

# **St. Mary's College (Autonomous)**

**(Re-accredited with 'A+' Grade by NAAC)**

**Thoothukudi – 628001, Tamil Nadu**



## **ABILITY ENHANCEMENT COURSE ENVIRONMENTAL STUDIES**

**w.e.f. 2021-2022**

**I Year - II Semester**

**Compilation of Different Chapters from Books on Environmental Studies**

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**Compilation of Different Chapters from Books on Environmental Studies**

**Compiled by Deans' Office**

**B.A. / B.Sc. / B.Com. / B.B.A.**

<b>Semester – II</b>			
<b>Environmental Studies</b>			
<b>Code : 21UAEV21</b>	<b>Hrs / Week : 2</b>	<b>Hrs / Sem:30</b>	<b>Credits : 2</b>

**Course Outcomes:**

**Upon completion of this course, the students will be able to**

1. Recognize the biotic and abiotic components of ecosystem and how they function.
2. Use natural resources more efficiently and know more sustainable ways of living.
3. Acquire an attitude of concern for the environment.
4. Participate in improvement and protection of environment.
5. Manage unpredictable disasters.
6. Create awareness about environmental issues to the public.

**Unit I Environment and Ecosystem**

Aim and need for Environmental Awareness - Components of Environment Ecosystem - Components of Ecosystem: Abiotic and biotic factors ( Producer, Consumer and Decomposer) – Food Chain, Tropic Levels - Food Web, Energy flow and Ecological pyramids

**Unit II Natural Resources:**

Renewable and non-renewable resources – Water Resources: Uses and Conservation of Water – Rain Water Harvesting – Forest Resources: Importance of Forests - Conservation of Forest Energy Resources: Solar Fossil Fuel – Wind – Role of individuals in the conservation of natural resources

**Unit III Environmental Pollution**

Pollutants – Types of pollution: Air, Water, Noise and Plastic Pollution – Causes, effects and Control measures – Global warming and Climate Change

**Unit IV Human Population and Environment**

Effect of human population on environment – Population Explosion problems related to population explosion – Involvement of population in conservation of environment – Measures adopted by the Government to control population growth – Environment and human health

**Unit V Disaster Management**

Floods–Drought–Earthquakes– Cyclones – Landslide–Tsunami–Control measures

**Books for Reference:**

1. Kaushik, A. and Kaushik, C.P.K., Perspectives in Environmental Studies – New Age, International Pvt. Ltd., New Delhi, 2004.
2. Odum, E.P., Fundamentals of Ecology, Natraj Publishers, New Delhi, 1996.
3. Saha, T.K. Ecology and Environmental Biology, Arunabha Sen Books & Allied Pvt. Ltd., Kolkata, 2007
4. Sharma, Environmental Biology, Rastogi Publications, Meerut, 2006.
5. Miller, Tyller g., Environmental Science, Thompeson Brooke / Cole, Singapore, 2004.
6. Vijayalakshmi, G.S. Murugesan A.G. and Sukumaran, N., Basic Environmental Science, Manonmaniam Sundaranar University Publications, Tirunelveli, 2006.
7. Dr. Sr. C. Shibana, Environmental Studies, Archers & Elevators Publishing Home, Bangalore -2019

## UNIT I : ENVIRONMENT AND ECOSYSTEM

### 1. Introduction

The science of environment is called **Environmental Studies**. It deals with every issue that affects an organism or the community as a whole. It is also called **Environmental Education**. The study of the basic components of our surroundings and their interactions is called **Environmental Studies**.

The environmental studies include the following aspects:

1. The components of the environment.
2. The interactions and the interdependence of the various components of the environment.
3. The ecosystem.
4. Biogeochemical cycles.
5. Natural hazards like **earthquake, cyclones, floods, landslides, volcanoes**, etc.
6. Man made hazards. Eg. Industries, atom bomb explosion, etc.
7. Pollution, etc.

### Aims of Environmental Studies

The aims of environmental studies are the following:

1. To get knowledge about our **surroundings**.
2. To know that our environment is our **house**.
3. To create **awareness** on the environment.
4. To **participate** in the movement on the conservation of our environment.

### Need for Environmental Studies

The earth is the big house of the human population. The earth and atmosphere constitute our environment. Among the nine planets of our solar system, earth is credited as the **living planet**. It alone contains man, animals and plants.

Millions of people lived and disappeared from the earth. Now we live on it. Yet millions have to continue to live. It is our profound duty to hand over our earth safely in their hands. But now the earth has become sick by the activities of man. She is bed-ridden and she needs the helping hand of all of us living on her.

The mother earth is severely disturbed. The disturbances are caused by the following factors:

1. **Green house effect**
2. **Global warming**
3. **Industrialization**
4. **Ecocide** – Destruction of natural environment by man. Eg. Conversion of forest into dwelling place.
5. **Eco terrorism**: Destruction of enemies of natural environment. Eg. Atomic bomb explosion in Hiroshima and Nagasaki

6. Atomic power plant accident. Eg. Chernobyl episode
7. Acid rain. Eg. Stone leprosy in Taj Mahal
8. Heavy metal pollution. Eg. Minamata disease in Japan
9. Air pollution
10. Water pollution
11. Noise pollution
12. Radioactive pollution
13. Marine oil pollution
14. Pesticide pollution
15. Natural calamities or Disasters Eg. Cyclone, Earthquake, Landslide, Volcanoes, Floods etc.,
16. Man made calamities  
Atomic bomb explosion, Atomic bomb testing etc

### **Environmental Education**

Introduction to students and public about every issue of environment that affects an organism is called **environmental education**. It enables the people to understand the **environmental crisis**, value of various things in the environment and to clarify concepts regarding the developmental issues. It is closely inter-linked with man, culture and the natural world. Hence, it is said to be a **multidisciplinary approach** of natural life events.

It approaches every problem in the light of environmental situation of natural world. Biology, geology, chemistry, physics, sociology, engineering, health, economics, statistics, computer science and philosophy are all components of environmental education.

In recent years, there have been so many problems in our environment due to pollution, deforestation, urbanization and industrialization. But most people think that the environment is clear because of lack of knowledge about the environmental problems. Only few people know the actual problems of the environment and what to do to solve the problems. For proper management of the environment, every individual should have adequate knowledge about the environment. Therefore, the Government has urged to educate people about the environmental crisis and possible solutions.

Environmental education has been given through **formal** and **non-formal education**. In India, much importance has been given to environmental education since 1979, when the first **International conference on Environmental Education** was held in New Delhi. The outcome of that conference has pointed out the basic necessities of environmental education to public.

In environmental education, each and every problem is viewed in its **totality** of various aspects. It is taught to people of all stages as a continuous process from primary school to college and informal levels.

