. This process produces valuable organic manure and methane that can be used as fuel to generate power.
2. VERMICULTURE (vermi composting) :- This technique is popularly known as earthworm farming. It is an important biotechnique for converting solid wastes such as sewage sludge and domestic wastes into compost with the help of earth worms. In about 15 days the waste will be decomposed by the action of the worms. The manure derived is fertile and rich in nutrients.
3. Recycling :- Recycling is an integral part of waste management and is truly an eco-friendly technique. In recycling, a product at the end of its service life i.e., waste, is converted into another useful product. A sheet of paper can be recycled to



other paper products, cans, bottles and pouches can be recycled for other uses. The process of creating a new products from a waste is important because it does not produce unwanted by product. The most important advantages of recycling are:

- (i) It reduces our reliance on landfills and incinerators.
- (ii) It protects our environment by effective handling of the waste.
- (iii) It conserves natural resources because it reduces the need for fresh raw material.

4. Land filling: Disposal of urban waste in sanitary landfill is one of the methods of handling urban garbage. In the land filling process all the collected materials is directly placed in a dump. A site of landfill should be away from human habitation because of public health and aesthetic reason.

5. Incineration: Incineration is a industrial process designed to reduce unwanted material to simple solid and gaseous residues. It is a process of controlled burning of the waste at high temperature (i.e  $850^{\circ}\text{C}$ ) in presence of air. It is an alternative to land filling and provide an efficient means for energy recovery. Although incineration reduces the volume of waste significantly so that much less land is required for final disposal, but it release a number of toxic chemicals in the atmosphere.



## 6. SOCIAL ISSUES AND THE ENVIRONMENT

### INTRODUCTION:-

Environment is defined as "the sum total of all conditions and influences that affect the development and life of organisms. The natural environment affects the people of that area in their way of living. The needs of life depend upon the interaction b/w organisms and the environmental complex."

### SUSTAINABLE DEVELOPMENT:-

The term "sustainability" refers to "keeping an effort going continuously" (or) the ability to "least out and keep from falling".

G.H. Brundtland, former prime minister of Norway and the director of world health organization (WHO), defined sustainable development as "meeting the needs of the present without compromising the ability of future generations to meet their own needs".

The issue of sustainable development was discussed in detail for the first time at international level in the UN conference on "Environment and development" held at Rio de Janeiro (Brazil) in 1992. The Rio conference is popularly known as "THE EARTH SUMMIT".



There are two aspects of sustainable development:

- (i) Inter-generational equity: That is to hand over a safe, healthy and resourceful environment to our future generations.
- (ii) Intra-generational equity: That is technical developments which promote economic growth of the poor countries so as to narrow wealth-gap b/w different nations.

### Strategies for sustainable development:-

The strategies suggested for sustainable development are as follows:

- (i) To use locally adaptable, eco-friendly and resource efficient technology, which will use of resources and produce minimum wastes.
- (ii) To adopt 3-R approach (Reduce, Reuse, Recycle approach) which emphasizes minimization of resource use, using them again and again and recycling the materials, so as to decrease pressure on our existing natural resources and reduce generation of wastes.
- (iii) To promote environmental education and awareness at all levels of education right from school stage to the university level. It will greatly help in changing the thinking and attitude of the people towards our earth and environment.
- (iv) To utilize resources as per carrying capacity of the environment. i.e consumption of resources should not exceed their regeneration and changes should not be allowed to occur beyond the tolerance capacity of the environment.



Today we need energy for agriculture, industry, transport, communication, comfort and defence. Energy plays a vital role in the socio-economic development of a society.

The energy demanding activities of urban areas includes-

- (i) Regular supply of electricity has become indispensable in high rising buildings, multiplexes and shopping malls of the cities. The activities come to stand still in such establishments, when there is an interruption in power supply. therefore, most of such establishments have their own very high capacity generator sets for power back up. These generator sets cause hazardous air and noise pollution.
- (ii) In many cities and towns, water supply is dependent on electricity. A acute shortage of drinking water is faced by the people living in these areas during the peak summers due to short supply of electricity.
- (iii) These days, many of the house jobs such as cooking of food, washing of clothes, cleaning of houses etc., have become electricity based in urban areas. Shortage of electricity makes the short supply of electricity.
- (iv) The modern life style of cities uses a large no. of electrical gadgets in houses, offices and business establishments which become non-operational when electricity is not available.
- (v) Means of transportation i.e. automobiles, trains, metro-rails etc. used for the movement of people needs energy. Shortage of fuel and electricity make people's movement difficult.
- (vi) Industrial plants use a big proportion of energy. The industrial production is badly affected in short-ages of energy.



vii) The disposal of urban wastes in many cities is also affected as it uses energy based techniques.

