

BLACK DIAMOND SCHOOL OF ENGINEERING,  
JHARSUGUDA

**STUDY MATERIAL**



ON

**ENVIRONMENTAL STUDIES (TH-5)**  
**THIRD SEMESTER CIVIL ENGINEERING**

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## **Unit 1: The Multidisciplinary nature of environmental studies**

### **Definition –**

Environmental studies are an interdisciplinary subject examining the interplay between the social, legal, management, and scientific aspects of environmental issues. Interdisciplinary means that issues are examined from multiple perspectives.

### **Scope of environmental studies-**

The environmental studies discipline has multiple and multilevel scopes. This study is important and necessary not only for children but also for everyone. The scopes are summarized as follows:

1. The study creates awareness among the people to know about various renewable and non-renewable resources of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country reanalysed in the study.
2. It provides knowledge about ecological systems and cause and effect relationships.
3. It provides necessary information about biodiversity richness and the potential dangers to the species of plants, animals, and microorganisms in the environment.
4. The study enables one to understand the causes and consequences due to natural and man induced disasters (flood, earthquake, landslide, cyclones etc.) and pollution and measures to minimize the effects.
5. It enables one to evaluate alternative responses to environmental issues before deciding on an alternative course of action.
6. The study exposes the problems of overpopulation, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from society.

inherited from our ancestors to the younger generation without deteriorating their quality.

### **Importance of environmental study -**

- Environmental study is based upon a comprehensive view of various environmental systems. Its aim is to make the citizens competent to do scientific work and to find out practical solutions to current.
- environmental problems. The citizens acquire the ability to analyse the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and anthroposphere.

### **Importance**

- World population is increasing at an alarming rate especially in developing countries. The natural resources endowment in the earth is limited.
- The methods and techniques of exploiting natural resources are advanced.

- The resources are over-exploited and there is no foresight of leaving the resources to the future generations.
- The unplanned exploitation of natural resources leads to pollution of all types and at all levels.
- The pollution and degraded environment seriously affect the health of all living things on earth including man.
- The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.
- Education and training are needed to save the biodiversity and species extinction.
- The urban area, coupled with industries, is major sources of pollution.
- The number and area extinct under protected area should be increased so that the wild life is protected at least in these sites.
- The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- The study motivates students to get involved in community action, and to participate in various environmental and management projects.
- It is a high time to reorient educational systems and curricula towards these needs.

#### **Need for public awareness –**



- Increasing population, Urbanization and poverty have generated pressure on the natural resources and lead to a degradation of the environment. To Prevent the Environment from Further Degradation, the supreme court has ordered and initiated environmental protection awareness through government and non-government agencies to take part in protecting our environment.
- Environmental pollution cannot be prevented by laws alone. Public participation is equally important with regard to environmental protection.
- Climate change, loss of biodiversity, declining fisheries, ozone layer depletion, illegal trade of endangered species, destruction of habitats, land degradation, depleting ground water supplies, introduction of alien species, environmental

pollution, solid waste disposal, storm water and sewage disposal pose a serious threat to ecosystems in forest, rural, urban and marine ecosystems.

- Both formal and informal education on the environment will give the interested individual the knowledge, values, skills and tools needed to face the environmental challenges on a local and global level.

## **Unit 2: Natural Resources**

### **Renewable and non renewable resources:**

#### **Renewable Resources**

The resources which cannot be exhausted even after continuous utilization are termed as renewable resources. Examples of renewable resources are the sun, wind, and tidal energy.

#### **Non-Renewable Resources**

The resources which cannot be immediately replaced once they are depleted are called Non-renewable resources. Examples of Non-renewable resources include fossil fuels, such as coal, petroleum and natural gas and rare minerals typically found in meteorites.

#### **a) Natural resources and associated problems – Forest Resources -**

Forest is important renewable resources. Forest vary in composition and diversity and can contribute substantially to the economic development of any country. Plants along with trees cover large areas, produce variety of products and provide food for living organisms, and also important to save the environment.

#### **Over exploitation of forests**

Forests contribute substantially to the national economy. With increasing population increased demand of fuel wood, expansion of area under urban development and industries has lead to over exploitation of forest .At present international level we are losing forest at the rate of 1.7 crore hectares annually. Overexploitation also occurs due to overgrazing and conversion of forest to pastures for domestic use.

#### **Deforestation**

1. Forest are burned or cut for clearing of land for agriculture ,harvesting for wood and timber , development and expansion of cities .These economic gains are short term where as long term effects of deforestation are irreversible
2. Deforestation rate is relatively low in temperate countries than in tropics If present rate of deforestation continues we may losses 90% tropical forest in coming six decades
3. For ecological balance 33% area should be under forest cover but our nation has only 20.6% forest cover.

## **Causes Of deforestation -**

Forest area in some developed area has expanded. However in developing countries area under forest is showing declining trend particularly in tropical region. Main causes of deforestation are

- a) *Shifting cultivation or jhum cultivation*
- b) *Commercial logging*
- c) *Need for fuel wood*
- d) *Expansion for agribusiness*
- e) *Development projects and growing need for food*
- f) *Raw materials for industrial use*

## **Case Studies -**

Jhum Agriculture or shifting agriculture has destroyed large number of hectare of forest tracts in North-Eastern states and Orissa. Jhum agriculture is subsistence agriculture in which tract of forest land is cleared by cutting trees and it is used for cultivation.

After few years, when productivity of the land decreases, cultivators abandon the land and clear next tract. As a result of this practise, combined with increasing population there is rapid deforestation as more and more cultivators clear forest to cultivate land. Also, with increase in population there is cultivators are forced to return to previous tracts. shortage of firewood and timber, due large scale tree cutting. Increased traffic volumes on these roads leads to increased pollution in the area.

## **Timber extraction**

There has been unlimited exploitation of timber for commercial use. Due to increased industrial demand; timber extraction has significant effect on forest and tribal people.

### ***Logging***

- Poor logging results in degraded forest and may lead to soil erosion especially on slopes.
- New logging roads permit shifting cultivators and fuel wood gatherers to gain access to the logging area.
- Loss of long term forest productivity
- Species of plants and animals may be eliminated
- Exploitation of tribal people by contractor.

### **Mining**

Major effects of mining operations on forest and tribal people are:

- Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining. It leads to degradation of lands and loss of top soil. It is estimated that about eighty thousands hectare land is under stress of mining activities in India
- Mining leads to drying up perennial sources of water sources like spring and streams in mountainous area.

- Mining and other associated activities remove vegetation along with underlying soil mantle, which results in destruction of topography and landscape in the area. Large scale deforestation has been reported in Mussoorie and Dehradun valley due to indiscriminating mining.

### ➤ **Effects of dams on forests and tribal people**

Pandit Jawaharlal Nehru referred dam and valley projects as “Temples of modern India”. These big dams and rivers valley projects have multi-purpose uses. However, these dams are also responsible for the destruction of forests.

- They are responsible for degradation of catchment areas, loss of flora and fauna, increase of water borne diseases, disturbance in forest ecosystems, rehabilitation and resettlement of tribal peoples.

- India has more than 1550 large dams, the maximum being in the state of Maharashtra (more than 600), followed by Gujarat (more than 250) and Madhya Pradesh (130).
- The highest one is Tehri dam, on river Bhagirathi in Uttaranchal and the largest in terms of capacity is Bhakra dam on river Satluj in Himachal Pradesh. Big dams have been in sharp focus of various environmental groups all over the world, which is mainly because of several ecological problems including deforestation and socio-economic problems related to tribal or native people associated with them.
- The Silent valley hydroelectric project was one of the first such projects situated in the tropical rain forest area of Western Ghats which attracted much concern of the people.
- The crusade against the ecological damage and deforestation caused due to Tehri dam was led by Shri. Sunder Lal Bahuguna, the leader of Chipko Movement.

### **WATER RESOURCES:**

- Water is the most abundant, inexhaustible renewable resource. It covers 70% of the globe in the form of oceans, rivers, lakes, etc. Of this 70%, only 3% is available as freshwater.
- From this 3%, roughly 2% is frozen in polar icecaps and only a fraction of the remaining 1% is used as drinking water (potable). 90% of the water is utilized for agricultural purposes in India.

### **USE OF SURFACE AND GROUND WATER**

- **Consumptive use:** In such uses, water is completely utilized and cannot be reused. Ex: Domestic, industrial and irrigation
- **Non-consumptive use:** In such uses, water is not completely utilized and is reused Ex: Hydropower plant

**Other uses:**

1. Water is used for domestic purposes like drinking, bathing, cooking, washing, etc.
2. Water is used in commercial establishments like hotels, theaters, educational institutions, offices, etc.
3. Almost 60-70% of fresh water is used for irrigation
4. 20-30% of water is used for industrial operations by refineries, iron & steel industries, paper & pulp industries, etc.
5. Water plays a key role in sculpting the earth's surface, moderating climate and diluting pollutants.

**OVER-UTILIZATION OF SURFACE & GROUND WATER**

The rapid increase in population and industrial growth led to severe demand on water resources. After using all available surface water resources to the maximum, human beings began using groundwater to meet their needs.

1. The increased extraction of groundwater far in excess of the natural recharge led to decreased groundwater level. The erratic and inadequate rainfall caused reduction in storage of water in reservoirs. This also led to decrease of groundwater.
2. Building construction activities seal permeable soil zone and reduce the area for percolation of rainwater thereby increasing surface runoff.
3. If groundwater withdrawal rate is higher than recharge rate, sediments in aquifers get compacted resulting in sinking of overlying land surface. This is called land subsidence which leads to structural damage in buildings, fracture in pipes and reverses the flow of canals leading to tidal flooding.
4. Over-utilization of groundwater in arid and semi-arid regions for agriculture disturbs equilibrium of reservoir in the region causing problems like lowering of water table and decreased pressure in aquifers coupled with changes in speed and direction of water flow.
5. Over utilization of groundwater in coastal areas leads to rapid intrusion of salt water from the sea thereby rendering it unusable for drinking and agriculture.

6. Over-utilization of groundwater leads to decrease in water level thereby causing earthquake, landslides and famine.

### **Drought**

- Water is a very basic necessity for the survival of life on earth. Imagine life with insufficient amount of water, it will be impossible to do the daily activities of cleaning, cooking, drinking etc.
- Life will turn out to be a miserable chaos. Water cycle has helped in maintaining the quantity of water on the surface of earth. About 50 liters of water is needed per day per person in order to sustain a healthy life.
- There are many areas where people do not receive this basic quantity of water. Areas that do not receive adequate amount of rainfall and have dry soil suffer from droughts. Whereas areas which receive heavy rainfall and have marshy soil generally get flooded.
- Drought conditions result from a lack of precipitation and this has many effects on the surrounding land and weather conditions. Drought conditions can worsen after prolonged periods of no rainfall, especially in areas where the water supply is short.

Causes drought?

Lack of rainfall (or precipitation): Droughts can occur when there is the lack of 'expected' precipitation (rain and snow).

**Note** that we say 'expected' because the lack of rain alone does not mean a drought.

### **FLOOD**

#### **Reasons of Flood**

- Rains: Each time there are more rains than the drainage system can take, there can be floods. Sometimes, there is heavy rain for a very short period that result in floods. In other times, there may be light rain for many days and weeks and can also result in floods.
- River overflow: Rivers can overflow their banks to cause flooding. This happens when there is more water upstream than usual, and as it flows downstream to the adjacent low-lying areas (also called a floodplain), there is a burst and water gets into the land.
- Strong winds in coastal areas: Sea water can be carried by massive winds and hurricanes onto dry coastal lands and cause flooding. Sometimes this is made worse if the winds carry rains them. Sometimes water from the sea resulting from a tsunami can flow inland to cause damage.
- Dam breaking (Dams are built along the side of a river and are used to prevent high water from flooding bordering land). Sometimes, too much water held up in the dam can cause it to break and overflow the area. Excess water can also be intentionally released from the dam to prevent it from breaking and that can also cause floods.

#### **Conflicts over water (international & inter-state).**

Conflict through pollution: Rivers are also used for industrial purposes. They act as reservoirs for supply of fresh water and also a receptor of waste water



and rubbish from the industry. Water crossing borders that has been polluted by wastes from one country develops into an international conflict.

#### Management of water conflicts

1. Concerted efforts are required to enforce laws that check these practices to control water pollution.
2. In order to overcome the problem of sharing river water in a country, the concept of interlinking of rivers has been suggested.
3. Rivers should be nationalized; the National Water Authority and River Basin Authority should be given powers to ensure equitable distribution of basin water

#### **Food resources:**

World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

#### **Food Resources:**

- Almost entirely from agriculture, animal husbandry and fishing. Although India is self-sufficient in food production, it is only because of modern patterns of agriculture that are unsustainable and which pollute our environment with excessive use of fertilizers and pesticides.
- The FAO defines sustainable agriculture as those which conserves land, water and plant and animal genetic resources, does not degrade the environment and is economically viable and socially acceptable.
- Most of our large farms grow single crops (monoculture). If this crop is hit by a pest, the entire crop can be devastated, leaving the farmer with no income during the year. On the other hand, if the farmer uses traditional varieties and grows several different crops, the chance of complete failure is lowered considerably.
- Many studies have shown that one can use alternatives to inorganic fertilizers and pesticides. This is known as Integrated Crop Management.

#### **World food problems:**

Our fertile soils are being exploited faster than they can recuperate.

- Forests, grasslands and wetlands have been converted to agricultural use, which has led to serious ecological questions.
- Our fish resources, both marine and inland, show evidence of exhaustion.
- There are great disparities in the availability of nutritious food.