### **Aims of Environmental Education**

Environmental Education is given to people for providing enough ideas about existing environmental problems, their causes and measures to be followed to solve the problems. It helps:

1. To increase the **general awareness** of people about the total environment and its various problems which are detrimental to life of man, plants and animals.
2. To provide enough training in the identification of causes, conditions and measures to be taken to correct the environmental problems.
3. To motivate public to participate in the schemes for protection of environment and upgrading the environmental conditions for better living.
4. To provide technical skill to identify and correct the environmental problems that arise in the locality.
5. To assist people in taking positive decisions for their future planning without damaging the immediate environment.
6. To provide an opportunity to all individuals to participate in the environmental issues of the Government.
7. To enable the public to acquire a set of social and ethical values concerning with the environment.
8. To enable the people to understand our dependence on nature that nobody can live healthy without protecting the environment.
9. To create the urge of Mother Nature of environment in people of all categories.

### **Man and the Environment**

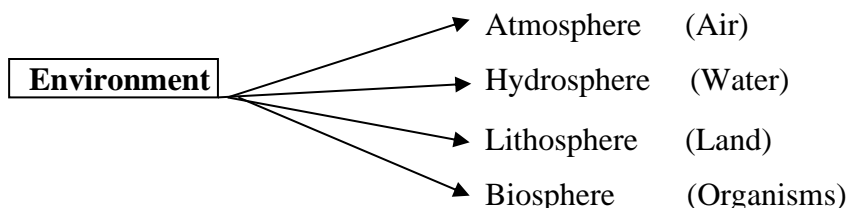
The environment is the **home of man**. He lives in the environment. He depends on the environment. He is inseparable from the environment. The safe and healthy living of a man needs a neat and clean environment. We live in our house. We keep our house neat and clean. When our house is not neat, we will not be comfortable and our stay in the house will not be pleasant.

Earth is a big house which provides a healthy living environment for the human population. Earth is the environment for the human beings. Now the mother earth has fallen sick. She needs a helping hand to become normal. The Earth, our environment, is deteriorating day by day. As it becomes worse, our life on the Earth becomes questionable.

Whatever we throw on the earth, will return to our body. When a pesticide (a drug used to kill insect) is sprayed on the paddy field, it reaches the paddy grains through the root system. When we eat the rice, the pesticide enters our body and gets deposited in the tissues. When the pesticide amount rises above the minimum level, the health is affected. When we disturb the environment, the environment will disturb us.

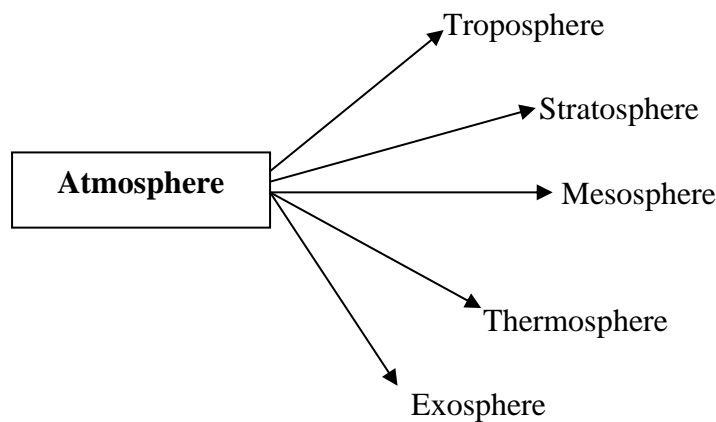
### **Components of Environment**

The environment is made up of four main components, namely



## 1. Atmosphere

- Atmosphere is the **gaseous** envelope of the earth
- It is present around the earth
- It extends upto 20,000 km.
- It consists of gases and some solid and liquid particles suspended in it.
- The gases include nitrogen, oxygen, ammonia, neon, krypton, xenon, etc. of these  $N_2$  makes upto 78%,  $O_2$  makes upto 21% and Argon makes upto 0.9%. The other gases are found in trace amounts.
- The atmosphere is divided into the following five layers on the basis of vertical distribution of temperature:



### (i) Troposphere

The lowest layer of the atmosphere, in which the temperature decreases with increasing altitudes is called **troposphere**. Clouds are formed and carried by winds in this layer. It extends from 6 to 8 km at the poles and to about 17 km at the equator. It contains 90% of the air of the atmosphere.

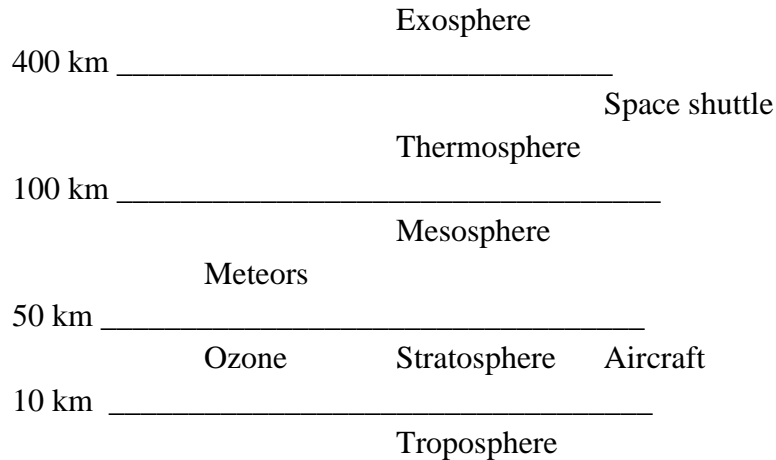
### (ii) Stratosphere

The layer of atmosphere above the troposphere, in which the temperature increases with increasing altitudes is called **stratosphere**. It extends to a height of **50 km**. Here the air is much thinner. Long-distance-aircrafts fly in the lower part of the stratosphere. The top of this layer contains **ozone**.

### (iii) Mesosphere

Mesosphere lies above 50km and extends up to 100km. It is characterized by decrease of temperature.





#### (iv) **Thermosphere**

It lies beyond the mesosphere. Here the temperature rises sharply attaining 1000°C. It extends to a height of 400 km.

#### (v) **Exosphere**

It lies above thermosphere beyond 400 km. The increase in temperature ceases at this layer. The density of the atmosphere is very low here.

### **Ozone Layer**

In the atmosphere, about 30 km above the surface of the Earth, ozone molecules are concentrated in the stratosphere. The concentrated layer of ozone is called **ozone layer**. It screens off UV light of the sun. It is often called **ozone umbrella**. It protects the life of the earth from the damaging effect of UV light. The thinning out of this layer is called Ozone Depletion.

This is caused by freons and other chloro-fluoro-carbons (CFC). They are used as coolants in refrigerators, air conditioners and in solvent cleaners. Ozone depletion may cause Inflammation of skin and skin cancer. The **ozone umbrella** prevents the damaging effects of UV radiation coming from the sun.

## **2. Hydrosphere**

The layer of water on the surface of the earth is called **hydrosphere**. It includes all liquid and frozen surface waters, groundwater held in rock and soil and atmospheric water vapour. It is estimated that the world has 1,46,000 cubic kilometre of water. Three fourth of the earth's surface is covered by water. It includes oceans, seas, ponds, lakes, rivers, dams, etc.

The oceans and seas constitute about 97% of water.

The polar ice caps and glaciers constitute 2%.

The freshwater bodies, groundwater and atmospheric vapour constitute 1%

All these waters of the hydrosphere are in constant circulation through **hydrologic cycle**.