### Measures to save electricity:

Following measures can be taken to save electricity:

- i) Turn off lights and fans as soon as you leave the room.
- ii) Use tubelights and energy efficient bulbs that save energy rather than bulbs. A 100W tube light gives as much as a 100W bulb.
- iii) Switch off the television (or) radio as soon as the program of interest is over.
- iv) Use pressure cooker, as it can save up to 70% of the energy required for cooking. It is also faster.
- v) Keep the vessel covered with a lid during cooking, as it helps to cook faster, thus saving energy.

### Consumerism and waste products

Technological development has been a key factor in the development of human society right from stone age to the present century, but the earlier technologies were less destructive than the modern technologies as the latter are meant for accelerated rate of exploitation of natural resources and their production into various forms to raise the material standard of human beings.

Modern technologies have enabled the man to produce huge amounts of consumer items. The manufacturing and use of several items such as refrigerators, Air-conditioners,



spray can dispensers etc., release substantial quantity of chlorofluoro carbons into atmosphere which deplete the life saving ozone layer of the stratosphere.

The production and use of electronic items, synthetic materials and biologically non-degradable materials have increased generation of waste beyond manageable limit. The problem of disposal of several products of modern technologies such as used batteries, plastics, polythene etc, has become headache even for the industrially developed and technologically advanced countries.

Consumerism and waste generation varies from country to country. More the consumption of resources more is the waste generated and greater is the degradation of the environment. In more developed countries (MDCs), though the population size is small but due to luxurious life style per capita consumption of resources is very high and so the generation of wastes.



## 1. RAIN WATER HARVESTING

Rainwater harvesting is a technique of collecting rain water and storing it by constructing special water harvesting structures for future use. It not only increase water availability but also increases water-table water management has always been practised in our communities since ancient times. Rainwater harvesting must be a part of everyday life in our village and cities [as a people's movement].

### OBJECTIVES:-

Rain water harvesting has following objectives:-

- (i) It checks the run off water and avoids flooding.
- (ii) It helps in meeting the increasing demand of water.
- (iii) It helps in raising the water-table by recharging ground water.
- (iv) This recharged ground water supplies during dry season.
- (v) It also reduces ground water contamination.

### Methods of Rainwater Harvesting:-

1. The rainwater that falls on the roofs of buildings (or) in courtyards is collected and stored in underground tanks (or) wells. The collected water may be drawn from the tank or well by using hand pump (or) Motor pump for future use.
2. The collected water can be supplied to the towns through pipes.
3. Artificial Recharging:- Harvesting rainwater by collecting the rainwater in earth check dams and ponds to increase water level in wells and tubewells. In villages & cities and the stored water was used during the lean season.



H. Rain water is collected in check dams, this technique was nicely used in Rajasthan by magasaysay Award winner sh. Rajender singh popularly known as "water man".

\* Some of the examples of rain water harvesting & artificial recharging of ground water are given below:

- In madhya pradesh, more than 1000 check dams and 1050 tanks have been constructed. this has increased food production by 38%.
- In Rajasthan, around 25 villages they built 2000 storage tanks in their houses.
- In maharashtra, they built 7000 tanks, it has converted the drought hit areas into green lands.
- Roof top rain water harvesting and recharging of wells of Gujarat has prevented drying up of wells.

## 2. WATERSHED MANAGEMENT:

Watershed management is defined as "the rational utilization" of land and water resources for optimum production that causes minimum damage to the natural resources".

Watershed is the land area from which water drains to a common drainage channel. the himalayas are one of the most critical watershed in the world. Most of the watersheds of our country lie in this region.



Importance of watersheds :- watersheds supply water for irrigation, hydro-power generation transportation, domestic use and reduce the chances of floods and droughts. They play significant role in the productivity of land and economy of the country.

Degradation of watershed :- watersheds are often degraded due to uncontrolled, unplanned, unscientific land use, overgrazing, deforestation, mining, construction activities, shifting cultivation, fires, soil erosion etc., our watersheds in Himalayan range are threatened resulting in the depletion of water resources due to damage of reservoirs and irrigation systems and misuse of slopes of the mountains. Therefore, watershed management treating them as a basic functional unit, is extremely necessary for the supply of water and economy of the nation.

Methods of watershed management :-

The important measures taken up for the management of watersheds are as follows

1. water harvesting :- In low rainfall areas, rainwater is stored in water harvesting structures (tanks, wells, haуз and check dams ....) for the use in dry seasons.

2. promotion of afforestation and agroforestry :- plantation of trees prevents run off logs and soil erosion, and also increases soil moisture. In high rainfall areas rows of woody trees are grown in between crop to reduce soil erosion and loss of fertile soil.



3. Mechanical measures:- The measures like banding, contour cropping, etc are promoted in the slopy regions of watersheds.
4. Scientific mining and quarrying:- mining and quarrying the hills in planned and scientific manner can minimize the destructive effects in watershed areas.
5. people's participation:- participation of local people including farmers and tribals should be promoted in the soil and water conservation programmes. people should be properly educated about the benefits of watershed management programmes.