Some communities such as tribal people still face serious food problems leading to malnutrition especially among women and children. These issues bring in new questions as to how demands will be met in future even with a slowing of population growth

## **Food security, loss of genetic diversity and alternate food sources**

### **(fisheries):**

Changes caused by agriculture and overgrazing:

Agriculture has both primary and secondary environmental effects. A primary effect is an effect on the area where the agriculture takes place i.e. on-site effect. A secondary effect, also called an off-site effect, is an effect on an environment away from the agricultural site. The effects of agriculture on the environment can be broadly classified into three groups, viz. global, regional and local:

(1) Global Effects: These include climate changes as well as potentially extensive changes in chemical cycles.

(2) Regional Effects: These generally result from the combined effects of farming practices in the same large region. Regional effects include deforestation, desertification, large scale pollution, increase in sedimentation in major rivers and in the estuaries at the mouths of the rivers and changes in the chemical fertility of soils over large areas. In tropical waters, sediments entering the ocean can destroy coral reefs.

### **Effects of modern agriculture - Fertilizer Pesticide problems, Water logging, Salinity**

Agriculture is an art, science and industry of managing the growth of plants and animals for human use. Agriculture includes preparation of soil for cultivation of crops, harvesting crops, breeding and raising livestock, dairying and forestry. The two major types of agriculture are:

1. Traditional agriculture
2. Modern or Industrialized agriculture

#### **MODERN AGRICULTURE**

Modern agriculture makes use of hybrid seeds of single crop variety, technologically advanced equipment, fertilizers, pesticides and water to produce large amounts of single crop.

Problems using fertilizers

1. Micronutrient imbalance
2. Nitrate pollution
3. Eutrophication

#### **WATER LOGGING**

If water stands on land for most of the year, it is called water logging. In water logged

conditions, pore-voids in the soil get filled with water and soil-air gets depleted. In such a condition the roots of plants do not get enough air for respiration. Water logging also leads to low mechanical strength of soil and low crop yield.

#### **CAUSES OF WATER LOGGING**

1. Excessive water supply to the croplands
2. Heavy rain
3. Poor drainage

#### **MEASURES TO PREVENT WATER LOGGING**

1. Avoid and prevent excessive irrigation
2. Sub-surface drainage technology
3. Bio-drainage by trees like Eucalyptus

#### **SALINITY**

Water not absorbed by soil, is evaporated leaving behind a thin layer of dissolved salts in the top soil. This is called salinity of the soil. Saline soils are characterized by accumulation of soluble salts like sodium chloride, calcium chloride, magnesium chloride, sodium sulphate, sodium carbonate and sodium bicarbonates. Saline conditions are exhibited when pH is greater than 8.0

#### **PROBLEMS IN SALINITY**

Saline soils yield less crop In order to remedy the condition of saline soils the following two techniques may be used:

1. Salt deposit is removed by flushing with good quality water
2. By using a sub-surface drainage system, the salt water is flushed out slowly.

#### **CASE STUDIES**

Canal irrigation in Haryana resulted in rising water table followed by water logging and salinity causing low crop productivity thereby huge economic losses. Similarly, the "Indira Gandhi Canal Project" in Rajasthan converted a big area into a "water soaked waste land". In Delhi, accumulation of pesticides and DDT in the body of mothers caused premature deliveries or low birth weight infants. Food centre at Centre for Science and Environment (CSE) India reported Pepsi and Coca-Cola companies sold soft drinks with a pesticide content 30-40 times higher than EU guidelines permit.

#### **Energy resources:**

#### **Renewable and non-renewable energy sources –**

Energy is broadly classified into two main groups: Renewable and Non-renewable.

## **Renewable Energy**

Renewable energy is the energy which is generated from natural sources i.e. sun, wind, rain, tides and can be generated again and again as and when required.

### **Pros and Cons of Renewable energy:**

- The sun, wind, geothermal, ocean energy are available in the abundant quantity and free to use.
- The non-renewable sources of energy that we are using are limited and are bound to expire one day.
- Renewable sources have low carbon emissions, therefore they are considered as green and environment friendly.
- Renewable helps in stimulating the economy and creating job opportunities. The money that is used to build these plants can provide jobs to thousands to millions of people.
- You don't have to rely on any third country for the supply of renewable sources as in case of Non-renewable sources.
- Renewable sources can cost less than consuming the local electrical supply. In the long run, the prices of electricity are expected to soar since they are based on the prices of crude oil, so renewable sources can cut your electricity bills.

## **Non-Renewable Energy**

Non-Renewable energy is the energy which is taken from the sources that are available on the earth in limited quantity and will vanish fifty-sixty years from now. Non-renewable sources are not environmental friendly and can have serious affect on our health.

### **USE OF ALTERNATE RENEWABLE ENERGY SOURCES**

1. Solar energy is renewable and does not cause environmental pollution
2. Energy sources that create minimum pollution, are safe not prone to security threats and have universal availability have the best chance of large-scale utilization in future.
3. Hydro-electric power generation is expected to the existing ecological balance.
4. Apart from generating heat, hydel power plants critically endanger aquatic and terrestrial biotic.
5. Radioactive pollutants released from nuclear plants are chronically hazardous. Commissioning of Boiling Water Power Reactors (BWRs) result in accumulation of large number of radionuclides in water
6. Dangerous radioactive waste cannot be buried in/land without the risk of polluting soil and underground water. The waste cannot be dumped in rivers as it poisons aquatic life and human beings.

7. Burning of coal, oil, wood, dung cakes and petroleum products have well established environmental problems. The smoke produced causes respiratory and digestive problems leading to lung, stomach and eye diseases.

### **CASE STUDIES**

Wind energy India is generating 1200 MW electricity using wind energy. The largest wind farm is in Kanyakumari in Tamil Nadu, which generates 380 MW electricity. Hydrogen-Fuel cell car General motor company of China invented experimental cars that run on electric motors fuelled by hydrogen and oxygen. These cars produce no emission and the only waste products being water droplets and water vapour. Commonly known alternative energy sources.

### **LAND RESOURCES**

- In India, land is generally called as “MOTHER LAND”. It is because of our life depend on it for food, fibre , fuel and other basic amenities. Therefore, it is the valuable gift of nature to human beings. Top layer of the land is called soil, which is renewable resource and essential for survival of life.
- Land available for cultivation is approximately 14 million hectares. But it is reducing day by day. It is due to mismanagement. The earth is made up of three principal layers cores, mantle and crust. Cores are inner most fluid layers.
- Land is classified in to 9 categories .  
They are (i) forests,  
(ii) land put to non-agricultural use  
(iii) barren land unculturable land  
(iv) permanent pastures and other grazing lands  
(v) misc. tree crops and groves  
(vi) culturable waste  
(vii) fallow land  
(viii) current fallow  
(ix) net area sown.

### **LAND SUITABLE FOR CULTIVATION AND OTHER USES :**

- There are four class of land which are suitable for cultivation and other purposes. Their details & limitations are as
- Soils in class I have very few or no limitations that restrict their use.
- This type of land is nearly level and the erosion hazard is low.
- soils are deep, well-drained, easily worked, hold water well and are either fairly well supplied with plant nutrients or are highly responsive to the application of fertilizers. The soils are not subject to damage because of overflow.
- Soils in this class are suited to a wide range of plants, may be used for cultivated crops, pastures, forests and wild life, food and cover.

The limitations of soils in class II may result from the effects of one or more of the following factors : (i) a gentle slope,

(ii) a slight susceptibility to erosion,

(iii) less than ideal soil depth,

(iv) occasional damaging overflow,

(v) wetness which can be corrected by drainage, but existing permanently as a moderate limitation, (vi) slight to moderate salinity or sodium, easily corrected but likely to re-occur, and

(vii) a slight climatic limitation on soil use and management.

Limitations of soils in class III may result from the effects of one or more of the following factors :

(i) moderately sloping land.

(ii) moderately susceptible to water or wind erosion.

(iii) frequent overflow accompanied with some crop damage,

(iv) very slow permeability of the subsoil,

(v) wetness or continuing water-logging after drainage,

(vi) shallow soil depth up to the bedrock, hard-pan or clay-pan which limits the rooting-zone and the water storage,

(vii) low moisture holding capacity,

(viii) moderate salinity or sodium, and

(ix) moderate climatic limitation.

The soils can be used for raising cultivated crops, pastures, forests and wild-life food and cover.

The use of these soils for cultivated crops is limited as a result of the effect of one or more permanent features, such as

(i) steep slopes,

(ii) severe susceptibility to water and wind erosion,

(iii) severe effect of past erosion,

(iv) frequent over-flow accompanied with severe crop damage,

(v) excessive wetness with a continuing hazard of water-logging after drainage,

(vi) severe salinity or sodium, and

(vii) moderately adverse climate.

These soils can be used for crops, pastures, forests and wild life food and cover.

## **LAND DEGRADATION**

- The total land under agricultural use is around 58.4% i.e. grossed cropped area is 167.41 million hectares. The land not fit for cultivation i.e. barren land is around 9.9%. The area under forest is 21.6%, but it needs to be raised.
- land resources are the precious resources. Food security depend on conservation and proper utilization of all resources.
- Due to use and over exploitation land resources are degraded. It is due to the more & more pressure with increasing population.
- Land degradation is a real alarm. Because soil formation is a very slow process. In millions of years we have a layer crust of fertile soil. In general, formation of 1.0 cm soil crust from parent material take 300 - 400 years.

- Fertile soil have high percentage of organic matter vis-a-vis microorganisms. Each gram of fertile soil have 30 billion micro-organisms.

### **Significance of the problem :**

- In India, green revolution brought about technological breakthrough, which led to the use of short duration high yielding varieties helping intense use of land in a year, increasing area brought under irrigation and more use of Chemicals such as fertilizers and pesticides.
- India, being vastly agriculture oriented. Development of agriculture would lead to overall development of the nation and help eradication of poverty.
- It has been of late recognised that the increasing efforts to raise agricultural growth has cost us clearly in the form of land & water degradation

### **LANDSLIDES**

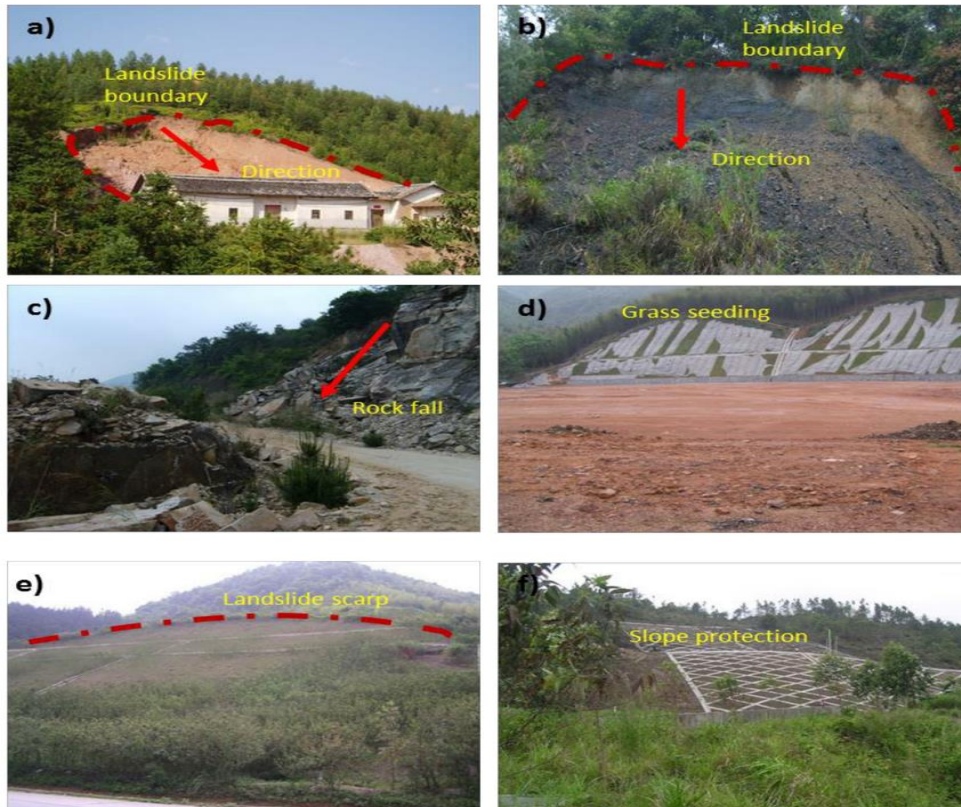
A landslide is a sudden collapse of a large mass of hillside. There are many different types of landslides where not only earth, but rock, mud, and debris flow down the side of a slope. Since the beginning of the monsoon season in June India has been hit by heavy rains and landslides affecting in particular, Arunachal Pradesh, Assam, and Bihar states

Landslides mostly occur

1. Where landslides have occurred before.
2. On steep slopes.
3. On benches.
4. Where drainage is causing a problem.
5. Where certain geologic conditions exists.

### **Types of landslides**

1. Shallow, disrupted landslide-Example of this type is the Santa Susana Mountains and the mountains north of the Santa Clara River Valley. Here more than 75% of the slope area was denuded by landslides triggered by strong shaking,
2. Deep. Coherent Landslides. These triggered by the earthquake were far less numerous than disrupted slides, they contributed significantly to the total volume of landslide material because they tended to be much larger. Some of these landslides are



### Man induces land slides:

Man can also cause slides by mining the earth, underground draining groundwater levels or overdeveloping hillsides. Man induced landslides are generally done for the development purposes i.e. industrial, forming roads, agricultural use, homes, etc. They use heavy explosives for that. In this case no serious casualties or damage occur because proper warned earlier to shift in safer places. affected

### Effects :

No heavy damage occur in man induced landslides but thousands of and killed due to landslides. Many houses can be damaged and the loss of public properties is also noticed. Roads and rail communication may remain cut off from rest of the regions. Thunder storms cause debris flows on hill slopes leading to deposits of mud. Heavy rains at the same time may worsen the situation.