### 3. Lithosphere

- The solid component of the Earth is called **lithosphere**. The part of the earth that is warm enough for us to survive is lithosphere, especially the crust.
- The lithosphere is made up of three layers, an outer **crust**, middle **mantle** and an inner **core**.
- The **crust** is the outer most solid zone of the Earth and its thickness varies from 12 to 60 km.
- The **mantle** is the middle layer and is in a molten state. The thickness of the mantle is estimated to be 2,900 km.
- The inner **core** is about 2,500 km thick. It is in a solid or molten state. It is composed of nickel and iron.
- The lithosphere can be compared to a hen's egg. It is elliptical. The shell of the egg represents the **crust**, the white of the egg is compared to the **mantle** and the yellow yolk is compared to the **core**
- The lithosphere is made up of rocks and soil. The rock is formed of **minerals**.

### 4. Biosphere

Biosphere is the **sphere of life**. It consists of the plants, animals and human beings of the earth. It is also called **Ecosphere**. The biosphere is found in the lithosphere, hydrosphere and atmosphere. The total mass of the biosphere is  $5 \times 10^{12}$  tonnes.

The biosphere consists of **organisms, population, community** and **ecosystem**. **Organisms** include the plants and animals. **Population** is a group of similar plants or animals living in an area. Eg. All the teak trees in a forest. A **community** refers to all the plants and animals living in an area. An **ecosystem** refers to all the non-living things, plants and animals of an area and their interaction.

### Eco System

The word **ecosystem** was coined by **A.G. Tansley** in 1935. This term is derived from two words, namely **eco** and **system**. **Eco** refers to environment and **system** refers to a complex co-ordinated unit.

An ecosystem is a sum total of living organisms, the environment and the process of interaction between and within all parts of the system (**Mathavan, 1974**)

According to **Odum** an ecosystem is the basic fundamental unit of ecology which includes both the organisms and the non-living environment each influencing the properties of the other and each is necessary for the maintenance of life.

An ecosystem is a **basic functional ecological unit**. It consists of **living** organisms (biotic factors) and **non-living** substances (abiotic factors)

It is an **interacting system** where the biotic and abiotic factors interact to produce an exchange of materials between the living and non-living factors.

**Pond** is a suitable example for ecosystem. **Forest** is another ecosystem. The **sea** forms the **marine ecosystem**. Other examples of ecosystem are **river, estuary, ocean, grassland, town**, etc.

In the ecosystem, there are plants, animals and microbes communities. The plant community is formed of several species of plants while the animal community is formed of several species of animals. The microbial community consists of assemblage of bacteria, fungi and viruses.

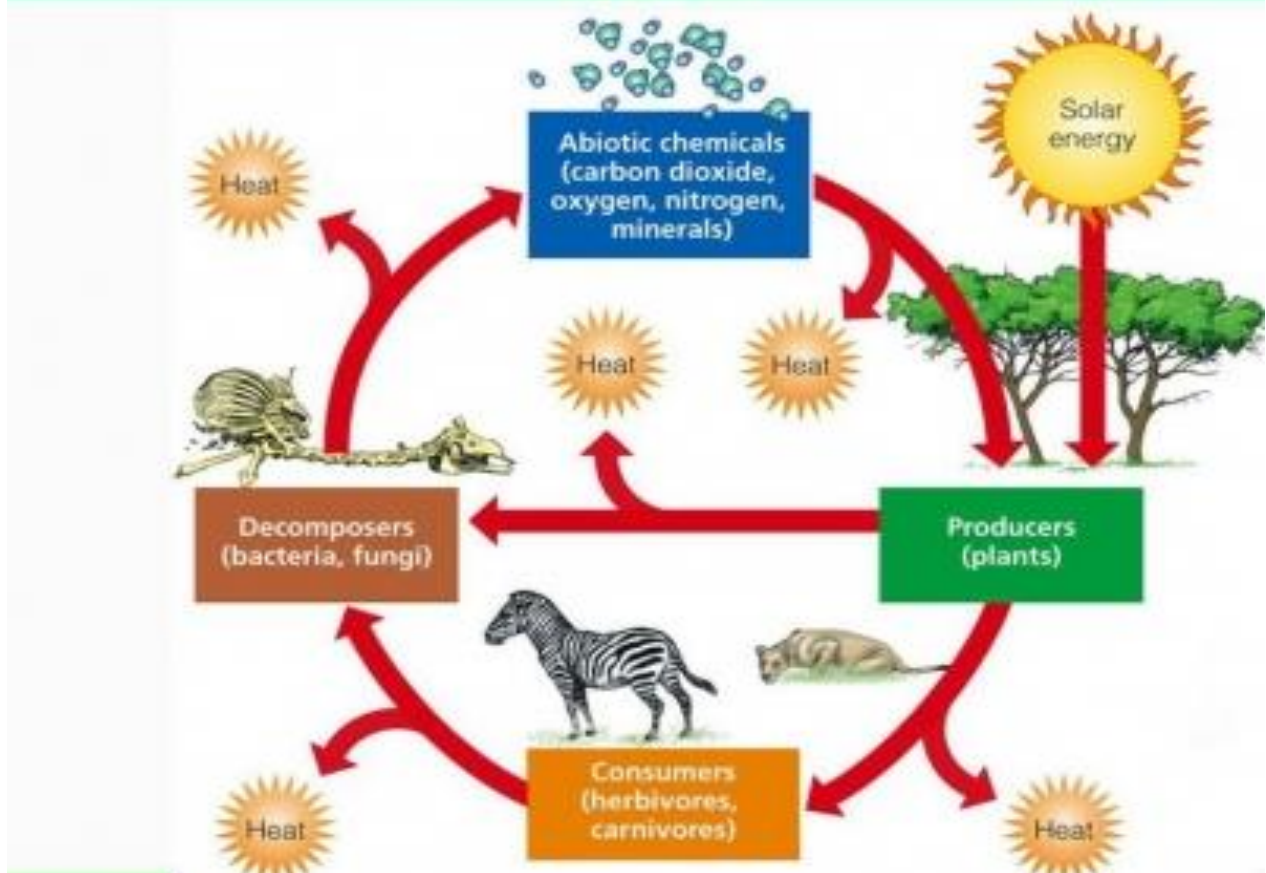
Each community is formed of several units called **populations**. A population consists of a group of individuals of a species. For example, an elephant population is formed of a group of elephants. Thus in an ecosystem there can be elephant population, deer population, eagle population, teak population and grasses living in coordination.