3. Resettlement and Rehabilitation of people: Their problems and concerns:-

Though developmental projects like construction of dams, mining, creation of national parks, etc., provide many benefits to the society and raise the quantity and standard of life of the people.

Cause of Displacement:-

The main cause of Displacement of people are described below:-

- (1) Displacement due to Dams:- Big river valley projects like Tehri dam, Sardar sarovar project etc, have caused large scale displacement of local people. In the last 50 years more than 20 million people have been displaced by dams.
- (2) Displacement Due to mining:- Mining operations cover thousands of hectares of land and cause displacement of native people.



3. Displacement due to creation of National parks:- When a forest area is converted into a national park, it affects the local people right of collection of forest products. As a result, the local people retaliate by starting destructive activities.
4. Displacement Due to natural Disaster:- Every year natural disasters like earthquake, landslides, drought, floods etc., displace millions of people from their home land.

#### Problems of displacement:-

- (1) Displaced people lose their land homes, jobs & property.
- (2) The joint families and tribal communities often face disintegration as the people are resettled at different places.
- (3) The social and cultural activities of tribal people vanish with their displacement.
- (4) The displaced people lose their identity and intimate link with the environment.
- (5) The knowledge and experiences of the local people about the plants and animals of that area and their uses get lost with the displacement.

Rehabilitation policy:- There is a need for national Rehabilitation policy "Land for land" is a better policy than crush settlements of displaced people.

- (1) The displaced people should get an appropriate share in the fruits of development.



- (2) The displaced people should be rehabilitated within their own environment.
- (3) Removal of poverty should be an objective of the rehabilitation policy and therefore some land for all should be provided.
- (4) Even the landless people should be given assurance of employment.
- (5) Training facilities should be setup to upgrade the skills of affected people and reservation in jobs should be made for the displaced tribal people.



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### THE ENVIRONMENT [PROTECTION] ACT, 1986

This act implemented on Nov. 19, 1986, the birth anniversary of our late Prime Minister Indira Gandhi. This act aimed to protect and improve the quality of environment by central Government with co-ordination of the state government.

Powers and functions of central Government:-

- (i) To set up the standards of quality of air, water or soil for various areas.



(2) To set-up maximum (permissible) limits of

concentration of various environmental pollutants for different areas.

(3) To examine procedures and safeguards for the handling of hazardous substances.

(4) To set up prohibition and restrictions on the handling of hazardous substances in different areas.

(5) To restrict the areas where industry, mining operations shall not be allowed.

(6) To lay procedures and safeguards for the prevention of accidents, which may cause environmental pollution and to provide remedial measures for such accidents.

(7) To examine manufacturing processes, materials and substances which cause environmental pollution.

(8) Establishment and recognition of environmental laboratories.

(9) Preparation of manuals, codes or guides relating to the prevention, control of environmental pollution.

(10) collection of information in respect [of matters relating] to environmental pollution.

### Functions of state Government:-

under the environmental (protection) Rules, 1986 the state pollution control Boards have to follow the guidelines, as follows.



- (1) Advise industries in the state to treat their wastes before their release in the environment.
- (2) Encouraging industries to recycle and reuse their wastes
- (3) Promoting implementation of clean technologies by the industries in order to reduce the generation of environmental pollution.

## 2. THE WATER [Prevention and control of Pollution] Act, 1974

The main aim of this Act as follows.

- (1) To prevent and control water pollution.
- (2) To establish central and state boards for the prevention and control of water pollution
- (3) To provide corresponding powers and functions to the central and state boards to restore wholesomeness of water.

### Functions of central Board:-

- (1) To advise the central Government on matters concerning with prevention and control of water pollution.
- (2) To provide technical assistance and guidance to state boards and sponsor investigation and research relating to water pollution.
- (3) To provide technical assistance and guidance to state boards and sponsor investigation and research relating to water pollution.



(4) To collect and publish technical and statistical data relating to water pollution.

(5) To examine the standards for a stream or well waters.

(6) To plan and organize nation wide programme for the prevention and control of water pollution.

(7) To establish the laboratories for analysis of water samples/ industrial effluent/ any sewage.

### Functions of state Board:-

(1) To advise the state Government on matters relating to the prevention and control of water pollution.

(2) To plan a comprehensive programme for the prevention, control of water pollution.

(3) To encourage and conduct investigations and research relating to the problems of water pollution.

(4) To the control of water pollution, organize related mass education programme.

(5) To establish or recognize laboratories for analysis of water or any sewage or trade effluents.

### 3. THE AIR [prevention and control of pollution] Act, 1981

This act was enacted by the Parliament to implement the decisions taken at the UN conference on the "HUMAN ENVIRONMENT", held at Stockholm in June 1972.



- (1) TO prevent and control air pollution.
- (2) TO establish central and state boards for the prevention and control of air pollution and
- (3) TO provide corresponding powers and functions to the central and state Boards to restore wholesomeness of air.