### Soil erosion:

Soil erosion means the removal of material from the surface of the soil by the agency of running water, wind or even by gravity. Since the superficial layers of the soil are the richest in plant valuable plant nutrients and if it becomes sufficiently intense, may lead to the complete destruction of the soil as the seat of plant growth.



- Normal or geologic erosion. Geologic erosion takes place steadily but so slowly that ages are required for it to make any marked alteration in the major features of the earth's surface. There is always an equilibrium between the removal and formation of soil, so that unless the equilibrium is disturbed by some outside agency, the mature soil preserves, more or less, a constant depth and character indefinitely.
- Accelerated soil erosion. The removal of the surface soil from areas denuded of their natural protective cover as a result of human and animal interference takes place at a much faster rate than that at which it is built up by the soil-forming processes.
- Wind erosion. Wind erosion takes place normally in arid and semi-arid areas devoid of vegetation, where the wind velocity is high.
- The soil particles on the land surface are lifted and blown off as dust-storms. When the velocity of the dust-bearing winds is retarded, coarser soil particles are deposited in the form of dunes and thus fertile lands are rendered unfit for cultivation.
- Sheet erosion. Sheet erosion removes a thin covering of soil from large areas, often from entire fields, more or less, uniformly during every rain which produces a run-off.
- Rill erosion. When sheet erosion is allowed to continue unchecked, the silt-laden run-off forms a well-defined, but minute finger-shaped grooves over the entire field. Such thin channelling is known as rill erosion.
- Gully erosion. When rill erosion is neglected, the tiny grooves develop into wider and deeper channels, which may assume a huge size. This is called 'gully' erosion.

## **DESERTIFICATION**

- Desertification is a process by which productive potential of arid or semiarid land falls. The decrease in productivity varies from 10%-50%. Thus, desertification leads to the conversion of irrigated crop land to desert (where productivity is minimum).
- It is characterized by de vegetation loss of vegetal cover, depletion of ground water, salinization and soil erosion.
- Draught in three consecutive years in Central India in recent years has accelerated the process of wind erosion and desertification.
- In Rajasthan and Kutch-Saurashtra area, extension in the area of desert is assuming serious proportion. Climatic change and anthropogenic activities are also responsible for desertification.
- During last so many years large area has destroyed (agriculture land) by Sahara Desert. In India, also, so many places which affected by desertification.
- Deforestation is also one of the causes of desertification. The increasing cattle population heavily graze in grasslands or forests and denude the land area, which is not suitable for seed germinations. Thus, overgrazing is also one of the causes for desertification.

## **Role of an individual in conservation of Natural resources :**

- Planning of a suitable strategy for the conservation of our natural resources and most judicious execution of planned strategies is called as Conservation Management.
- Environmental planning, evaluation, monitoring, and impact assessment are methods of conservation management. The Indian philosophy of conservation is to keep “Harmony with Nature”.

1. People should at once stop the over utilization of natural resources instead they must be properly used.
2. Instead of deforestation, reforestation should keep in mind. We should take help from the Govt. for plantation programmes. Everybody should take part in plantation and care the plants.
3. We should protect wildlife. Though hunting is not allowed even then the persons are doing so. For these educated young should teach the lesson of wild life act.
4. Mixed cropping, crop rotation, and proper use of fertilizer insecticide, pesticides should be taught to farmers. Encourage the use of manures, biofertilizers organic fertilizers.
5. We should make habit for waste disposal, compost and to restore biodiversity.
6. Try to educate local people for the protection and judicious use of natural resources.
7. We should use light, fans and other domestic appliances when it is needed.
8. Maintain a balance between resources and human needs.
9. Maintain the essential ecological processes and the life support systems.
10. Install rain water harvesting system in houses, colonies.

We know “collecting drop-drop-drops form a big ocean”, similarly if each of us will aware about the judicious use of natural resources, all of us will conserve the nature.

### **Equitable use of resources for sustainable life Style:**

- The equal distribution of natural resources should be for all irrespective of rich or poor. There must be balance between the need and consumption particularly for drinking water, food, fuel etc.
- The developed countries are utilizing more resources as compared to developing countries. This imbalance is responsible for rich become richer and poor gone poorer.
- This is due to sharp increase in population in developing countries. But it does not mean that people of developed countries are rich and having good life style, and less developed countries people are poor.
- Less developed countries also have rich and poor both but facing the problem of population and available natural resources.
- Developed countries like USA, Canada, Japan, Australia etc. have 22% of world's population utilising 86% of natural resources. Thus it is needed to divert the resources to poor countries to narrow down the gap between the two.

- To achieve sustainable life style, there should be equal distribution of global resources and income to meet everyone's need. But in the long process of economic development only the powerful and strong people exploited most of the environmental resources even at the cost of migration of poor people already using those resources.

## Unit 3: Systems

### CONCEPT OF ECOSYSTEM

Now, we can say Ecology deals with interrelationships between the biotic and abiotic compounds of an Ecosystem. The term ecosystem was first coined by A.G. Tausley 1935. It is derived by two words "eco" means environment and 'system' implies a complex of co-ordinated units.

*An ecosystem concept is that the living organisms of a community not only interact among themselves but also have functional relationship with their non-living environment. This structural and functional system of communities and their environment is called an ecosystem.*

### FUNCTIONING AND TYPES OF ECOSYSTEMS

Depending upon the species, diversity and the manner in which they are organised, are of following types

**1. Permanent and Natural ecosystem.** These operate under natural conditions without any interference (even by human beings). These can be further classified in to

(i) Terrestrial ecosystem (ii) Aquatic ecosystem

Terrestrial ecosystems operate on land hence Forest, Desert and grassland and Agro-ecosystem included in this type. While Aquatic ecosystem operates in water. It can be divided in two

(a) Fresh water ecosystem

(b) Marine ecosystem

Freshwater ecosystems are usually named after the size and nature of the fresh water body such as pond, lake & river.

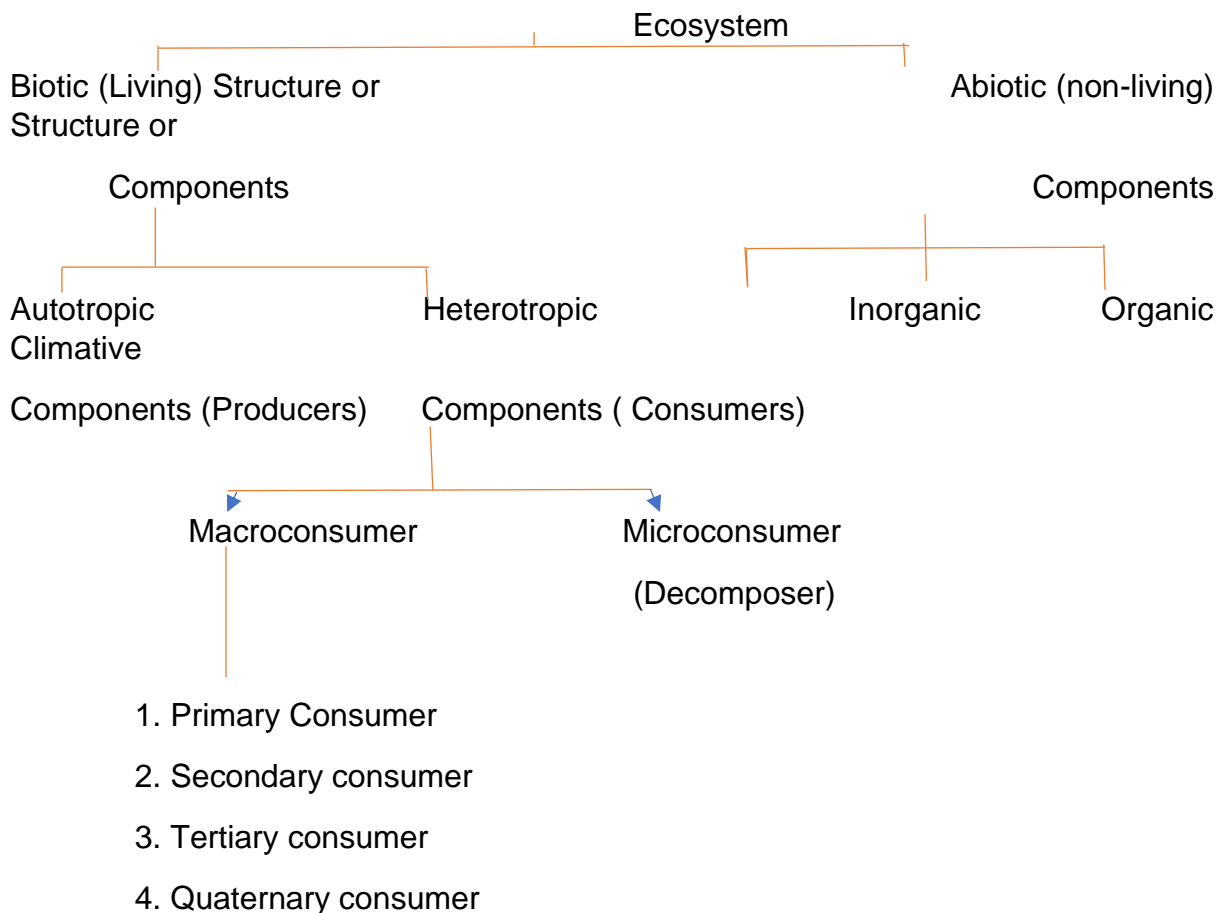
Marine ecosystem is largest ecosystem on earth, which consists of several subdivisions each having its physico-chemical and Biological characteristics. For example, in the deepest ocean producers are absent but in many other organisms survive which dependent for food on the dead organic matter coming from the upper layers of the ocean.

**2. Temporary and Natural ecosystems.** These are short lived but operate under natural conditions.

**3. Artificial or Anthropogenic ecosystems.** These are man-made like fishery tanks dams, croplands and space ecosystems also. Fish aquarium is also come under this head.

### STRUCTURE OF AN ECOSYSTEM

It is a description of the species of organisms that are present (including information on their life histories, populations and distribution in space). The structure of ecosystem provides information about the range of climatic conditions that prevail in the area, composition and organization of Biological Communities and Abiotic compounds constitute the structure of an ecosystem. According to Odum, from the trophic (Food) point of view, an ecosystem has the following components:



#### 1. Biotic Structure.

Producers, consumers and decomposers are components of biotic ecosystem. Living organisms exchange, expel, convert, assemble, disassembles, organise and otherwise manipulate the constituents of earth, air and water. Biotic structure includes plants, animals and microorganisms present in an ecosystem. We have identified producers, decomposers and consumers are the basic components of biotic ecosystem. These can be distinguished on the bases of their source of energy and material

##### (a) Autotrophic components (Autotrophic = self nourishing)

In which the fixation of light, energy, the use of simple inorganic substances and manufacture of complex material predominates. These are also called producers.

### **(b) Heterotrophic Components (Heterotrophic = other nourishing)**

These utilize, rearrange and decompose the complex materials synthesized by the autotrophs. The most intense heterotrophic activity takes place where the organic matter accumulates in the soils and sediments. These are also called consumers.

### **PRODUCERS**

All green plants are producers. They are also called "converters" or "transformers". They are living members of the ecosystem that utilize sunlight as their energy source and simple inorganic rich chemicals as their own food. Producers are largely photosynthetic plants and their kind varies with the kind of ecosystem. In dense forest the trees are the most important producers. In lakes and ponds, the producers are rooted or large floating and microscopic plants (phytoplankton) usually the algae.

### **CONSUMERS**

As we have seen earlier, consumers are heterotrophs, the living organisms which ingest other organisms. They derive their food directly or indirectly from the producers. The food is then digested i.e. broken down to simple substances which are metabolized in the consumer's body and released as waste product to the environment. Consumers are of following types---

**(i) PRIMARY CONSUMERS-** These are also called 'HERBIVORES' which feed directly on the producers. They vary with the kind of ecosystem. For example a deer and giraffe is a primary consumer in forest ecosystem, while cow or a goat is in a grassland or crop ecosystem. Protozoans and certain crustaceans which feed on floating algae are also primary consumers.

**(ii) SECONDARY CONSUMERS-** They are also called "CARNIVORES" (meat eaters). For example insects, gamefish in a pond eat primary consumers.

**(iii) TERTIARY CONSUMERS.** - In most of ecosystem some organism that eat other carnivores like they are tertiary consumers.

**(iv) OMNIVORE--** A person or animal eating plants and animals is called omnivore.

**(v) TOP CARNIVORES-** Some ecosystem have animals like lion and vulture, which are not killed or rarely killed and eaten by other animals are called top carnivores.

**(vi) DETRITIVORES-** These are the bottom living which subsist on the rain of organic detritus from autotrophic layers e.g. beetles, termites, ants, crabs etc.

**3. DECOMPOSERS-** They are also the living components, mainly bacteria and fungi which breakdown complex compounds of dead protoplasm of producers and consumers to simple organic compounds and ultimately into inorganic nutrients. In all the ecosystems, this biotic structure prevails.

**2. ABIOTIC STRUCTURES OR COMPONENTS.** - The physical and chemical components of an ecosystem constitute its abiotic structure. It includes two things

**(i) MATERIALS OR CHEMICAL FACTOR-**The materials are like water, minerals, atmospheric gases and other inorganic salts. They also include some organic matter such as amino acids, decay products, lipids, carbohydrates, proteins etc. The quantity of abiotic materials like the minerals present at any given time in an ecosystem is termed as the 'standing state' or 'standing crop'.