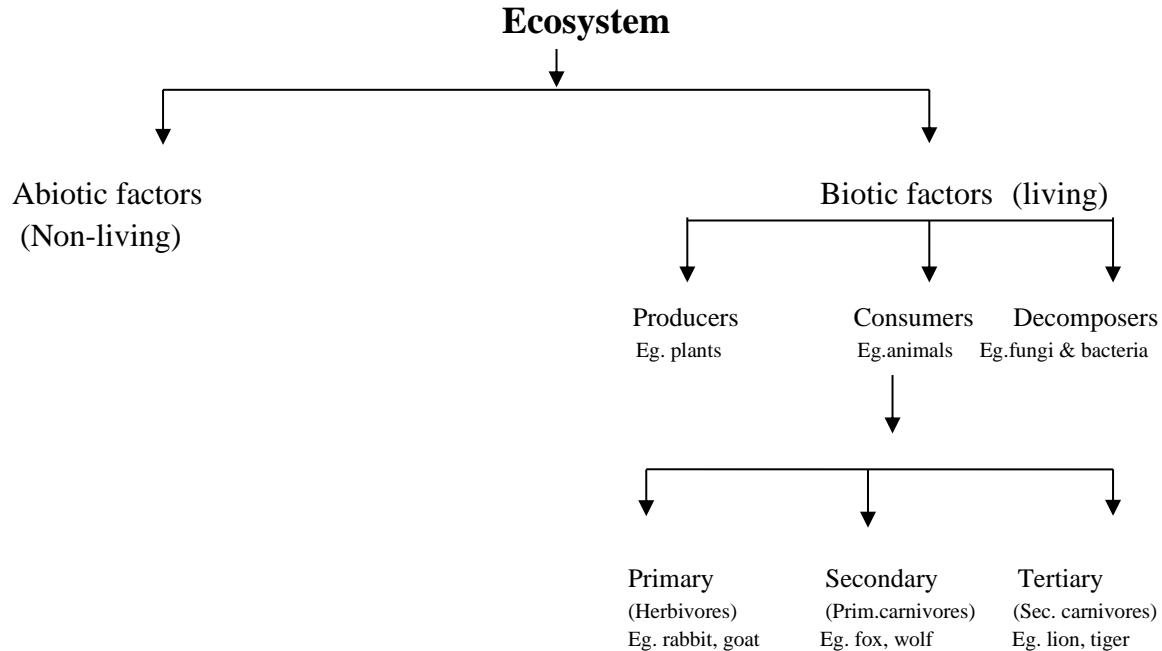
Each population is formed of many individuals of the same species. Therefore, individual is the basic unit of ecological level of organisation of biosphere.

### Structure

The structure of any ecosystem is formed of two components, namely Abiotic factors and Biotic factors.

## The Main Structural Components of an Ecosystem





## I. Abiotic Factors

The abiotic factors of an ecosystem include the non-living substances of the environment. Eg. Water, soil, air, light, temperature, minerals, climate, pressure, etc .

## II. Biotic Factors

The biotic factors include the living organisms of the environment. Eg. plants, animals, bacteria, viruses, etc. The biotic factors of the ecosystem depend on the abiotic factors for their survival. The biotic factors of an ecosystem are classified into three main groups namely **Producers, Consumers and Reducers or Decomposers.**

### 1. Producers

The organisms which carry out photosynthesis constitute the **producers** of an ecosystem. Eg. Plants and Photosynthetic bacteria. The producers depend on the abiotic factors of the ecosystem for producing energy. They contain **chlorophyll**. Chlorophyll is used for the synthesis of food with the utilization of abiotic factors like light, CO<sub>2</sub>, water and minerals. The process is called **photosynthesis**.

The producers use inorganic substances of the abiotic factors and convert them into organic food materials. A portion of the food synthesized, is used by the producers for their growth and survival and the remaining food is stored for future use.

### 2. Consumers

Consumers are organisms which eat or devour other organisms. All animals are consumers. The consumers are further divided into three or more types. They are **primary consumers, secondary consumers and tertiary consumers.**

**Primary Consumers:** They eat the producers like plants, algae and bacteria. The primary consumers are also called **herbivores**. **Elton** referred the herbivores as **key industry animals**. Rabbit, deer, cow, goat, etc. are primary consumers in a terrestrial ecosystem.

**Secondary Consumers:** They kill and eat the herbivores. They are also called **carnivores**. As these carnivores directly depend on herbivores, they are called **primary carnivores**. Fox, wolf, etc. are the **secondary consumers** in a terrestrial ecosystem.

**Tertiary Consumers:** They kill and eat the secondary consumers. They are also called **secondary carnivores**. Eg. lion, tiger, etc.

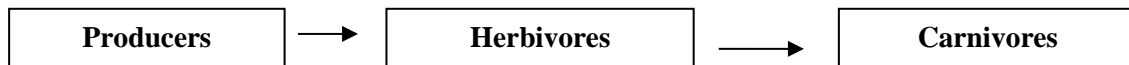
### 3. Reducers or Decomposers

The reducers or decomposers are organisms that break up the dead bodies of plants and their waste products. They include **fungi** and certain **bacteria**. They secrete enzymes. The enzymes digest the dead organisms and the debris into smaller bits or molecules. These molecules are absorbed by the reducers. After taking energy, the reducers release molecules to the environment as chemicals to be used again by the producers.

### Food Chain

The sequence of the eaters being eaten is called **food chain**. The biotic factors of the ecosystem are linked together by food. For example, the producers form the food for the herbivores. The herbivores form the food for the carnivores.

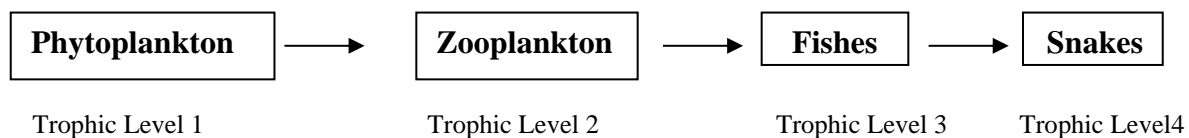
In a food chain **green plants** form the **first trophic level**. **herbivorous animals** form the **second trophic level** and **carnivores** form the **third trophic level**.



The various steps in a food chain are called **trophic levels**. Each trophic level is said to be a **link**. In each link some food is lost for daily activities. A food chain usually consists of **four** or **five** such links.

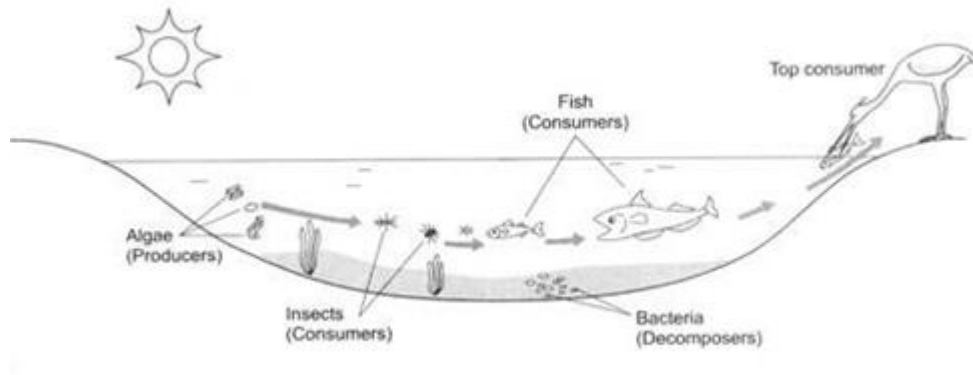
Owing to repeated eaters being eaten, the energy is transferred from one trophic level to another trophic level. This transfer of energy from one trophic level to another is called **energy flow**.