### Functions of central Boards:-

- (1) TO advise central Government and state boards about improvement in the quality of air and issues related to air pollution.
- (2) TO plan and supervise implementation of nation wide programme for prevention of air pollution.
- (3) TO utilize the services of mass media in educating public about the causes, effects prevention and control of air pollution.
- (4) TO utilize to lay down standard for quality air
- (5) TO establish laboratories for the analysis of air samples.
- (6) TO plan and organize training of persons in the field of air pollution.
- (7) TO collect, publish technical and statistical data relating to air pollution.



### Functions of State Board:-

- (1) To advise state Government on matters concerning air pollution.
- (2) To plan programmes for prevention and control of air pollution.
- (3) To identify the areas or industries causing air pollution.
- (4) To inspect air quality in air control area from time to time and take steps to reduce the pollution.
- (5) To lay down standard for air quality in consultation with central board.
- (6) To collect information related to causes, prevention and control of air pollution.

### 4. Wildlife [Protection] Act 1972:-

This act protects wild animals, birds and plants. The wildlife act has the following objectives:-

- (1) restriction and prohibition on hunting and trapping of wild life
- (2) protection of lists of endangered, rare and threatened species by Botanical survey of India (BSI) and zoological survey of India (ZSI)
- (3) protection of rare and specified plant species.
- (4) preservation of biological diversity by setting up and managing national parks, wildlife sanctuaries and Biosphere reserves.



(5) Empowering Zoo authority with control of zoo and protect the endangered species.

(6) control of trade of wildlife species, wildlife products and trophies.

(7) setting up of guideline for issuing licence for army in surrounding areas of wildlife sanctuaries.

Several conservation projects for individual endangered species like Lion (1972), Tiger (1973)

● Crocodile (1974) and Brown antlered deer (1981) were started under this Act. The Act is adopted by all states in India except Jammu and Kashmir, which has its own Act.

### 5. FOREST CONSERVATION ACT, 1980;

This act deals with the conservation of forest and related aspects. Except Jammu and Kashmir the act is adopted all over India. The act covers all types of forests including reserved forests, protected forests or any forested land.

⇒ The salient features of the Act are as follows:-

(1) The state government has been empowered under this act to use the forests only for forestry purposes. If it wants to use forests in any other way, it has to take prior approval of central government after which it can declare some part of reserve forests for non-forest purposes (eg mining) or for clearing some natural habitat.



growing trees and replacing them by economically important trees (reforestation).

(2) It makes provision for conservation of all types of forests.

(3) Any illegal non-forest activity within a forest area can be immediately stopped under this Act.

Non-forest activities include clearing of forest land for cultivation of any type of plants/crops or any other purpose. However, some construction work in the forest for wild life or forest management is not considered as non-forestry activity. eg. fencing, making water-holes, pipelines, checkpoints, wireless communication etc.

### WATER CONSERVATION

Water is an essential natural resource for sustaining life and environment. The available water resources are under great pressure due to increased demands.

The world is facing severe water crisis. Africa and west Asia are severely affected by water scarcity. Due to increasing population, water may fall short even in other parts of the world.

According to a recent UN report, this supply of clean and fresh water is depleting in some regions, so within 30 years, about  $\frac{2}{3}$ rd of



Population will suffer with severe stress.

We often face scarcity during the summer seasons. As a result, the municipal water supply is restricted. Our wells and hand pumps become dry resulting into water crisis. Such frequent situations of water crisis alarm us to conserve water and avoid its misuse.

Following steps may be adopted for conservation of water

Prevention of Run-off Losses:- The sum of losses of water can be reduced by allowing most of the water to infiltrate into the soil. It can be achieved by using contour cultivation, terrace farming, mulching and developing water storage structures (Hauz) etc.

Reduction of Irrigation Losses:- The irrigation losses of water can be reduced by drip irrigation, early morning or late evening irrigation, cultivation of crop varieties with low water requirement.

Prevention of Wastage of water:- The wastage of water in household, commercial buildings and public places can be prevented by closing taps, when not in use, repairing any leakage from pipes.



Re-use of water: The waste water can be used for watering lawns and gardens, washing vehicles and floors of buildings. It also helps in saving fresh water.

With these methods, rainwater harvesting and watershed management are also important measures for management and conservation of water.



ENVIRONMENTAL MANAGEMENTImpact Assessment :

The changes caused by a development project on the land scape and ecology of the area and on the quality of water and air along with that on various socio - economic aspects of human life is defined as impact

Impacts could be categorized in different manners:

A) positive and negative impacts: some of the development action have beneficial impacts while other have deteriorative or adverse effects. Accordingly they are designed as positive and negative impacts.

For example, most development projects are aimed to raise the quality of life. Thus, there are usually positive socio - economic impacts. Like better employment opportunities, better infrastructure facilities, better medical facilities etc. However, sometimes the project (e.g. a big dam) has serious negative socio - economic impact on the local inhabitants who are uprooted from their native place their displacement and rehabilitation are big issue to be tackled.