**(ii) ENERGY OR PHYSICAL FACTOR.** This is in the form of light, heat and stored energy in chemical bonds. Annual rainfall, wind latitude and altitude etc. are also some physical factors, which have a strong influence on ecosystem. For proper functioning of an ecosystem there must be a continuous 'flow of energy' and 'cycling of minerals' among the organisms of the ecosystem.

### **ENERGY FLOW IN THE ECOSYSTEM**

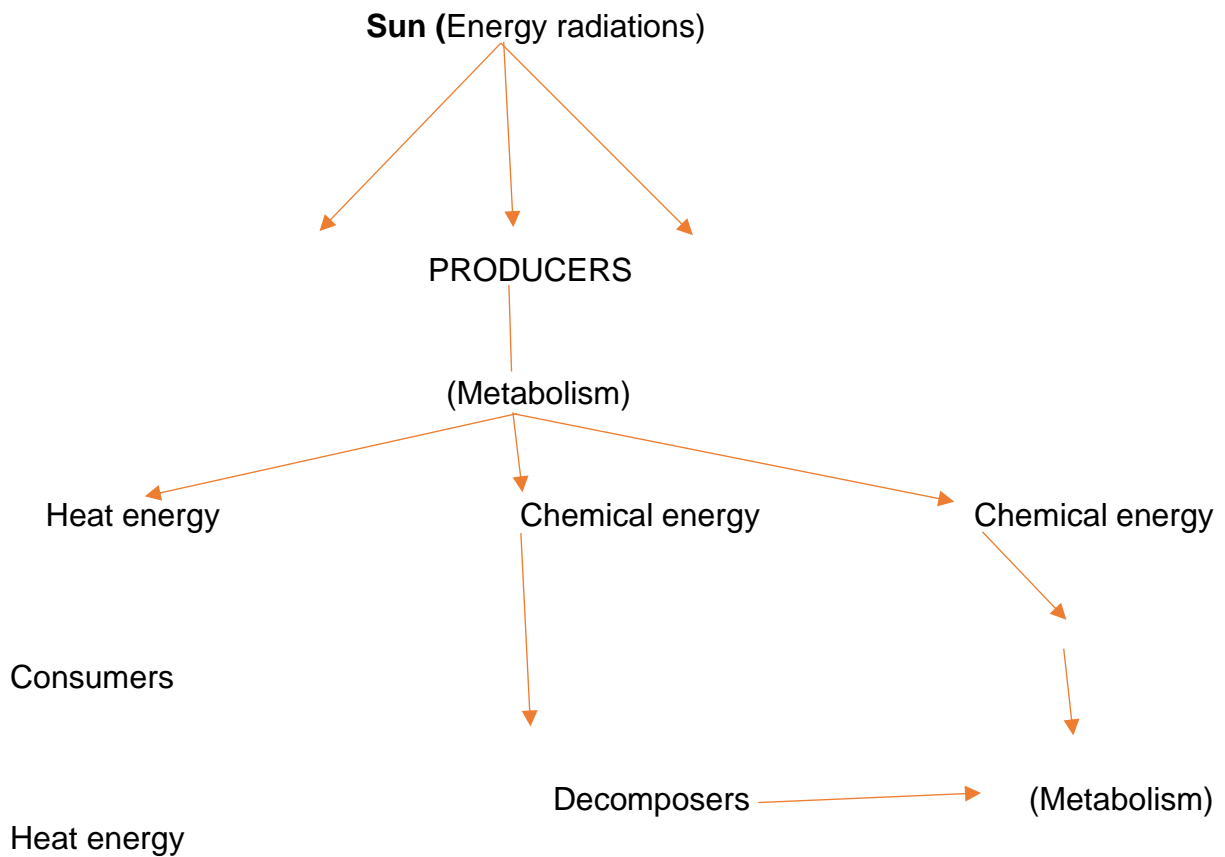
Energy is needed for every biological activity. Solar energy is transformed in to chemical energy by a process of photosynthesis. This energy is stored in plant tissue and then transformed in to mechanical and heat form during metabolic activities.

**The flow of energy follows the two laws of thermodynamics.**

**1<sup>st</sup> law of thermodynamics:** The law states that energy can neither be created nor be destroyed but it can be transformed from one form to another. Similarly , as we have read earlier Solar energy utilized by green plants in photosynthesis converted in to biochemical energy of plants and later in to that of consumers.

**2nd law of thermodynamics.** The law states that energy transformation involves degradation or dissipation of energy from a concentrated to a dispersed form. We have seen dissipation of energy occurs at every trophic level. There is loss of 90% energy, only 10% is transferred from one trophic level to the other.

**SUN AS THE SOURCE OF ENERGY.** Sun is the source of energy which extends radiations from high frequency to low frequency. Approximately 99% of total energy is in the region between UV and IR. The visible spectrum spreads over 0.38  $\mu$  to 0.77  $\mu$  involving about 50% of solar p radiations. Some autotrophs however utilize energy released from oxidation processes for the synthesis of organic food.



## ENERGY FLOW MODELS

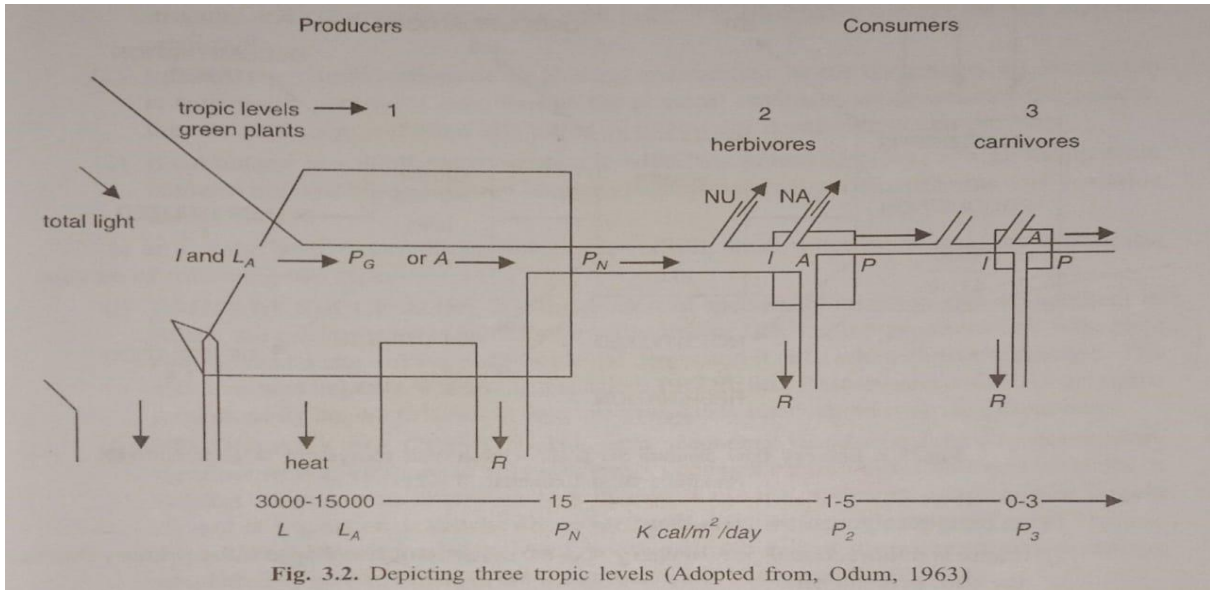
As we have seen that there is unidirectional flow of energy from sun to the producers and then various types of consumers. Therefore, behaviour of energy in ecosystem can be termed Energy flow. About 34% of the sunlight reaching the atmosphere is reflected back in to its atmosphere . 10% is held by ozone layer, water vapours and other atmospheric gases. Rest 56% reaches the earth surface. Out of this 1-5% is used by green plants for photosynthesis.



Rest is absorbed as heat by ground vegetation or water. The flow of energy in an can be explained with the help of various energy flow models ecosystem

### 1. ODUM'S ENERGY FLOW MODEL

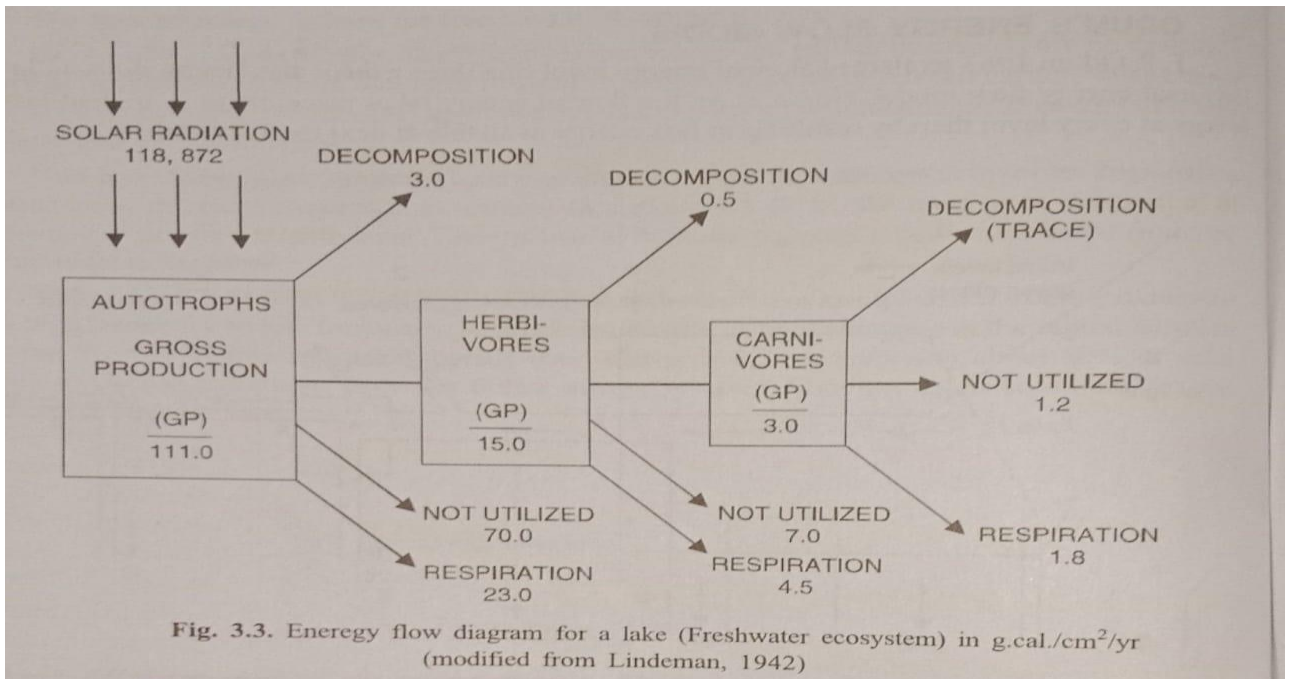
E.P. Odum 1963 explained flow of energy involving three trophic levels with the help of his universal energy flow model. As the flow of energy takes place, there is gradual loss of energy at every level thereby resulting in less energy available at next trophic level.



Out of total 3000 K Cal of light falling (L) on producers level, only 50% i.e. 1500 KCal is absorbed by autotrophs with an efficiency of energy capture is only 0.1 - 1%. As reported 21% of this energy is consumed in metabolic reactions of autotrophs for their growth, development, maintenance and reproduction. Thus gradual decline in energy at the second trophic level i.e. herbivores and then at third trophic level i.e. carnivores in grazing food chain is observed.

## 2. LINDEMAN'S ENERGY FLOW MODEL

Lindeman in 1942 gave the unidirectional energy flow model of fresh water ecosystem. Model shows that out of total 118,872 g.cal/cm<sup>2</sup>/year incident solar radiations, producers can utilize only 1% (111.0 g cal/cm<sup>2</sup>/year) in their photosynthesis.





- About 21% of this gross production (GP) is utilized in metabolic functions of producers, 3% is utilized in decomposition and 63% remains unutilized in decomposition and 63% remains unutilized.
- Thus only 13-14% i.e. 15 g.cal/ cm<sup>2</sup>/year of GP is available to herbivores. At this level about 30% of it (i.e.15 g.cal/cm<sup>2</sup>/year) is utilized in metabolic functions i.e. respiration, growth and reproduction etc.
- This is more than the autotrophs consumed i.e. 21%. Again 3% of it is utilized in decomposition while 47% is remains un-utilized. Thus only 20% energy of the autotrophs is available (i.e. 3 g.cal/cm<sup>2</sup>/year) to carnivorous.
- It is also reported that about 70% energy is available for carnivores, which is not utilized and only 28-6% of net production passes to carnivorous. Carnivores utilized 60% energy at this level in metabolic activities and rest is remains as un-utilized.

From both the figures it is clear that

1. There is unidirectional flow of energy i.e. the system would collapse if the primary source, the sun were cut off.
2. Progressive decrease in energy at each trophic level.
3. There is also a corresponding decrease in biomass. But there is no correlation between biomass and energy. This relationship may differ according to situations.

## **ECOLOGICAL SUCCESSION**

Succession is the "birth" of an ecosystem, and subsequent "aging process of its abiotic and biotic features. ODUM (1971) has rightly included the following three parameters in his definition of ecological succession.

- (1) It is an orderly process of community development that involves changes in species structure and community processes with time, it is reasonably directional and therefore predictable.
- (2) It results from modifications of the physical environment by the community, i.e. succession is community controlled even though the physical environment determines the pattern, the rate of change and often sets limits as to how far development can go.
- (3) It culminates in a stabilized ecosystem in which maximum biomass (or high information content) and symbiotic function between organisms are maintained per unit of available energy flow.