### Four trophic levels of a food chain in a pond ecosystem



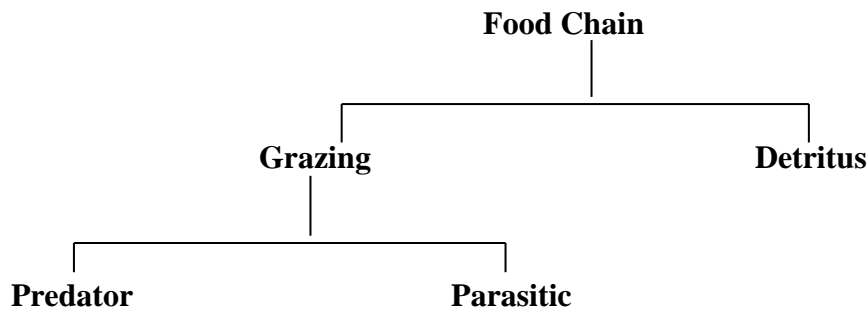
Plants —→ Mouse —→ Snake —→ Hawk - **Grassland ecosystem**  
 Plants —→ Goat —→ Man —→ Lion - **Forest ecosystem**

Energy flows through food chains. The arrows indicate the direction of energy flow.  
A typical food chain can be seen in a pond ecosystem. The phytoplankton are eaten by the zooplankton.



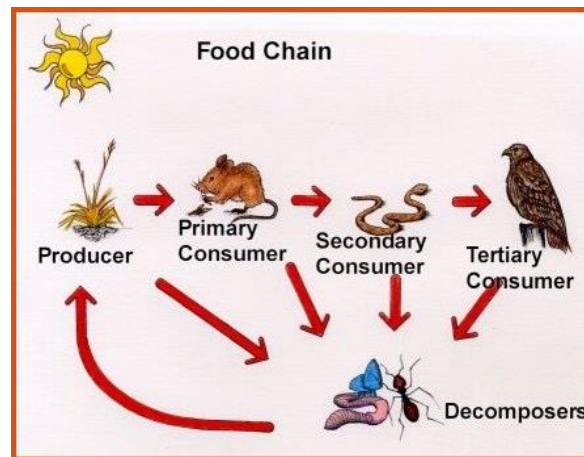
**Food Chain in a Pond**

The zooplankton are eaten by fishes. The fishes are eaten by snakes.  
The food chains are of two types: 1. Grazing food chain and 2. Detritus food chain



### 1. Grazing Food Chain

This food chain starts from plants, goes through herbivores and ends in carnivores.  
Plants → Herbivores → Primary Carnivores → Sec.carnivores



**Grazing Food Chain**

This type of food chain depends on the autotrophs which capture the energy from solar radiation. A few chains are given below:

Grass → Grasshopper → Lizard → Hawk  
Grass → Mouse → Snake → Hawk  
Phytoplankton → Zooplankton → Fish → Snake

The grazing food chain is further divided into two types, namely Predator food chain and Parasitic food chain

#### a. Predator Food Chain

In a predator food chain, one animal captures and devours another animal. The animal which is eaten is called **prey** and the animal which eats the other animal is called **predator**. The predator food chain is formed of plants, herbivores, primary carnivores, secondary carnivores and so on.

#### b. Parasitic Food Chain

The plants and animals of the grazing food chain are infected by parasites. The parasites derive their energy from their hosts. Thus the **parasitic chain** is formed within the grazing food chain.

### 2. Detritus Food Chain

It starts from dead organic matter and ends inorganic compounds. There are certain groups of organisms which feed exclusively on the dead bodies of animals and plants. These organisms are called **detritivores**.

The detritivores include algae, bacteria, fungi, protozoans, insects, millipedes, centipedes, crustaceans, mussels, clams, annelid worms, nematodes, ducks, etc. These organisms ingest and digest the dead organic materials. Some amount of energy is trapped and the remainder is excreted in the form of simple organic compounds. These are again used by another set of detritivores until the organic compounds are converted into CO<sub>2</sub> and water.

Dead organic materials  $\xrightarrow{\text{Detritivores}}$  CO<sub>2</sub> + H<sub>2</sub>O

#### Linking of Grazing and Detritus Food Chains

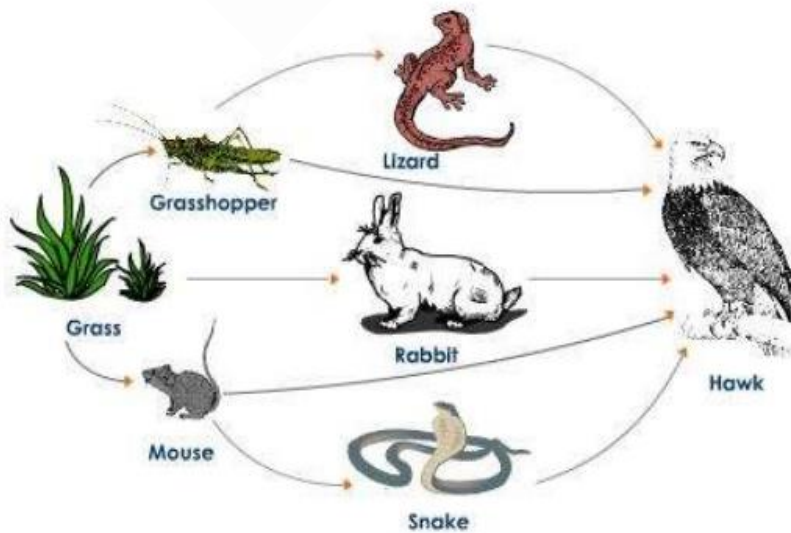
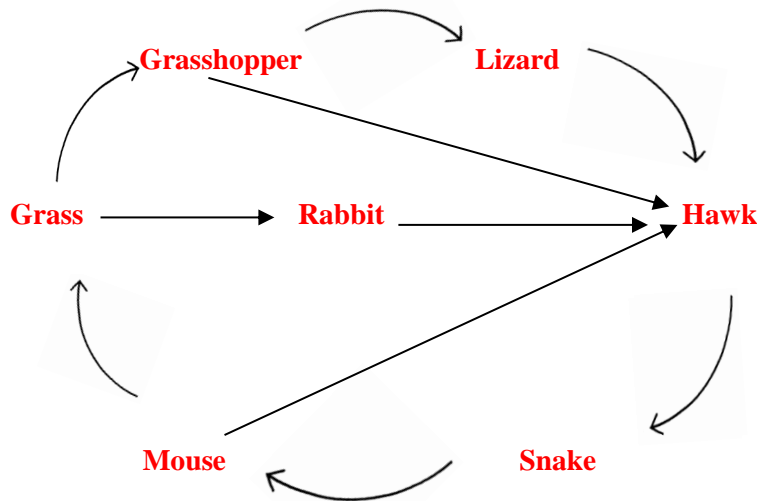
The two main food chains cannot operate independently. They are interconnected at various levels. According to **Wilson and Bossert** (1971) the stability of the ecosystem is directly proportional to the number of such links. The detritus feeders obtain energy from the dead bodies of animals and plants which are components of the grazing food chain.