(b) Reversible and irreversible impacts : Some of the impacts caused by the development projects are for a short-term and could be reversed over a period of time by adopting appropriate control or remedial measures.

For instance damage caused to a water body near the development area would be considered reversible if we are able to restore its quality using proper treatment technologies.

### Environmental Impact Assessment (EIA)

Environmental Impact Assessment (EIA) is a procedure to plan some development activity with well-defined environmental goals so that damage due to the activity both during developmental stage and production stage have minimum impact on the natural system and the population in the area.

The national environmental policy Act (NEPA) U.S.A in 1969 first of all provided the guidelines for environmental impact assessment through Council for Environmental Quality (CEQ)



In India, the gazette notification EIA was issued in 1994 vide which the ministry of environment and forests provided guidelines for project proponents to have EIA and prepare an environmental impact statement prior to clearance of the project.

### ● Goals of EIA

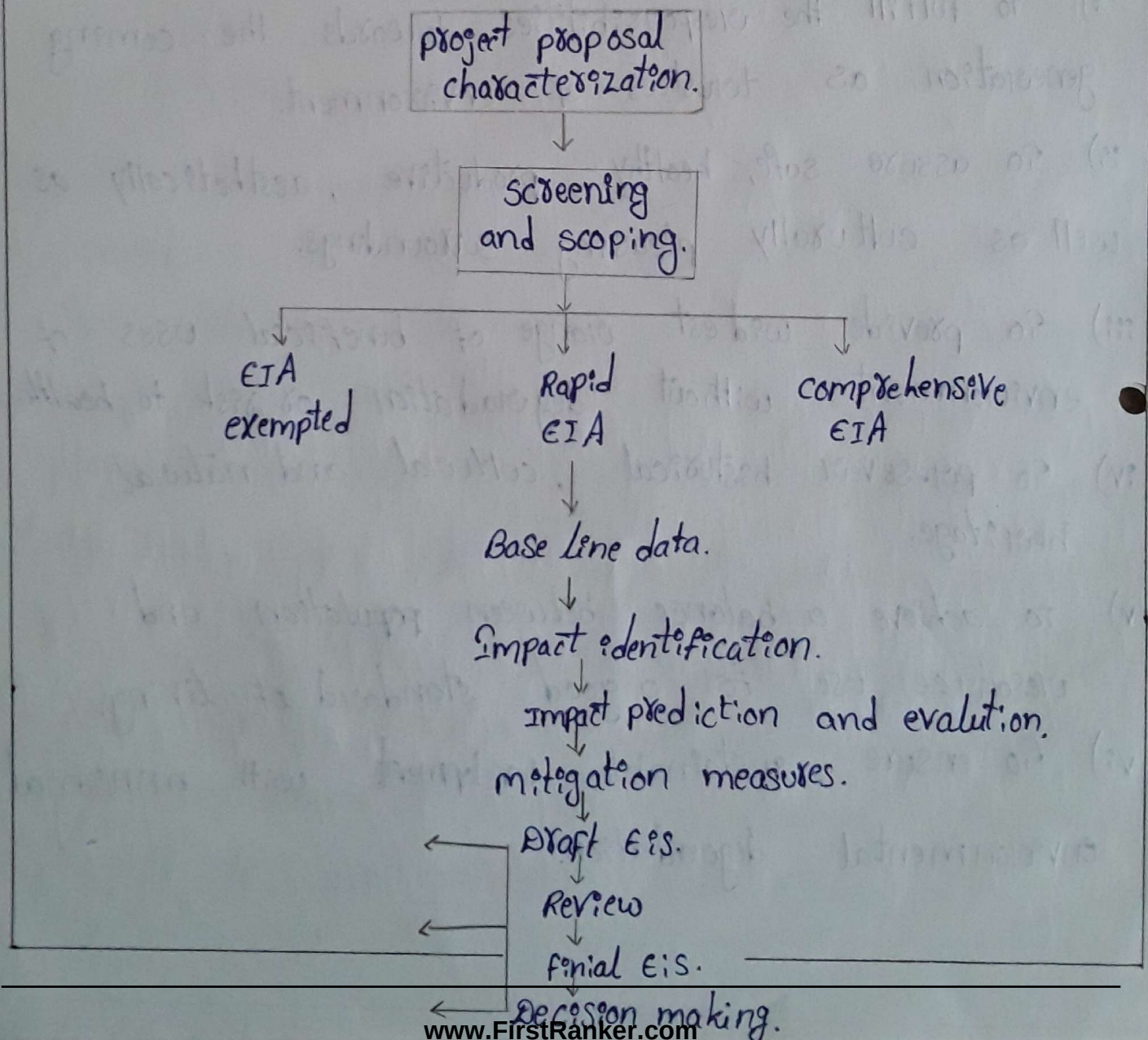
- i) To fulfill the responsibilities towards the coming generation as trustees of environment.
- ii) To assure safe, healthy, productive, aesthetically as well as culturally pleasing surroundings.
- iii) To provide widest range of beneficial uses of environment without degradation or risk to health.
- iv) To preserve historical, cultural and natural heritage.
- v) To achieve a balance between population and resource use for a good standard of living.
- vi) To ensure sustainable development with minimal environmental degradation.