In any of the basic environments such as terrestrial, fresh water or marine, the succession may be of following two types

- (i) **PRIMARY SUCCESSION.** It is the process of species colonization and replacement in which the environment is initially virtually free of life, i.e. the process starts with base rock or sand dune or river delta or glacial debris and it ends when climax is reached. The series involved in primary succession is called **PRESERIE**. Primary succession

occurs when a community begins to develop on a site previously unoccupied by living organisms.

(ii) **SECONDARY SUCCESSION.** The term secondary succession refers to community development on locations or sites previously occupied by well developed communities. It occurs where a community has been disrupted and the surface is completely or largely devoid of vegetation. It may be due to earthquake, fire or even clearing of forests by man. In each case organisms modify the environment in a way that allows one species to replace another. The series involved in secondary succession is called **SERIES**.

Depending on the moisture contents, the primary and secondary successions may be of the following types

(A) **HYDRACH** or **HYDROSERE.** The succession when starts in the aquatic environment such as ponds, lake, streams, swamps, bogs etc.

(B) **MESARCH** OR **MESOSERE.** It is an intermediate type with adequate moisture. The succession when begins in such an area is called mesarch.

(C) **XERACH** OR **XEROSERE.** The succession when starts in Xeric or dry habitat having minimum amounts of moisture, such as rocks, dry deserts etc is called xerach. A temporary community in an ecological succession on dry and sterile habitats is called Xerosere. It may be of three types

(i) **LITHOSERE.** i.e. succession initiating on rocks.

(ii) **PSAMMOSERE.** i.e. succession initiating on sand.

(iii) **HALOSERE.** i.e. succession initiating on saline water or soil.

Some times succession is also classified into two on the basis of community metabolism.

(a) **AUTOTROPHIC SUCCESSION.** It is characterised by early and continued dominance of autotrophic organisms like green plants. It begins in a predominantly inorganic environment and the energy flow is maintained indefinitely.

(b) **HETEROTROPHIC SUCCESSION.** It is characterised by early dominance of heterotrophs such as bacteria, actinomycetes, fungi and animals. It begins in an organic environment and there is a progressive decline in energy content.

## **GENERAL PROCESS OF SUCCESSION**

The complete process of a primary autotrophic ecological succession involves the following sequential steps which follow one another.

**1. NUDATION.** The process of succession begins with the formation of a base area or nudation by several reasons such as volcanic eruption, flood, landslide, erosion deposition, fire, disease etc. Some base areas are also created by man e.g. walls, burning, digging etc.

**2. INVASION.** The invasion is the arrival of the reproductive bodies or propagules of various organisms and their settlement in the new or base area. Plants are the first invaders (pioneers) in any area because the animals depend on them for food. It include the three steps

**(1) Dispersal or migration.** It is the process in which propagule leaves the parent plant and arrives the bare area. The seeds, spores or other propagule of the species reach the bare area through the agency of air, water or animals.

**(ii) ECESIS.** This is the successful establishment of migrated plant species in to new area. It includes germination of seeds, growth of seedlings and starting of reproduction.

**(iii) AGGREGATION.** This is the final stage of invasion where immigrant species increase their number by reproduction and aggregate in a large population in the area.

**3. COMPETITION.** As the number of individuals grows, there is competition both interspecific (between different species) and intra specific (within the same species) for space, water and nutrition. They influence each other in a number of ways known as COACTION.

**4. REACTION.** When living organism grow, use water and nutrients from the substratum in turn they cv have a strong influence on the environment which is modified to a large extent and known as reaction. When they become unsuitable for the existing species, favour some new one, which replace them. Thus, reaction leads to several seral communities.

**5. STABILIZATION OR CLIMAX.** Eventually a stage is reached when a final terminal community becomes more or less stabilised for a longer period of time and it can maintain itself in the equilibrium or steady state with climate of that area. This last seral stage is mature, self maintaining, self reproducing through development stages and relatively permanent. This final stable community of the sere is the CLIMAX COMMUNITY and the vegetation supporting it is the CLIMAX VEGETATION.

## **FOOD CHAINS**

- Small herbivorous organisms such as Caterpillars field mice etc. Consume this 'vegetable material and convert it to animal material, which serve as food to meat eating animals. They are eaten by larger carnivores.
- This sequence of eating and being eaten, with the resultant transfer of energy is known as FOOD CHAIN.
- Thus in food chains organisms of an ecosystem are linked together. Each step is known as trophic level and the study of the energy flow through these steps is called trophic ecology. Food chains are not isolated from each other.
- Primary producers trap radiant energy of sun and transfer that to chemical or potential energy of organic compounds such as carbohydrates proteins and fats.
- When herbivore eats a plant and these compounds are oxidised. As we have read earlier the energy liberated is just equal to the amount of energy used in synthesizing the substances. When this animal is eaten by another one, along

with transfer of energy from a herbivore to carnivore a further decrease in energy occurs as the carnivore oxidise the organic substances for the first to liberate energy to synthesize its own cellular constituents. Such transfer of energy from organism to organism sustains the ecosystem.

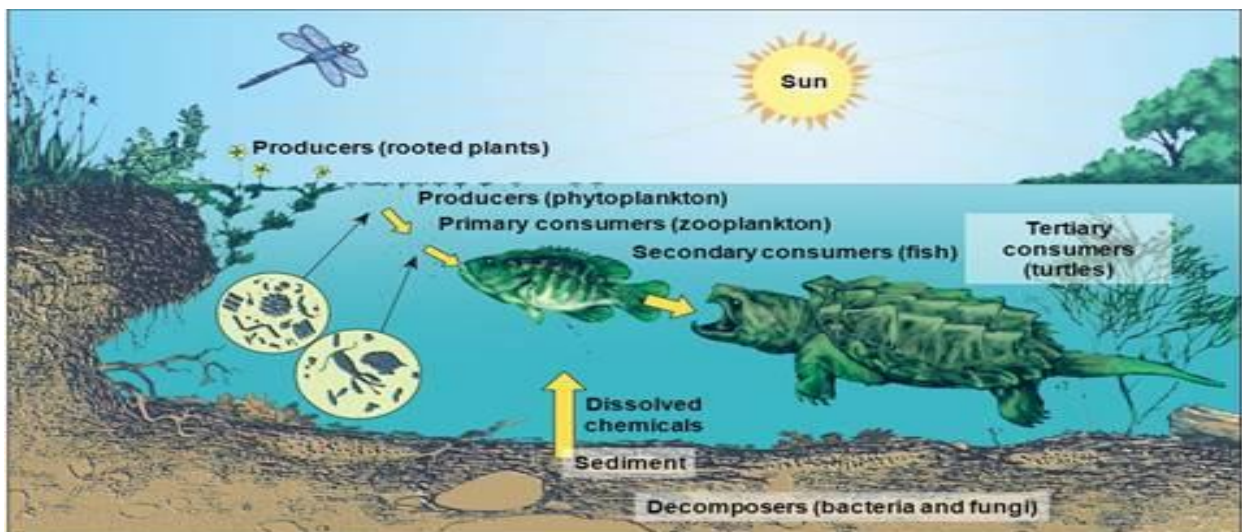
- The energy flows from primary producer to primary consumers, from primary consumer to secondary consumers and from secondary consumer to tertiary consumers and so on . This simple chain of eating and being eaten away is known as food chain.

Examples of food chains are :

1. Grass → Rabbit→ Fox→ Wolf→ Lion. (Grass land ecosystem)



2. Phytoplankton → Water fleas → Small fish → Tuna . (Pond ecosystem)



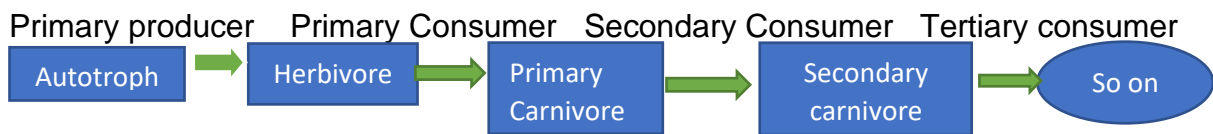
3. Lichens → Reinder → Man. (Arctic tundra)

In nature we can distinguish two types of food chains.

### 1.GRAZING FOOD CHAIN

This type of food chain starts from green plants and ends carnivores by passing through herbivores The primary carnivores or secondary consumers eat herbivores or primary consumers of the ecosystem. And likewise, secondary carnivores or tertiary consumers eat primary carnivores. The total energy assimilated by primary carnivores or gross tertiary production and its disposition in to respiration, decay and further

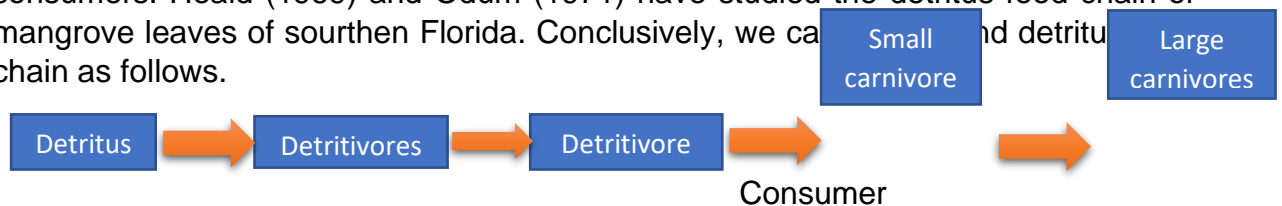
consumption by other carnivores is entirely analogous with that of herbivores. Thus much of the energy flow in these chains can be described as follows



### DETRITUS FOOD CHAIN

The term detritus is given to organic wastes, exudates and dead matter derived from grazing food chain. The energy contained in this detritus is not lost to the ecosystem as a whole, rather it serves as the source of energy for a group of organisms (Detritivores), they differ from grazing food chain called the detritus food chain. Such food chains operates in the decomposing accumulated litter in a temperate forest.

In some ecosystems, considerably more energy flows through the detritus food chains than through the grazing food chains. The organisms of the detritus food chains are, algae, bacteria, slime molds, fungi, actinomycetes protozoa, insects, mites, crustaceans, molluscs worms, nematodes etc. Some species are highly specific in their food requirements and some can eat almost anything. All these are detritus consumers. Heald (1969) and Odum (1971) have studied the detritus food chain of mangrove leaves of southern Florida. Conclusively, we can divide the detritus food chain as follows.



### FOOD WEBS

In nature simple food chain occur rarely. The same organism may operate in the ecosystem at more than one trophic level i.e. it may derive its food from more than one source. organism may be eaten by several organisms of a higher trophic level or an organism may feed upon several different organisms of lower trophic level. In this way individual food chains interconnect to form a complex network with several linkages and are known as food web. Thus food web is defined as —"**A network of food chains where different types of organisms connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level.**"

The following five types of food chains are interconnected to form food web in this figure.

- (1) Grass → Grasshopper → Predatory bird (Hawk)
- (2) Grass → Grasshopper → Lizard → Hawk.
- (3) Grass → Rabbit Hawk (or vulture or man)
- (4) Grass → Mouse/Rat → Hawk
- (5) Grass → Mouse/Rat → Snake + Hawk.

This shows, food chains in natural conditions never operate as isolated sequences but are interconnected with each other forming some sort of interlocking pattern .

## ECOLOGICAL PYRAMIDS

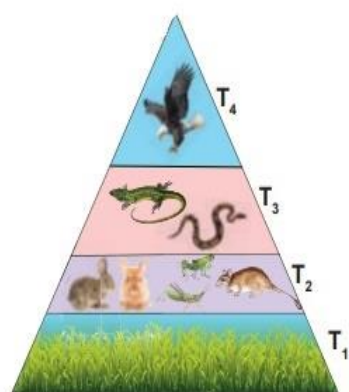
Charles Elton in 1927, noted that the animals at the base of the food chain are relatively abundant, while those at the end are relatively few in number i.e. there is progressively decrease in between the two extremes. Secondly, there is some sort of relationship between the numbers, biomass and energy content of the primary producers, consumers of the first and second orders and so on to top, Carnivores in any ecosystem.

Ecological pyramids are of three general types

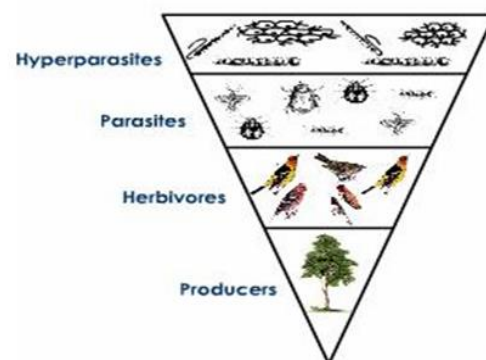
1. Pyramid of numbers - (Based on number of organisms at each level.)
2. Pyramid of Biomass - (Based on biomass of organisms)
3. Pyramid of energy - (Showing the rate of energy flow and/or productivity at successive trophic levels.)

The pyramids of numbers and biomass may be upright or inverted depending of the food chain in the particular ecosystem whereas pyramids of energy are always upright.