Again some of the detritus feeders are eaten by the consumers of the grazing food chain. For example, in a pond ecosystem earth worms belonging to the detritus food chain are eaten by fishes belonging to the grazing food chain.

## Food Web

In an ecosystem, the various food chains are interconnected with each other to form a network called **food web**. Simple food chains are very rare in nature. This is because each organism may obtain food from more than one trophic level. In other words, one organism forms food for more than one organisms of the higher trophic level.

Example: In a grassland ecosystem, grass is eaten by grass hopper, rabbit and mouse. Grasshopper is eaten by lizard which is eaten by hawk. In addition, hawk also directly eats grass hopper and mouse. Thus there are five linear food chains which are interconnected to form a food web.



Food web in grassland ecosystem

## Significance of Food Web

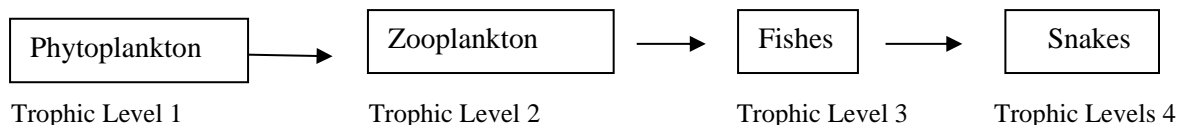
Food webs are very important in maintaining the stability of an ecosystem. For example, the deleterious growth of grasses is controlled by the herbivores. When one type of herbivore becomes extinct, the other types of herbivores increase in number and control the vegetation.



Similarly, when one type of herbivorous animal becomes extinct, the carnivore predating on this type may eat another type of herbivore.

### Trophic Levels

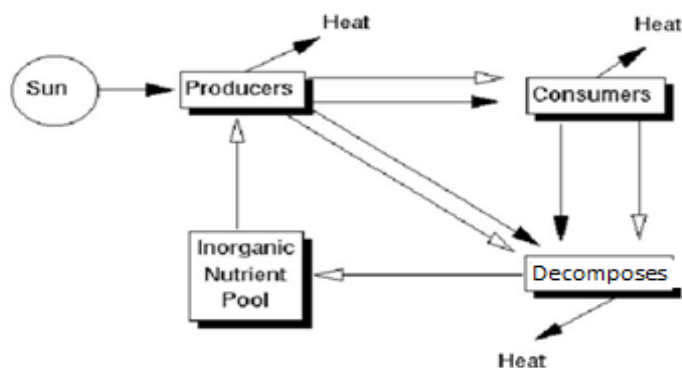
Each food chain contains many steps like producers, herbivores, primary carnivores and so on. Each step of the food chain is called a trophic level. The number of trophic levels in a food chain is always restricted to 4 or 5. But very often the chains are very much complicated with many trophic levels.



### Energy Flow

The transfer of energy from one trophic level to another trophic level is called **energy flow**. The producers synthesize and store energy in their body by **photosynthesis**. When the consumers eat the producers, the energy is transferred to the body of consumers. The flow of energy in an ecosystem is unidirectional. Hence energy can be used only once in the ecosystem. When the herbivores eat the producers, the energy is transferred to the body of herbivores, but only 10% is stored. The remaining 90% is lost through faces and respiration as unused energy.

A large amount of energy is lost at each trophic level. It is estimated that 90% of the energy is lost when it is transferred from one trophic level to another. Hence the amount of energy available decreases from step to step. When the food chain is short, the final consumers may get a large amount of energy. But when the food chain is long, the final consumers may get a lesser amount of energy.



Energy Flow in an ecosystem

Let us assume that the total amount of energy stored in the producers is 15 calories. When the producers are eaten by herbivores, only 10% is transferred to the body of carnivores i.e., only about 1.5 calories (10%) is incorporated into the body of herbivores. When the herbivore is eaten

by the carnivore, again only 10% i.e. 0.15 calories is incorporated into the body of carnivores. The remaining 90% is lost as heat.

The energy flow in the ecosystem follows the two laws of **thermodynamics**. The first law states that 'energy can neither be created nor destroyed; it can simply change in form. The **light energy** of the sun is converted into **electrical energy** in the chlorophyll. The electrical energy is converted into **chemical energy** during photosynthesis.

The **chemical energy** is transformed into **heat energy** during metabolism. The heat energy is transformed into **mechanical energy** for doing work. Thus the first law is obeyed. The second law states that 'during energy transfer, large part of energy is degraded into heat and dissipates'. When energy is transferred from producers to herbivores about 90% of energy is lost as heat.

### **Ecological Pyramids**

The number, biomass and energy of organisms gradually decrease from the producer level to the consumer level. This can be represented in the form of a pyramid called **ecological pyramid**.

Ecological pyramid is the graphical representation of the number, biomass and energy of the successive trophic levels of an ecosystem. The use of ecological pyramid was first described by **Charles Elton** in 1927. In the ecological pyramid, the producer forms the base and the final consumer occupies the apex.

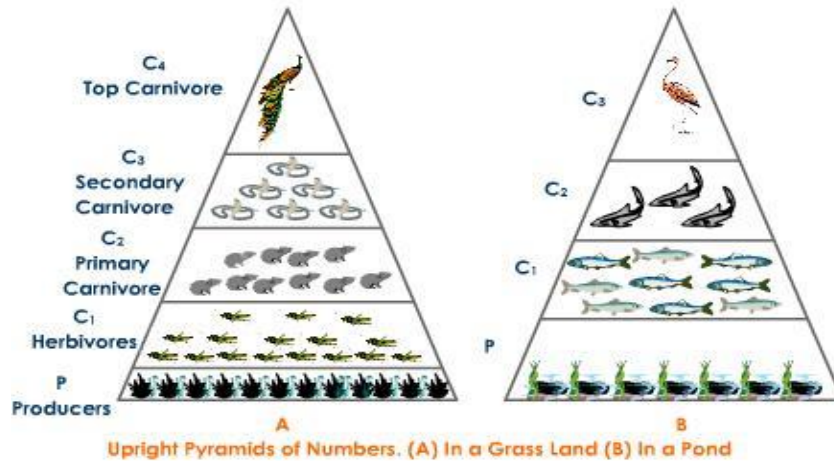
There are three types of ecological pyramids, namely

1. The pyramid of number
2. The pyramid of biomass
3. The pyramid of energy

#### **1. The Pyramid of Number**

The number of individuals at the trophic level decreases from the producer level to the consumer level. That is, in an ecosystem the number of producers is far high. The number of herbivores is lesser than the producers. Similarly, the number of carnivores is lesser than the herbivores.

**In a Cropland Ecosystem**, the crops are more in numbers. The grasshoppers feeding on crop plants are lesser in number. The frogs feeding on grasshopper are still lesser in number. The snakes feeding on frogs are fewer in number.