goals of EIA

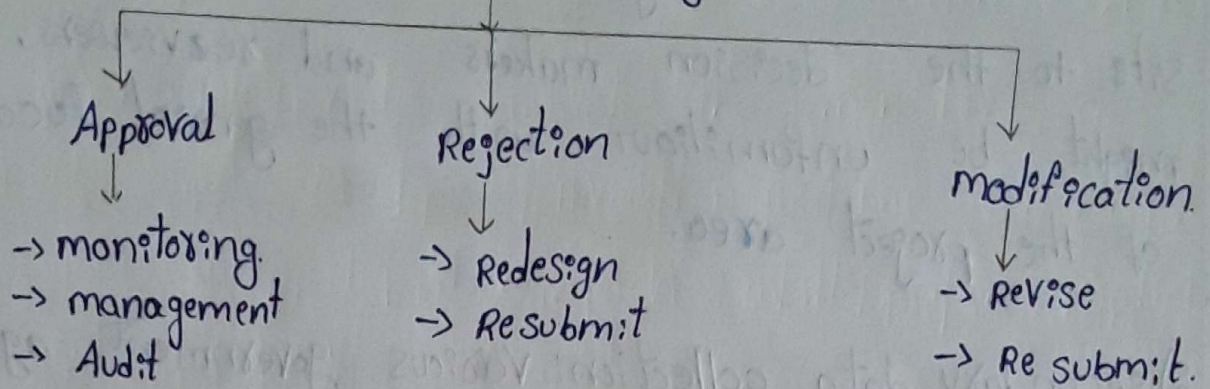
EIA methodology.

The basic steps followed in EIA are screening, scoping, base line data, impact identification, prediction evaluation, mitigation, EIS preparation, review and environment audit, involving public participation at various stages, as shown in fig. 6.1.





## Decision making.



i) screening is done to see whether the project needs and EIA for clearness or not. Further, there are some prohibited areas where generally development projects are not allowed e.g., Coastal Regulation Zone (CRZ), Daharu Taluka in Maharashtra, Aravalli Range, Reserved forests etc.

ii) scoping involves determination of the extent of EIA required for the project. Depending upon the project, basically two types of EIA may be carried out when the EIA report is based on a single season data (other than monsoon period) it is called rapid EIA. When the EIA report is based on detailed seasonal data, it is called comprehensive EIA.

iii, Baseline data give a holistic picture of the overall environmental setting of the project location showing any significant environment items prior to initiation of the action any potentially critical



environmental change and information about the site to the decision makers and reviewers, who might be unfamiliar with the general location of the project area.

2) secondary data collection: Various government agencies and boards have the relevant data available with them on a time-scale basis while meteorological stations possess the data on annual rainfall, humidity, temperature, evaporation, soil temperature, wind speed and wind direction, the Agriculture Departments can make available the data on cropping patterns and irrigation. Archaeological Department can provide us the required data on any historical or cultural heritage of the area. Base-line data on ground water level, surface water resources are also available in various water Boards. census data provides useful base-line information on population, demography, socio-economic status, etc.

ii) primary data collection: This can be done by actual visit to the area and collection of data by survey method. Scientific methodology can be adopted for assessment of all relevant parameters and questionnaire method can be used to collect data.



on socio-economic aspects, occurrence of some diseases, information on some important natural, cultural, & historical heritage, etc.

iii) use of remote sensing and GIS for data acquisition: satellite data available through remote sensing and

• use of geographical information system (GIS) are very useful modern techniques for acquisition of base line data on vegetation, land-use, land-cover, water bodies, major soil types, water logging, deforestation, urbanization, irrigation systems, water resources, industrial growth etc. The data acquired on satellite imageries and digitized and overlaid by GIS to get a comprehensive account of various parameters. Ground truthing is however, necessary to confirm the interpretation of the images.

iv) impact identification: It includes the details of project characters and base line. environmental characteristics to ensure the identification of full range of environmental impacts.

During identification process, the positive and negative, direct and indirect significant and insignificant impacts are considered.



impacts evaluation:- Impacts evaluation is done by considering the costs and benefits of the project. long-term effects and side-effects of the project are also evaluated. Indirect valuation of environmental parameters are also done, e.g. loss of a rare species, degradation of a lake etc.

mitigation:- once the impacts are predicted and evaluated, mitigation measures are to be suggested to avoid, reduce or rectify the adverse changes due to the project. Review and a draft impacts statement is prepared at this stage.