1. **Pyramid of numbers.** This deals with the relationship between the number of producers, herbivores and carnivores at successive trophic levels. At the base of such figure (pyramid) is always the number of primary producers and the subsequent structures on this base are represented by the number of consumers at successive levels. a grassland ecosystem, the producers which are mainly grasses are always many in number. This number then shows a decrease towards apex, as the primary consumers or herbivores like rabbits are less in



Pyramid of numbers  
in grassland ecosystem



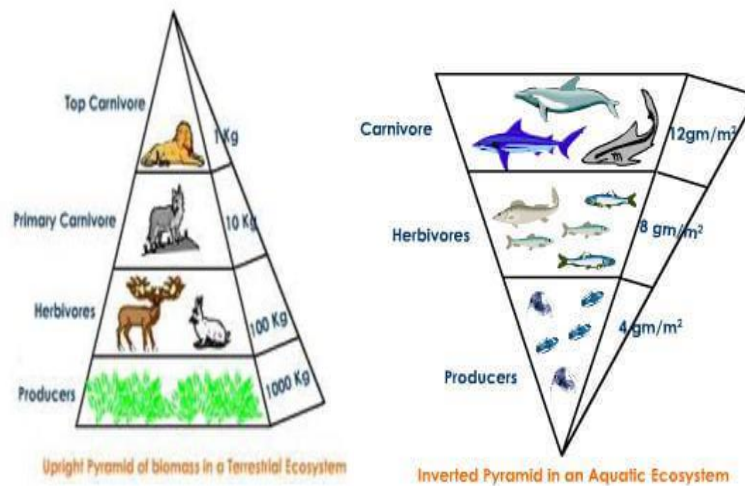
Inverted pyramid of number

### (Uprite pyramid)

number than the grasses. The secondary consumers are lesser in number than primary consumers. Finally the top consumers (tertiary) like hawks or other animals

are least in number. Thus the pyramid becomes upright. In a pond ecosystem, the pyramid is also upright.

**2. Pyramid of Biomass.** Pyramid of numbers of biomass is given where the weight of primary producers forms the base. The ecosystem, where the pyramid of biomass is upright. The biomass of one tree is very high. The biomass of a number of birds feeding upon the tree is far less than that of the tree. Similarly, the biomass of even a very large number of parasite in and on the body of the birds is far less.



### 3. Pyramid of energy

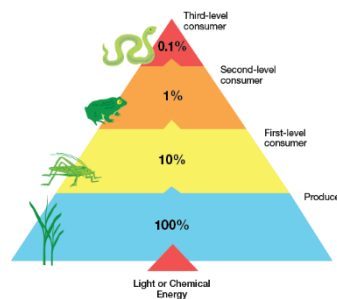
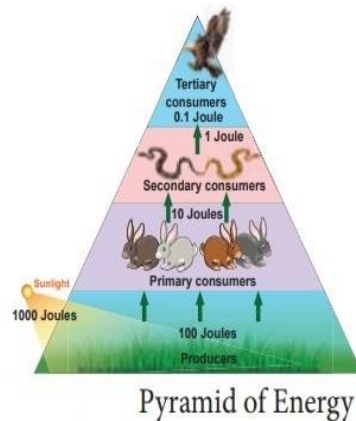


Figure 9. Energy Pyramid

- Generally three types of ecological pyramids, the energy pyramid give the best picture of overall nature of the ecosystem. As against the pyramids of numbers and biomass the shape of the pyramid of energy is always upright, because in this the time factor is always taken in to account.
- The pyramid of energy represent the total quantity of energy utilized by different trophic level organisms of an ecosystem per unit area over a set period of time. The population of phytoplanktons in aquatic ecosystem also complete sets of new generation in every few hours or days.
- The cumulative energy content of these generations of phytoplanktons trap in course of a year is certainly much more than that of only a few

generations of herbivore fishes in the corresponding time and space. The energy content of top carnivores (utilized in one year) is the least.



Therefore, the pyramid of energy is upright. The ratio of the amount of energy absorbed and the amount of energy which would be retained in biomass is known as ecological efficiency.

## SOME MAJOR ECOSYSTEMS

There are three types of ecosystems in nature ..

1. Terrestrial ecosystem
2. Freshwater ecosystem
3. Marine ecosystem

A large geographical area with its specific and complex flora and associated fauna is called a biome. The physical factors like, nature of soil, rainfall, temperature, light etc. effects the vegetation of a biome. The ecological characteristics of some major ecosystems are given.

### Terrestrial ecosystems

The terrestrial ecosystems may be Latitudinal biome or altitudinal. It consists of

- (i) Forest ecosystem
- (ii) Grassland ecosystem
- (iii) Desert ecosystem

### FOREST ECOSYSTEM

Roughly 40% of the land is occupied by forest. But in India it is one-tenth. In India, tropical rain forests are found in Western Ghats, Andamans and North-East Himalayas. So these have maximum bio-diversity. The different components of a forest ecosystem are as:

**Abiotic Component :** These are the inorganic & organic substances present in the soil & atmosphere. In addition to the minerals present in the forests, we find the dead



organic debris. The light conditions are different due to complex stratification in the plant communities.

**Biotic Component:** The living organisms present in the food chain occur in the following order

**1. Producers.** These are mainly trees that show much species diversity and greater degree of stratification specially in tropical moist deciduous forest. In northern coniferous forest needle leaved evergreen tree, specially the spruces, firs and pines are with poor development of shrub and herb layers. Deciduous forest is greatly modified by man and much of it is replaced by cultivated and forest edge communities

**2. Consumes.** These are as follows

**(a) Primary Consumers ;** These are the herbivores that include the animals feeding leaves as ants, flies, beetles, leafhoppers bugs, spiders etc. Many of the larger herbivorous vertebrates some animals like elephants, nilgai, deer, moles, flying foxes, fruitbats, mongooses etc. are like moose, snowshoe hare, grouse are found on broad leaved developmental communities. Similarly on shoots and/or fruits. on tree grazing

**(b) Secondary Consumers :** These are the carnivores like snakes, birds, lizards, fox etc. feeding on herbivores. lion, tiger etc. that eat carnivores

**(c) Tertiary Consumers:** These are the top carnivores like lion,tiger etc. that eat carnivores of secondary consumers level.

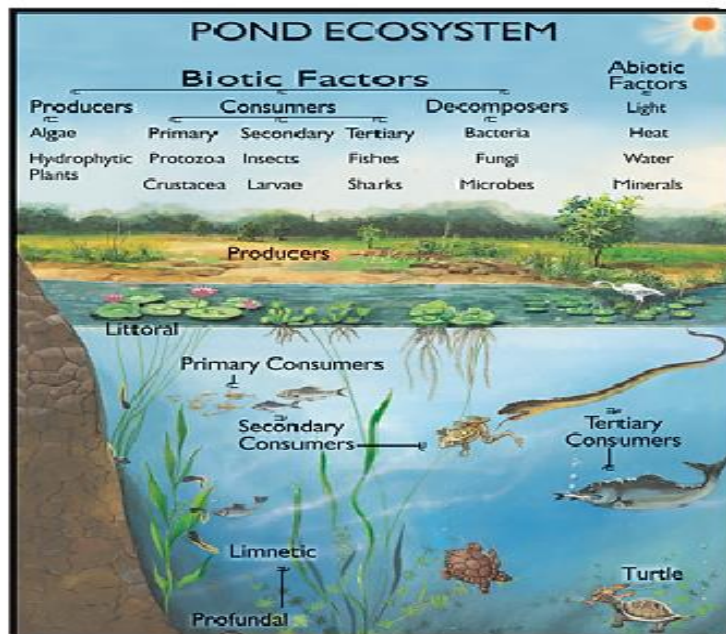
**3. Decomposers.** These are wide variety of micro-organisms like actinomyces(streptomyces) , bacteria (Bacillus, clostridium, Pseudomonas etc.), Fungi (species of Aspergillus, Coprinus, Polyporus, Fusarium, Trichoderma etc.). Rate of decomposition in tropical and subtropical forests is more rapid than that in the temperate ones.

## **AQUATIC ECOSYSTEMS**

More than 70% of the land is covered by water. The important ecosystems are....

### **POND ECOSYSTEMS.**

Ponds are small bodies of water in which the littoral zone is relatively large and the limnetic and profundal regions are small or absent. Stratification is of minor importance . Ponds may be found in most regions of adequate rainfall . They are continually being formed, as a stream shift position, leaving the former bed isolated as a body of standing water where organic materials are accumulated.



Temporary ponds are dry for part of the year are specially interesting and support a unique community organisms in such ponds must able to survive in a dormant stage during dry period.

Ponds play an important role in the villages where most of the activities like washing clothes, bathing, swimming, cattle bathing etc. are centre around ponds. We may study the pond as an ecosystem.

**Abiotic Component.** Apart from heat, light the basic inorganic and organic compounds, elements are water, CO<sub>2</sub>, oxygen, calcium, nitrogen, phosphorus, amino acids etc. The amount of the minerals present at any time in the physical environment of the pond. "Standing state" may be estimated by appropriate methods. Light intensity and turbidity index of water at different depths can also be measured by lux-photometer and Secchi disc respectively.

**Biotic Components** They are as follows

**1. Producers.** These are autotrophic, green plants and bacteria. They fix radiant energy and with the help of minerals from water & mud form complex organic substances like Carbohydrates, proteins & lipids. Producers are of the following types

**(a) Macrophytes.** These are mainly rooted larger plants which include partly or completely submerged floating and emergent hydrophytes. The common species of the plants are Trapa, Typha, Sagittaria, Nymphaea, Chara, Hydrilla, Utricularia, Marsilea, Azolla, Sylvania, Spirodella, Lemna etc...

**(b) Phytoplankton.** These are minute, floating or suspended lower plants like Ulothrix, Spirogyra, Cladophora, Oedogonium, Cosmarium, Eudorina Pandorina, Volvox, Chlamydomonas etc. and some flagellates. Biomass is estimated as weight of standing crop per unit area or volume. Generally, biomass and energy content of the vegetation decreases from the margin of the pond towards its centre. Energy content is generally expressed in terms of cal/gm dry wt.

**2. Consumers.** Most of the consumers are herbivores except insects and some large fish. But generally are heterotrophs. In pond consumers are distinguished as

**(i) Primary Consumers.** These are herbivores, also known as “primary macro consumers” feeding directly on living plants. They may be large or in small size. They are further differentiated as

**(a) Benthos.** These are the animals associated with living plants labelled as 'a' in fig and those bottom forms which feed upon the plants remains at the bottom labelled as 'b' in fig. Benthic population include fish, insect larvae, mites, molluscs, crustaceans etc. Besides there some animals like cows, buffaloes and birds also visit the pond.

**(b) Zooplanktons.** These are chiefly the rotifers, (Brachionus, Lecane etc.), protozoans (Euglena, Coleps etc.) and Crustaceans (Cyclops, Stenocypris etc.). They feed on phytoplanktons .

**(ii) Secondary Consumers.** These are Carnivores like insects and fish which feed on primary consumers (herbivores) like Zooplanktons.

**(iii) Tertiary Consumers.** These are some large fish feed on smaller fish.

In pond fish may occupy more than one trophic levels.

**3. Decomposers.** These are microconsumers, which absorb only a fraction of the decomposed matter. They decompose organic matter of both producers as well as microconsumers in simple forms. Thus they play an important role in return of mineral elements again to pond. The bacteria, actinomycetes and fungi (species Aspergillus, Cladosporium, Pythium, Penicillium, Circinella etc.) are most common decomposers in water and mud of the pond.

## **MARINE (OCEAN) ECOSYSTEM**

The marine environment of seas and oceans is large occupying 70% of the earth surface. The volume of the surface area of marine environment lighted by sun is small in comparison to the total volume of water involved.

The biotic components of an ocean are as follows

### **1. PRODUCERS**

These are autotrophs, which are mainly the phytoplanktons. They trap radiant energy from sun through their pigments. A number of macroscopic seaweeds (Brown and red algae) are also come in this category. They are in distinct zones at different depths of water.

## 2. CONSUMERS

These are heterotrophic macroconsumers being dependent for their nutrition on the primary producers. These are directly on producers

(i) The herbivores like Crustacians, molluscs, fishes etc. which feed are called primary consumers. called secondary.

(ii) The carnivores fishes like shad, herring etc. feeding on herbivores are secondary consumers

(iii) The top carnivores fishes like cod, haddock, halibut etc. that feed on are called tertiary consumers.

**3. Decomposers.** The microbes active in the decay of dead organic matter are chiefly and some fungi.

## ESTUARIES (ESTUARINE ECOLOGY)

Estuarine is derived from the word aestus means tide. Pritchard in enclosed coastal body of water, which has a free connection with the open sea. It is thus strongly affected by tidal action and within it sea water is mixed with fresh water from land drainage. River mouths, coastal bays, tidal marshes and bodies of water behind barrier beaches are examples To illustrate estuaries, the different classifications will be represented based on

- (1) Geomorphology
- (2) Water Circulation and stratification
- (3) Systems energetics.

According to Pritchard 1967, four subdivisions of estuaries are from zeomorphological point of view

- (i) Drowned river valleys
- (ii) Fjord type estuaries
- (iii) Bar - built estuaries
- (iv) Estuaries formed by tectonic processes.

River - delta estuaries found at the mouths of large rivers such as Mississippi or the Nile. It is different from former. On hydrographic basis estuaries can be placed in three broad categories.

- (a) Highly stratified or salt wedge estuary.
- (b) The partially mixed or moderately stratified estuary.
- (c) The completely mixed or vertically homogenous estuary

The Hypersaline estuary is a special type.

## Physico Chemical Aspects of Estuaries :

- Current and salinity both are important here. Estuarine currents result from the interaction of a one direction stream flow which varies with the session and rain fall with oscillation ocean tides and with wind. The salinity varies vertically and horizontally and fluctuates amazingly between 0.5 to 0.35%.
- The sessional and tidal cycles causes changes in nutrient concentration in the estuary. Any how, all estuaries have high productivity.
- The concentration of nutrients and fix carbon is The sessional and tidal cycles cause level of production within the detritus food chain.

## LAKE ECOSYSTEM

Lakes are inland depressions containing standing water. They vary in size and depth (few feet to 5000 feet). Some lakes wave outlet streams. In lake there are three to five well recognized horizontal strata namely.

### (i) Littoral zone

Shallow water near the shore forms this zone. - Different zone of a deep freshwater lake. It contains upper warm and oxygen rich circulating water layer, which is called epilimnion. It include rooted vegetation.