Crop → Grasshopper → Frog → Snake → Hawk

**Grassland Ecosystem:** In grasslands, the grasses are there in large numbers. The consumers decrease in the following order:

Grass → Grasshopper → Lizard → Hawk  
 Grass → Rabbit → Fox → Lion

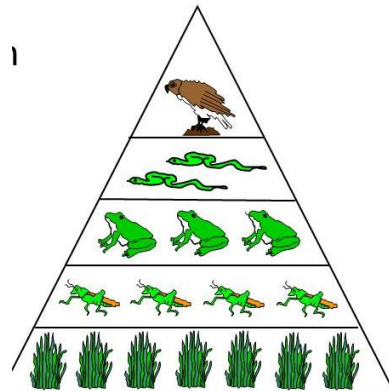
**Pond Ecosystem:** The number in a pond ecosystem decreases in the following order:  
 Phytoplankton → Zooplankton → Fishes → Snakes

## 2. The Pyramid of Biomass

Biomass refers to the total weight of living matter per unit area. In an ecosystem, the biomass decreases from the producer level to the consumer level.

**Grassland:** In a grassland, the biomass of grasses is the maximum and it gradually decreases towards the consumer level in the following order:

Grass → Mouse → Snake → Hawk  
 Grass → Grasshopper → Lizard → Hawk



Pyramid of Biomass in a grassland

In a forest, the biomass of trees is the maximum and the biomass of the top consumer is the minimum. The decrease in weight occurs in the following order:

Plants → Deer → Fox → Tiger  
 Plants → Rabbit → Fox → Lion



Pyramid of Biomass in a forest

### 3. Pyramid of Energy

The energy flows in an ecosystem from the producer level to the consumer level. At each trophic level 90% of energy is lost. Hence the amount of energy decreases from the producer level to the consumer level. This can be represented in a pyramid of energy.

In a grassland, green plants trap the maximum light energy. The energy gradually decreases towards the top consumer level.

Grass → Grasshopper → Lizard → Hawk  
 Grass → Rabbit → Fox → Lion  
 Grass → Mouse → Snake → Hawk

In a pond, maximum energy is trapped by the phytoplankton. Then the amount of energy decreases towards the top consumer level.

Phytoplankton → Zooplankton → Fish → Snake  
 Phytoplankton → Zooplankton → Small fish → Large fish

### Upright Pyramids

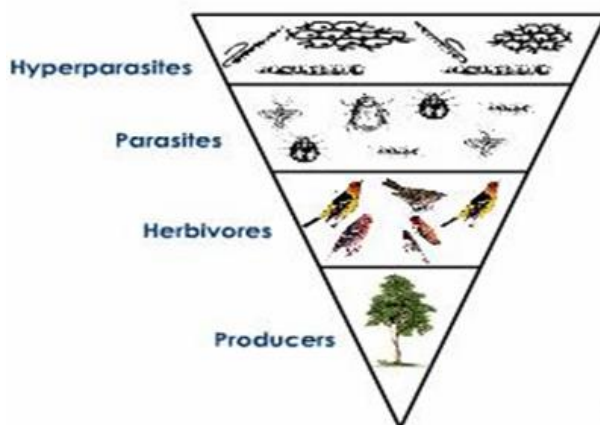
In most of the ecosystems, the number and biomass of producer are more and those of consumers are less. This type of ecosystem has a pyramid where the apex is pointed upwards. This type of pyramid is called **upright pyramid**.

## Inverted Pyramid

In some ecosystems, the number and the biomass of the producers are less and those of consumers are more. This type of ecosystem produces a pyramid where the apex is directed downwards. This type of pyramid is called **inverted pyramid**. Inverted pyramid occurs in numbers and biomass. The pyramid of energy is always upright.

### Inverted Pyramid of Numbers

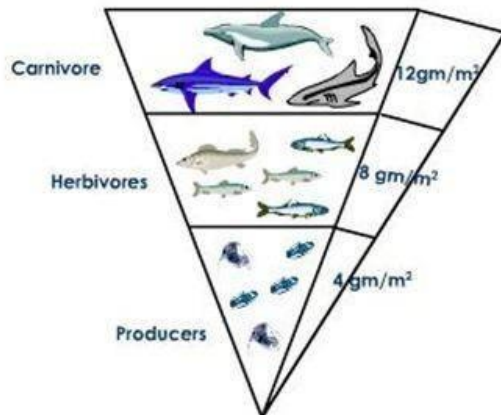
When the ecosystem contains lesser number of producers and more number of consumers, the pyramid will be inverted in shape. Inverted pyramid occurs in a tree ecosystem. A single tree (producer) contains many fruit eating birds (primary consumers). The birds contain numerous parasites (secondary consumers). The birds contain numerous parasites (secondary consumers)



Inverted Pyramid of numbers

### Inverted Pyramid of Biomass

When the biomass of producers is less and that of consumers is more, the pyramid will have inverted shape. It occurs in a pond or lake ecosystem. Here the biomass of diatoms and phytoplankton are negligible as compared to that of crustaceans and small fishes.

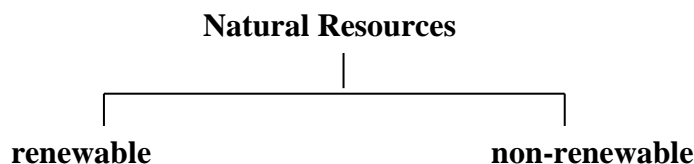


Inverted Pyramid of biomass

## UNIT II : NATURAL RESOURCES

**Natural resources** are the **wealth** of the earth. They are the raw materials available in nature and useful to human beings, animals and plants. Eg. Water, air, land, plants, animals, coal, petroleum, minerals, forest, wood, etc.

The natural resources are of two types, namely **Non-renewable resources** and **renewable resources**. The non-renewable resources cannot be replaced after their use. Eg. Coal, petroleum, iron, natural gas, etc.



**Renewable resources** are replenished after their use. Eg. water, aquafood, forest, grassland, plants, animals, etc.

Based on **chemical nature**, natural resources are classified into ***inorganic resources*** and ***organic resources***.

The **inorganic resources** do not contain carbon. They include air, water, minerals, sunlight, etc. The **organic resources** contain carbon. They include coal, petroleum, natural gases, forest, aquafood, etc.

### Water Resources

Water is the **mother of life**. It is the universal solvent and also called liquid gold. About 97% of earth surface is covered with water. Water is a very important prerequisite for drinking, agriculture and domestic purposes. Hence, **river banks** are the world's most populous regions. Man, animals and plants cannot live without water. It is an **inorganic compound** formed of **hydrogen** and **oxygen** ( $H_2O$ ). It exists in three forms, namely **liquid**, **solid** (ice) and **vapour** (steam). Water sources include precipitation (rain), lakes, ground water, rivers, ponds, seas etc.,

The water may be **hard water** or **soft water**. Hard water does not give foam with soap. Soft water gives foam with soap. The water may be **freshwater**, **seawater** or **brackish water**. In freshwater, the salt content is less than 0.2%. In seawater it is 32%. In brackishwater, the salt content varies from 0.2% to 32%. Salt water is converted into potable water by **reverse osmosis**. **World Water Day** is celebrated on March 22.