Decision analysis:- public participation is involved by arranging group discussion or by adopting questionnaire method to arrive at a decision about the project and its evaluation.

environment impact statement (EIS): Based on the data obtained and review suggestions a final EIS is prepared as per the format provided by the ministry of environment and forests in our country.

The EIS clearly mentions the objectives of the project, its environmental impacts that are unavoidable mitigation measure to minimize the impacts, alternative



to the proposed action etc.

Environmental audit : It compares the impacts predicted in EIS before the project was started and actual impacts after implementation of the project.

### Environmental impact statement (EIS)

The EIS prepared by the project proponents at the time of submission of the proposal, which is known as the draft EIS. After evaluation and review by the Impact Assessment Agency, the final EIS is prepared.

EIS:

- Effect on land including land degradation and subsidence
- Deforestation and compensatory afforestation
- Air pollution and dispersion along with possible health effect
- Water pollution including surface water and ground water
- Noise pollution due to the project.
- Loss of flora and fauna due to the project during construction
- Socio-economic impacts including displacement of native people, cultural loss and health aspects.
- Risk analysis and disaster management plan.
- Recycling and reduction of waste.
- Efficient use of inputs including energy and matter.



EIA is done with an aim to select the best alternative through which adverse impact on the environment can be nullified or minimized without compromising with the economic and social benefits of the development project.

Thus, the main purpose of EIA is precisely to estimate the type and level of damage caused to natural environment in a well-defined time scale so that remedial measures can be initiated on those aspects requiring action at the right time.

### environmental management plan (Emp)

After impact prediction and evaluation an environmental management plan (Emp) is prepared so as to minimize the negative impacts, increase the positive impacts and restore the damages done to different environmental components. A comprehensive list of measures to be taken is ~~into~~ included in the Emp which included mitigation measures and future guidelines for maintenance of a good quality environment, as discussed below.

### Technological solutions:-

There are technological solutions to many of the adverse impacts caused by various development activities, cleaner technologies are emerging that produce much less pollutants in the environment. Recovery and recycling processes further help in minimizing the adverse impacts. Selection of



## Treatment methods.

To convert the harmful substance produced by various industrial projects, into less harmful nature or to reduce their concentrations to safe permissible limits, treatment methods are available. For treatment of the waste waters we have primary treatment, secondary treatment and tertiary treatment technologies by using which, the suspended solids, organic waste and some harmful methods and excess nutrients are removed from the waters. Both aerobic and anaerobic treatment methods are available.

## Green Belt Development:-

Trees and shrubs are known to act as sinks of many toxic gases and particulates. They also absorb  $\text{CO}_2$  and release  $\text{O}_2$ , thus purifying the air. Recently, they are also reported to attenuate noise. Therefore development of green-belts around development sites has been made mandatory. There are hundreds of types of species available, but we have to select those species in our green-belt, which are adapted to that climate and soil type, and which have a higher capacity to tolerate and absorb the toxic pollutants. Succulent and broad-leaved trees generally show greater air pollution tolerance index (A.P.T.I.) There are several species that are hyperaccumulators of heavy metals. Such species should be selected for green-belt.



appropriate technology with appropriate use of raw material in the process are important in reducing the impacts. In order to prevent or avoid damage to the environment by a development activity, the harmful or hazardous substances produced should be handled properly and removed from that site to some safe area where they could be properly disposed of.

To prevent the loss of habitat of some wildlife due to a project, measures are taken in advance for safe and timely migration of such species to another nearby forest (which could be an artificially afforested area).

To prevent the loss of top fertile layer of the soil during mining operation, layer by layer dumping of the soil is done during digging, which are later restored.

control methods:-

The control the damage due to various emissions coming from development projects like industries, power plants or highway projects with stone-crushing units. Various control methods are available. Particulate matter can be adsorbed or controlled using cyclone separators, baghouse filters, wet scrubbers or electrostatic precipitators. Various gaseous pollutants can be absorbed or condensed using suitable methods. Boundary walls around stone crushing units and use of frequent water spray help prevent the particulate emissions moving to nearby areas.



in sites where metals contamination is predicted.

## ENVIRONMENTAL Audit

definition:-

Internal chambers of commerce (ICC) in 1989 has defined environmental auditing as a management tool comprising a systematic, documented periodic and objective evaluation of how well environmental organization, management and equipment are performing, with the aim to help safeguard the environment by:

- i) facilitating management control of environmental practices and
- ii) assessing compliance with company policies which would include meeting regulatory requirements.

objectives:-

The overall objectives of environmental auditing is to help safeguard the environment and minimize risks to human health. The key objectives of an effective environmental audit are:

- To determine how well the environmental management systems and equipment are performing.
- To verify compliance with the relevant national, local or other laws and regulations.
- To minimize human exposure to risks from environmental, health and safety problems.



### Scope:-

→ Audits can address on topic, or a whole range of issues. The greater the scope of the audit, the greater will be size of the audit team.