(i) **Sublittoral zone.** It extends from rooted vegetation to the non circulating cold water with poor oxygen zone i.e. hypolimnion.

(iii) **Limnetic zone.** It is the open water zone away from the shore. It is up to the depth of effective light penetration where rate of photosynthesis is equal to the rate of respiration. (iv) **Profundal zone.** It is the deep water area beneath limnetic zone and beyond the depth of effective light penetration.

(v) **Abyssal zone.** It is found only in deep lakes since it begins at about 2000 meter from the surface.

**Kinds of lakes.** Based on the physical factors, productivity etc. different classifications of lakes are given. Based on temperature, Hutchinson (1957) classified into dimictic, monomictic and polymictic. Based on Humic acid contents, the lakes are classified in to clear water lakes and Brown water lakes.

## Physico-chemical properties of lakes

Lakes have the tendency to become thermally stratified during summer and winter to undergo definite seasonal periodicity in depth. Light too penetrates only to a certain depth, depending on turbidity.

## Biotic Communities of lakes

Organisms depending on substratum are called pedonic forms and that are free from it called limnetic forms. The lakes have several type of organisms.

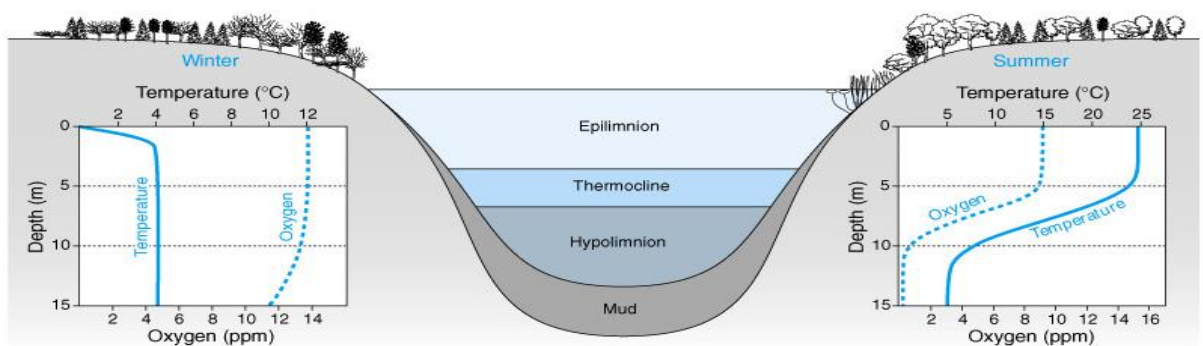
(1) **Neuston.** These including floating plants such as duckweeds and many type of animals.

Animals are called epineuston while others including insects called hyponeuston.

(ii) **Plankton.** These are small plants and animals whose powers of self locomotion is very limited. Certain zooplanktons are very active some planktons are called as nektoplanktons, (iii) **Nekton.** These animals are swimmers.

(iv) **Bethos.** These includes the organisms living at the bottom of the water mass. These living above the sediment water interface are termed benthic epifauna and those living in sediments itself are termed as infauna.

### Stratification in lakes.



- During the summer the top water become warmer than the bottom waters, as a result only the warm top layer circulates and it does not mix with the more viscous colder water, called thermocline.
- The upper water layer is epilimnion. Colder noncirculating water is the hypolimnion. Subtropical lakes having surface temperatures that never fall below 4°C. In terms of water circulation patterns most of the lakes of the world can be conveniently assigned to one of the following categories (Hutchinson 1957).

(a) Dimictic (mictic = mixed) Two sessional periods of free circulation.

(b) Cold monomictic. Water never above 4°C (polar regions), seasonal overturn in summer. (c) Warm monomictic. Water never below 4°C. One period of circulation in winter.

(d) Polymictic. More or less continually circulating with only short, if any, stagnation period. (e) Oligomictic. Rarely mixed.

(f) Micromictic. Permanently stratified.

## **STREAMS**

Biotic community in streams is quite different from that of ponds. Most streams in the vicinity of urban areas are polluted. Streams are fresh water aquatic systems where water current is a measure controlling factor, oxygen and nutrients are in water. Differences between streams and ponds revolve around a triad of conditions.

### **ZONATION IN STREAMS**

- In streams zonation is longitudinal. In streams we find zones increasingly older stages from source to mouth. Changes are more pronounced in the upper part, because of gradient, volumes of flow and chemical composition changes rapidly.
- The change in composition of communities is likely to be more pronounced in the first mile than in the last fifty miles . The longitudinal distribution of fish in a stream may be selected as a specific example. Thompson & Hunt found that the number

human population and the enrollment :-  
population growth and distribution :-

~~through~~ of  
Though the population of the world is increasing  
from time in memorial. The rate of increasing  
~~is~~ witness in 20<sup>th</sup> century remarkable.  
The world population has increase from 1.6 ~~bil~~  
billion in ~~the year~~ 1900 and <sup>two</sup> 6 billion  
1999 currently the world is adding ~~to~~  
80 million person every ~~to~~ year.

✓ The world population has double from 0.25  
billion to 0.50 billion over period of  
1615.

✓ The population has double from 0.5 billion  
to 1 billion over a period of 130 years  
during 1650 to 1780.

✓ The population has double from 1 billion to  
2 billion over a period of 150 years  
during 1780 to ~~at~~ 1930.

World population distribution

• At present approximately 75% of world population  
is distributed in developing nation.  
only 25% of population is distributed  
in develop nation.



Year	Asia	Africa	Europe	Other region	Total
1950	54.67	8.91	15.63	20.79	100
1990	58.47	12.42	9.42	19.59	100

The ~~table~~ above table indicate that 1990 more than 70% of population is distributed in Asia and Africa and less than 30% of population is distributed in Europe and other region. In percentage distribution Asia and Africa is increasing and the reason is declining population in India, size and growth.

India population problem may be view 3 aspect

- \* The absolute size of population
- \* The rate of growth of population
- \* The age structure of population.

The absolute size of population:-

According to 1981 the total count of population of India was 683.8 million. India population has ~~at~~ thus a very huge population base. The large size population itself accentuates the problem of economy and social development by the demand it makes on consumer goods and capital.

1. The rate of population growth.

The economy size of population and the rapid population growth are two most important characteristics of India's population which significantly consequence for the country's social and economic reasons.

Age structure.

Any population does not become a problem just because it is quantitatively large.

The age structure of population is also an important aspect of the problem.

When the country's birth rate is high in India, a large number of non-productive persons are added to the population base every year. If the population base is large, the number of such new entrants is even bigger.

Population explosion :-

Population explosion means the rapid population growth which is unexpected and unimaginable.

Effects of population explosion :-

- \* Increase in consumption of resources available in the environment and depletion of same quickly.
- \* Due to over consumption of natural resources environment gets deteriorated and polluted.

- \* There will be desertification, deforestation, soil erosion, loss of fertility and productivity.
- \* mass poverty, poor per capita availability of food, high consumption and prevalence of disease on a large scale.
- \* Rapid urbanisation resulting in growth of slum in cities and towns.

### Family welfare program -

A response to our phenomenal population growth India seriously took up an effective family planning program which was renamed the family welfare program.

Female sterilization is the most popular method of contraception used in developing country at present. ~~It is followed~~

### Importance of family welfare program:

- \* Energy use is growing both due to an increasing population and a more energy hungry lifestyle.

The increased use of consumer goods which required large amount of energy for their production and packaging and transport. outgrowing population

add to the enormous amount of waste.  
will all this linkage between population  
growth and the environment. ~~But~~  
family welfare programmes have  
become critical to human existence.

Family welfare programme in India:-

The family welfare programme in India  
attempts a variety of measures to  
control population.

There are several methods of temporary  
birth control.

Enufoment and human health:-

Health is viewed differently by different  
people. A common man in the street  
~~has~~ may consider better nothing more  
than being sick.

A young youngster ~~has~~ may view it  
having good grooming and ~~be~~ able  
to climb tall.

Health is considered as a quality of life  
that enable the individual to live  
more and become best.

Health is a state of complete physical  
mental and social wellbeing and not  
merely the absence of disease of  
infirmity.

# Relation between <sup>Health</sup> health, wellness and fitness.

~~Health~~ Health is composed several dimension, physical health, mental health or spiritual health and ~~the~~ emotional health.

The public has view good health as the absence of disease. Given this perspective if an individual was not sick he/she was by definition health.

The following ~~6~~ simple lifestyle habit can significantly increase longevity.

- i) sleeping 7 to 8 hours every day,
- ii) Eating breakfast every day.
- iii) Not eating between meals.
- iv) Eating less sweets and fatty food.
- v) Maintaining ideal body weight.
- vi) Exercising regularly.

~~vi)~~  
The combination of fitness program with a healthy lifestyle program has been refer to by expert as the wellness approach to better health and quality of life. The concept of wellness approach to better health and quality incorporate many other components

other than those associated with physical fitness such as proper nutrition, disease prevention, spirituality, smoking cessation, stress management, substance abuse control safety and health education.

## Human rights

India is a democratic country the aim of our government is to ensure happiness to all the citizen with equal comfort, opportunity and ~~use~~ right.

## Human rights in India

1. Right to equality.
2. Right to freedom.
3. Right to exploitation.
4. Right to freedom of ~~region~~ religion.
5. Cultural and educational right.
6. Right to constitutional remedy.

## <sup>Imp</sup> Declaration of human rights and environment

The principle of draft declaration.

- \* Human right for an ecologically sound & environment, sustainable development and ~~peace~~ peace focal.
- \* Human right related to environment free from pollution and degradation. It also emphasize the right to enjoyment of natural ecosystem with ~~the~~ their rich biodiversity.
- \* Right ~~at~~ to every person to environment information, education, awareness and also public participation in environment ~~and~~ development.
- \* Deals with the duty to protect and preserve the environment and measure to taken for sustainable resource use.

Value of education :-

The social economic and cultural progress of a country depends upon education.

Education does not mean simply acquiring knowledge and information but also right use within the frame work.

of ethical value.

\* value based environmental education.

• we must recognize man immature rather than nature <sup>for</sup> of man.

• we must have love, compassion, tolerance and justice towards nature.

• we should learn that the human civilization is a part of the earth and various natural phenomenon are inter-connected and interlink with special bond of homogeneity.

• we should develop the principle of self restraint, self discipline, reduction of wants, freedom from severity & in our attitude. Such value will help us in attaining the goal of sustainable development and environmental ~~re~~ education.

women welfare in India:-

\* women constitute nearly half of the available human resource. It would be advantageous to optimise the resource not only for the development of individual but also for the nation.



For the social, educational, <sup>economic</sup> empowerment of women, the government of India has undertaken the following measures:-

1.  
child welfare in India:-

\* Children are considered to be assets of the society ~~to~~ but several children in our country are working as child labour in many of them in hazardous industries - and

In Dec 1974 the government of India has setup national children board headed by ~~the~~ PM. Following are some of the programs undertaken by Indian government for the welfare of children:-

1. Integrated child development scheme, it is a centrally sponsored scheme started in 1974, which is aim at
  - a. Improving nutritional and health status for children.
  - b. proper ~~biological~~ ~~psy~~ psychological and social development of children.

Environmental study : scope and importance

Nature consist of two very much complex independent, mutually reactive and interrelated entities. (organisms and the environment)

The organisms can survive only in appropriate environment. Interact with each other and are influenced by the whole complex of environment factors.

The various principal that govern the relationship between the organisms and the environment is called ecology.

OR

The study of reciprocal relationship between organisms and their environment is called ecology.

Environment :-

weather and climate :-

The term weather refers to the short term property of the atmosphere such as temperature, pressure, humidity, rainfall, sunshine, cloud cover and wind etc, at a given place and time. The average weather

of a given place and time.

of area including general pattern of atmospheric circulation, seasonal variations and weather extremes. Average over a long period of time is called climate. Thus weather refers to the hourly daily or ~~week~~ weekly change in the above property.

Climate reflexed longer ~~period~~ <sup>period</sup> properties such as season and also.

### Components of environment

biotic and abiotic. (non living component) (living component).

The abiotic or non living component ~~include~~ include the climatic factors and edaphic factors.

The climatic factors include temperature humidity, ~~edaphic~~ ~~edaphic~~ ~~edaphic~~ and snow fall, etc.

The edaphic factors ~~include~~ comprise the ~~soil~~ soil substratum.

abiotic  
Factor

temperature, life, water, humidity, wind, mineral element.

Biotic or living component :-

The living organisms for the biotic component of the environment. All organisms <sup>require</sup> energy of their life process and material for the formation and maintenance of body structure. Food supply for both energy and material for sustenance of life.

Types of environment :-

Nature and man-made environment

Natural environment :-

The environment that comes into ~~existence~~ ~~existence~~ existence without interference of man is called natural environment.

Man-made environment :-

(~~or~~ Anthropogenic ~~or~~ environment)  
The environment which has been modified by human activity is called man-made environment.

needs for public enlightenment :-

- \* with the advancement in technology, explosive increase in human population, scarcity of space and food, deterioration of hygienic condition, depletion of natural resource and socio economic problem would needs extensive study of environment and particularly its relation to environment survival and benefits.

objective of environment education :-

- \* Awareness to help people acquire an awareness and of sensitivity to the total environment and its problem.
- \* Knowledge to help people acquire basic understanding of total environment and associated problem.

\* ~~attitude~~ attitude.

\* SKPII

\* evaluation ability

\* participation

△ principle

- importance of environmental education.
- environmental education is important for economic and welfare of human society.
  - It helps us in careful handling the issue like <sup>pop</sup> population maintenance ~~by~~ over exploitation of natural resource and food security and sustainable development.
  - In this age of science and technology especially technology or ecotechnology it's the need of our because it promote the blending of the traditional knowledge with technology and modern technology. It can achieve only through proper environmental education.
  - environmental ~~to~~ education train us to conserve our ~~to~~ fast depleting the natural resource.
  - environment has been a source of happiness for man and ~~to~~ we have come to preserve this happiness.

four main by imparting environmental education.

Scope of environmental education:-

- i) There is a need for train manpower at every level to deal with environmental issue like ~~safe~~ safe and clean drinking water, hygienic living condition, clean and fresh air, fertile land, healthy food and sustainable development.
- ii) environment protection and management, environmental law, ~~dis~~ Dismissive Administration and environmental engineering are emerging new career opportunity.
- iii) Since the pollution control law becoming most stringent industries need environment expert to control pollution and disposal of waste.
- iv) Environmental expert are now in ~~great~~ great demand in industries for adopting green technology to reduce pollution and to cut down the cost of ~~effluent~~ effluent treatment.
- v) These days there is huge market <sup>waste</sup> for disposal and pollution control technology and environmental expert.

# ENVIRONMENTAL ENGINEERING

Environment is the sum of all social, environment, economical, biological, physical, chemical factors which constituted the surrounding of man which is both creator and modular.

OR

Environment refers to the sum of total combination which surround man at a given point in space and time.

OR

Environment is the representative of physical components on the earth with in man is the important factor influence his environment.

## SOCIAL ISSUES AND THE ENVIRONMENT

Environment is defined as "the sum total of all conditions and influences that affect the development and life of organisms."

Sustainable development:

The term sustainability refers to keeping an effort going continuously; or the ability to last out and keep from falling.

The successful management of resources for development to satisfy, the changing human needs, while maintaining or enhancing the ability of environment and conserving natural resources.



carrying capacity has two basic components:

- i) supporting capacity
- ii) assimilative capacity

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 less of resources and produce minimum wastes.

ii) To adopt 3-R approach (Reduce, Reuse, Recycle) 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 so as to inculcate a feeling of belongingness to the earth. 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.

## Urban problems related to energy:

Today we need energy for agriculture, industry, transport, communication, comfort and defence.

Energy plays a vital role in the socio-economic development of society.

The energy demanding activities of urban areas include:

i) Regular supply of electricity has become indispensable in high rising building, multiplexes, shopping mall, etc

ii) Many cities and town water supply depends on electricity, acute shortage of drinking water is faced by the people living in this area during the peak summer due to short supply of electricity.

iii) These days many of the house jobs such as cooking of food, washing of clothes, cleaning of house etc has become electricity based in urban area of shortage of electricity make the life miserable, of the people living in the cities.

iv) The modern life style of cities uses a large number 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, metros, 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 shortage of energy.

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

Measure 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 tube lights and energy efficient bulbs that save energy rather than bulbs. A 40W tube light gives as much as a 100W bulb.
  - iii) Switch off the television as 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) Regular dusting of bulbs and tubes as dust deposited on these equipments decreases the lighting levels by 20-30%

Water conservation:

Water is an essential natural resource for sustaining life and environment.

The available water resource are under tremendous pressure due to increased demands. The time is not far when water, which is the free gift of nature, will become a scarce commodity.

Following strategies may be adopted for conservation of water:

1. Prevention of run of losses -

The run of losses of water can be reduced by allowing most of the water infiltrate into the soil. It can be achieved by using contour cultivation, terrace farming, mulching, developing water storage structures (such as farm ponds) etc. The adoption of chemical wetting agents (surfactants)

and chemical condensation (such as gypsum hydrous) or polyacrylamide etc) to the soil.

## 2. Reduction of evaporation losses:

The evaporation losses of water can be reduced by deep irrigation, early morning or late evening irrigation, cultivation of deep root crops with low water requirements and reducing the seepage by lining and insulating the canals.

## 3. Prevention of wastage of water:

The wastage of water in household, commercial building and public place can be prevented by closing taps when not in use. Repairing any leakage of pipe and using small capacity flush in toilet.

## 4. Reuse of water:

The treated waste water can be used for water lawns and garden, washing vehicles and floor of the building. It also help in saving fresh water.

## Rain water harvesting:

Rain water harvesting is a technique of collecting rain water and storing it by construction special water harvesting structure for later use.

It not only increases water availability but also checks the declining water table.

## Following are objective of Rain water:

- It checks the run off water and avoid flooding.
- It helps in meeting the increase demand of water.
- It helps in rising the water table by recharging ground water.
- It supplements ground water supply during lean season.
- It also reduce ground water contamination.

1) The rainwater that falls on the roofs of buildings or in courtyards is collected and stored in underground tanks or diverted to some abandoned well. The collected water may be drawn from the tank or well by using hand pump or motor pump for future use.

2) In foothills water flowing from springs is collected in embankment type water storage. The collected water can be supplied to the towns through pipes.

3) Artificial recharge is an indigenous technique of harvesting rainwater by collecting the rainwater in earth check dams and ponds to increase water level in wells and tube wells.

4) In arid and semi-arid seasons artificial recharge is done by constructing cellopercolation tank.

5) Rainwater from large catchment area is collected in checkdam, this technique was nicely used in Rajasthan.

by magasaysay Award winner Sh. Rajender Singh popularly known as "water man".

examples :-

1. In Madhya Pradesh more than 1000 check dam and 1050 tanks have been constructed in Jabua district alone.
2. In Jodhpur district of Rajasthan, Gramin Vigyan Vikash Samiti motivated the residents of 25 villages and built 2000 storage tanks in their houses.
3. In Maharashtra more than 7000 percolation tanks have been built after the severe drought of 1971-72.

## WATER-SHED:

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

Important of watershed:

watershed supply water for irrigation, hydropower 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:

watershed are obtain degraded due to uncontrolled generation, transportation, domestic use and reduce the chances of floods and droughts. They play significant role in the

watersheds are often degraded due to uncontrolled unplanned, unscientific land use, over grazing, deforestation, mining, construction activities, shifting cultivation, fires, soil erosion etc.

Methods of watershed management:

- \* water harvesting.
- \* promotion of afforestation and agroforestry (crop plantation)
- \* Mechanical measures.

- \* Scientific mining and quarrying.
- \* People's participation.

### 1) WATER HARVESTING:

In low rainfall area rain water is stored in water harvesting structure for use in dry season.

### 2) PROMOTION OF AFFORESTATION AND AGROFORESTRY:

Plantation of tree prevent run off loss and soil erosion, and also increase soil moisture in high rainfall area rows of woody trees such as sheesham, teak, khair etc are grown in between crop to reduce the run off and loss of fertile soil.

### 3) MECHANICAL MEASURES:

The measures like terracing, banding, contour cropping etc, are promoted in the slopy seasons 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.

Resettlement and rehabilitation of people: their problems and concerns

Though developmental projects like construction of dams, mining etc, provide manifold benefits to the society and raise the quality and standard of life of the people.

## Causes of Displacement:

The main cause of displacement of people are described below:

- \* Displacement due to dams.
- \* Displacement due to mining.
- \* Displacement due to creation of ~~national~~ national parks.
- \* Displacement due to natural disasters.

### Displacement due to dams:

Big river valley projects like Hirakund dam (Orissa), Bhakra Nangal dam (Punjab), Tehri dam (Uttaranchal), Sardar Sarovar project (Gujarat) and Damodar valley project (West Bengal) etc. have caused large scale displacement of local people.

In the last 50 years more than 20 million people have been displaced by dams.

### Displacement due to mining:

Mining operation cover 1000 of hectares of land and cause displacement of native people.

### Displacement due to creation of national parks:

When a forest area is converted into a national park it deprives the local dwellers of their ancestral rights of collection of forest products. ~~As a result the people migrate~~

### Displacement due to natural disasters:

Every year natural disasters like earthquake, landslides, droughts, floods etc. displace millions of people from their homeland.



## problem of displacement:

- \* Displace people loss their homeland, jobs, properties which obtain leads to social isolation and increased morbidity and mortality.
- \* The joint family and tribal communities often face disintegration as the people are resettled at different places
- \* The social and cultural activities and kinship system of tribal people vanish with their displacement.
- \* The displace people loose their identity and intimate links with the environment.
- \* The inherited 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:

1. The displace people should get and 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 outcastes should be given assurance of employment.
- s- while dealing with tribals, their traditions, culture and rights on land and forests should be preserved.
- a. Training facilities should be set up to upgrade the skills of affected people and reservation in jobs should be made for ~~the~~ ~~within~~ the willing adults among the evacuees.

7. Special attention should be given to the maintenance of widows and village people.
8. villagers should be taken into confidence at every stage of implementation and they

Environmental ethics and resources use.

Environmental ethics or earth ethics refers to the moral principle and guidelines relating to human relationships with their environment.

ECO - centric thinking (Environmental Ethics)

1. Nature exists not for human beings alone, but for all the species.
2. The earth resources are limited and they do not belong only to human beings.
3. Economic growth is good till it encourages earth-sustaining development and discourages earth-degrading development.
4. A healthy economy depends upon a healthy environment.
5. The success of mankind depends upon how best we can cooperate with the rest of the nature while trying to use the resources of nature for our benefit.

Guidelines for environmental ethics :-

1. we should love and honour the earth since it has blessed us with life and governs us our survival.
2. we should be grateful to the plants and animals which nourish us by giving food.
3. we should not waste our resources.
4. we have no right to drive other living things to extinction by holding ourselves above them.

- 2
5. we should not overburden the earth and should offer to the two children more.
  6. we should not run after gain at the cost of nature.
  7. we should not prohibit the right of future generation to live in clean and safe environment.
  8. we must celebrate sacred day the turning of seasons of earth.
  9. we ~~must~~ must consume the natural resources ~~the~~ in such a manner that all may share this treasure.

### Resource use:

- \* The pattern of resource consumption differs in economically developed and developing countries.
- \* The people in developed countries have higher demand for resources than necessary for reasonable living due to their aspirations for better quality of life. Therefore, they exploit the resources to the level that degrades the global environment seriously. On the other hand people in developing countries have lesser demand for resources due to their simpler quality of life.

### Global Environment changes

The unlimited exploitation of nature by man has disturbed the delicate ecological balance of the biosphere.

## Greenhouse effect

A glass house used for cultivating delicate plants is called greenhouse. A greenhouse has higher temperature inside than outside through the enclosure used for loss of heat, it is called greenhouse effect.

The factors which contribute to this effect are

- (i) glass walls
- (ii) high carbon dioxide content
- (iii) high water vapour content of the air in the greenhouse.

## Gases of greenhouse

1) carbon dioxide ( $\text{CO}_2$ ) -  $\text{CO}_2$  is the most abundant greenhouse gas in the atmosphere. It produced by the burning of fuels also due to plants and animals released it during respiration. The level of  $\text{CO}_2$  in the atmosphere has increased due to <sup>pre-</sup> industrial level of 280 ppm to 368 ppm in 2000.

2) methane ( $\text{CH}_4$ ) -  $\text{CH}_4$  is produced of incomplete decomposition caused by a group of bacteria called methanogens, under anaerobic conditions. The concentration of  $\text{CH}_4$  in atmosphere is more than double in 2000.

3) chlorofluorocarbon (CFCs) - CFCs are synthetic gaseous compound of carbon and halogens. It is used in refrigerants, aerosol propellants, insulators and fire extinguishers. The main source of CFCs in the atmosphere are leaking AC and refrigeration units, production of plastic foams. CFCs can persist become about 82 ppt in recent time.

20/11/2020  
Different greenhouse gases do not contribute equally to global warming.

According to an estimate CO<sub>2</sub> contributes 4% to the warming which amounts to be about 2°C of the total 2°C warming.

The contribution of natural greenhouse gases is also significant.

The increasing concentration of greenhouse gases in the atmosphere has 3 possible effects:

1) CO<sub>2</sub> fertilization effect on crops

2) global warming

3) depletion of ozone layer in the stratosphere.

4) Acid rain

Global warming :-

The increasing ~~concentration~~ concentration of greenhouse gases in the atmosphere leads to global warming.

Effect on weather and climate:

It is expected that the rise in temperature will be more marked in regions of middle and higher latitudes.

The moisture carrying capacity of the atmosphere is also expected to increase due to warming of the atmosphere.

The stratosphere warm and stratosphere will cool down.

It would cause a ~~wide spread~~ <sup>wide-spread</sup> change in precipitation patterns due to changed pattern of air mass movement.

The precipitation will increase at higher latitudes but will decrease at lower latitudes. The frequency of extreme ~~dry~~ drought and flood will increase.

## \* Rise in sea level :-

The global warming also contributes to rise in sea level due to thermal expansion of ocean and melting of glaciers and Greenland ice sheets. The level of sea has been rising by 1 to 2 mm per year during the 20th century. If the rise in sea level goes on with the present rate, the global mean sea level will increase upto 0.88 m from the year 1990 which lives within 60 km of a coast line.

The rise in sea level will have a negative impact on human settlements, tourism, fisheries, agriculture, birds, fishes inhabiting.

## \* Effect on Range of species Distribution :-

Each plant and animal species occurs within a specific range of temperature. The global warming will shift the temperature ranges which would affect altitudinal and latitudinal distribution patterns of organisms. Rapid rise in temperature may cause large scale death of many trees, as they are sensitive to temperature stress, and the area may be occupied by scrub vegetation. Many species may disappear, as they are unable to migrate fast enough to reach temperature change.

## \* Food production :-

Global warming will reduce crop production due to increased incidence of plant diseases and pests, explosive growth of weeds and enhanced basal rate of respiration of plants. In temperate regions, small rise in temperature may enhance the crop productivity slightly but larger temperature change will decrease the crop productivity there.