→ The scope can vary from simple compliance testing to a more vigorous examination including not only operational environmental, health and safety management, but also product safety quality management. Various aspects to be included within the scope of environmental audit are shown Table 6.1

**The Audit process:** An audit is usually conducting by a team of people who will assemble factually information prior to and during a site visit, analyse the facts and compare them with the criteria for the audit, draw conclusion and report their findings.

**a) criteria:** An essential step in establishing an audit programme is to decide the criteria against which the audit will be conducted and to ensure that management throughout the organization and knows what these criteria are. Typically criteria used for audits are.

- company policies and procedures on environmental matters.
- applicable legislation and regulations.
- good environmental management practice.



The audit team gathers information on the various controls by observation, interviewing staff and the use of detailed questionnaires.

Auditors look for indicators such as clearly defined responsibilities, competence of personnel, appropriate documentation and records and system of authorization.

The audit team attempts to verify that the steps and controls work as intended. Evidence may be collected through inquiry, observation and testing.

All the information obtained is recorded on the audit protocol document and a comprehensive record of the audit and the state of the facility at the time is thus produced.

The audit team integrates and evaluates the finding of the individual team members and if requires an informal discussion with the plant manager is held before finalising the report.

After onsite work, a draft report is prepared, which is reviewed by the plant management to confirm its accuracy. It is then distributed to senior management according to the requirements of the company.



An action plan is developed to address the deficiencies some companies ask for recommendation for corrective action to be included in the formal audit report. The plant will then base its plan on implementing these recommendation.

### Benefits of Environmental Audit.

- Helps safeguard the environment.
- verifies compliance with local and national laws
- Indicates training programmes and provide data to assist in training.
- enable companies to build on good environmental performances, give credit where appropriate and highlight deficiencies.

~~Identifies~~ Identifies potential cost saving mainly through waste minimization.

Assists the exchanges and comparison of information between different plants or subsidiary companies.

Demonstrates company commitment to environmental protection to employees the public and authorities.



Ecotourism emphasises on basic three principles:

conservation community involvement and sustainable development

conservation:- the areas of tourist interest are attractive environments rich in biodiversity. generally these areas are the protected areas where the native places for species of flora and fauna are allowed to exist and propagate in their natural habitat without human interference. therefore, tourists should make minimal impact on the local environment.

community involvement:- tourists should involve local people as their resources are used by the tourists. they should be made a part of the ecotourism project should be adequately compensated and their social and cultural traditions should be respected. they should not be exploited by engaging them as cheap labour.

sustainable development: sustainable development means the pattern of resources utilisation that ensures development which can be sustained in future without any compromise. ecotourism should not add unwanted materials and should not extract/waste local resources beyond the carrying capacity of the system.



## ECOTOURISM.

The concept of ecotourism developed a few decades ago in essentially visit of tourists to the unpolluted areas rich in biodiversity for recreation and boosting the economy of region.

### Definition of Ecotourism:-

The term ecotourism was coined by Ceballos-Lascurain in 1983 to describe a new form of nature travel. Thereafter many definitions of ecotourism have been given according to the International Ecotourism Society, ecotourism is defined as "responsible travel to natural areas that conserves the environment and improves the well being of local people."

### Principles of Ecotourism.

Ecotourism has become an international trade which generates revenue and can empower local people to overcome poverty. It helps the tourists and the local communities to share their experiences for environmental understanding through education and interpretation. Besides involving recreation, adventure and enjoyment, ecotourism helps to spread environmental awareness for protection of natural, social and cultural heritage and sustainable development.



## Advantages and Disadvantage of Ecotourism.

Like other industries there are advantages and disadvantages of ecotourism. with proper management this industry has more advantages than disadvantages if the investors and corporation respect the claim of local people the the advantages are many.

The major advantages are as under.

- Funds generated by ecotourism should be used to fund the local communities in their effort to preserve nature and earth's natural resources, wildlife and local species.

However, ideal condition for this industry also do not prevail many individuals, organisations and even nations have less interest in preserving the environment than making money out of his industry. The human greed which values profit more than the environment, results in many disadvantages of ecotourism.

Some of the disadvantages are mentioned below.

- communities are displaced in gross violation of their fundamental rights
- To make room for ecotourists a lot of natural resources have be sacrificed.



- Forests are cleared to build hotels and resorts.
- Tourists put pressure on already scarce resources like drinking water, food, energy etc.
- Frequent movement of vehicles pollutes the environment by emission of air pollutants and noise.
- Tourist industry also disrupts local life-system by polluting the environment with solid waste, sewage etc.

landscape disturbance are caused by soil erosion due to excessive movements.

ecotourism can result in invasion by alien species which can change the local community composition.

Agricultural practices are disturbed.

Sometimes the endangered species are hunted to make souvenirs.

Some of the local species are kept in cages to attract the tourists.

Some time the innocent local communities and tribes are exploited and not paid adequately for their inputs.