### Water conservation

- Use minimum water and prevent wastage
- Use quality water taps
- Rain water harvesting can be practiced
- Treated sewage water can be used for agriculture

- Construction of Dams across slopes and canal
- Drip and sprinkling irrigation for crops

## **Rain Water harvesting**



**Rain Water Harvesting**

The process of collection of rain water directly or recharging it into ground to improve ground water storage is called “rain water harvesting”.

### **Need for rain water harvesting**

- To reduce water scarcity
- To increase water table
- To reduce flood

## **Methods of Rain water harvesting**

### **1. Collection in vessels and ponds**

Rain water is harvested in surface of water bodies like ponds, lakes etc. The rain water falling on slopping roofs of houses can be collected in vessels.

### **2. Rain water harvesting in open places**

In open places, polythene or asbestos sheets are laid in a slanting manner. The rain water falls on it and can be collected.

### **3. Percolation pit (Absorption pit)**

This method is suitable for gravelly soil. A pit of 10” x 4-8 meters is made on the ground. It is filled with pebbles or broken bricks at bottom and river sand at top. A square or circular collection chamber with silt aerator. At the ground level a perforated slab is used to cover the pit.

### **4. Percolation well method**

Wells are constructed with 0.6-2m. diameter cement rings and closed well. The rain water is diverted into the well using PVC pipes through filter chamber.

### 5. Percolation well cum bore pit method

This method is suitable for clayey soil. Percolation well upto 5 metre and hand bore upto 5 metre height is made within the well. PVC pipes of 150 mm diameter is inserted into the bore. The well is filled with pebbles and sand and pipe is filled with pebbles.

#### Advantages :

- Increase ground water level
- Decrease salt content of ground water
- Prevents soil erosion and flood
- Decrease the problems related to drinking water

## FOREST RESOURCES

A Forest is a large area of land inhabited by trees, shrubs, herbs, climbers, etc. The vegetation of forests is uncultivated and it forms the wild growth. The term **forestry** refers to the science of planting and caring of forests.

### Forest Area of the World

About one third of the World's land surface is covered with forests. It forms about 4028 million hectares in the World. In India also 1/3 of the land is covered by forests. The total area of forests in Tamilnadu is about 21,000 square kilometers. Tropical rain forests in India occur in **Assam**.

### Importance of Forests

Forests are vast resources for man. They provide the following contributions to man:

1. Forests are the main source of **timber** used in furniture and buildings.
2. They yield **firewood** and **fuel**
3. They yield the raw materials (**pulp**) necessary for the manufacture of **paper** and **boards**
4. They yield the raw materials for **textiles**.
5. They give **fodder** (dried food, hay, etc.) to farm animals, horses, etc.
6. Forests help in **precipitation** (rainfall)
7. Forests help in the **recycling of moisture** by transpiration.
8. Forests check **floods and soil erosion**.
9. Forests provide **shelter** and food for **wild animals**.
10. Forests provide facilities for human **recreation**.
11. Forests regulate the **Earth's temperature**.
12. Forests help to maintain a balance between **CO<sub>2</sub>** and **O<sub>2</sub>** in the atmosphere.
13. The natural forests maintain the **fertility of soil** by returning the nutrients to the soil through litter.
14. Forests are the main source of **fossil fuel**.
15. Many **medicines** are obtained from forests. Eg. Eucalyptus oil.



## **CONSERVATION OF FORESTS**

Forests are most affected through human activities. Forests are destroyed by civilizations, urbanization, agriculture, fire, felling of trees, grazing, plant diseases, etc. **Deforestation** (destruction of forest) leads to serious ecological imbalance. Hence it is inevitable to take necessary steps to conserve forests. Conservation of forests requires the following steps:

1. Protection from fire
2. Prevention of fire
3. Regulation of tree-felling
4. Regulation of grazing
5. Fencing
6. Protection from wild animals
7. Control of pests and diseases
8. Growing tolerant species

### **1. Protection from fire**

Large areas of forests are destroyed by fire accidents. Forests can be protected from fire by the following methods:

1. Starting fire-extinguishing organizations.
2. Dividing forest into blocks separated by fire lines. Fire lines may have a width up to 100 feet or more. The vegetation in the fire lines must be cleared off. This will prevent the extension of fire from one block to another.
3. Construction of fire-resistant belts along the railway lines, roads and paths from which fire may start and spread.
4. Growing a strip of evergreen species of plants to protect certain forests such as coniferous forests and plantations.
5. All materials that easily catch fire should be removed from belts around dangerous spots.
6. People must be educated about the dangers of forest fire.

### **2. Prevention of Fire**

Fire can be prevented by spotting it out at the initial stage itself. This can be done by appointing look-out men near dangerous spots. This helps to find out the fire immediately and facilitate its extinction.

### **3. Regulation of Tree-felling**

‘**Felling**’ refers to the cutting of trees for timber and firewood. The shrinkage of forests can be prevented by the regulation of felling as follows:

1. A sufficient number of trees must be reserved per acre for regeneration.
2. Sufficient intervals between fellings must be given for regeneration.

#### 4. Regulation of Grazing

Forests are exposed to destruction through grazing by wild and domestic animals. Grazing is regulated by allowing only a reasonable number of stock during specific times in the year.

#### 5. Fencing

Forest destruction can be prevented by constructing fences all around.

#### 6. Protection from Wild Animals

Wild animals cause severe damage to forest vegetation, seedlings and saplings. They prevent regeneration. Therefore facilities should be provided for regeneration atleast in some areas.

#### 7. Control of Pests and Diseases

Insects cause severe damage to forests. They can be controlled by two methods. They are as follows:

1. Spraying insecticides like DDT.
2. Biological control. By rearing and propagating the enemies of pests.

#### 8. Growing Tolerant Species

Forest conservation is made efficient by growing plants tolerant of diseases, fire and grazing.

### ENERGY RESOURCES

#### 1. Solar Energy

Sunlight is the **solar energy**. It forms the major energy source for the plants. Plants synthesize starch with the help of Sunlight. All animals in the World depend on the energy stored by the plants. Solar energy is the best source of renewable energy to the world. The solar energy is also used in **solar cooker, solar light, solar calculator**, etc.



**Solar Cell**

Solar cells generate electricity using sunlight. They are pollution free. In solar cells two layers of silicon are used.



Solar Cell with Street light

### Solar cells are used for:

Calculators, electric appliances, radios, water pumping, weather stations, street lights, cars etc.,

## 2. Fossil fuels

Fossil fuels are coal, oil and natural gas formed over geological time under the Earth. They are **organic compounds**. They are **nonrenewable** energy resources. They are formed from the dead bodies of plants and animals. They are used as energy resources.

### a. Coal

Coal is a fossil fuel. It is a **nonrenewable** natural resource. It is found under the Earth. It is an **organic compound**. It is a **black product** formed by organic decomposition of plant materials millions of years ago. Coal is found in stratified beds.

### b. Oil

**Oil** is a **non-renewable resource**. Oil is the most abundant fluid in the Earth's crust, next to water. It is **hydrocarbon**. It is the mineral oil. It is a **fossil fuel**. The crude oil is the **petroleum**. It is formed by the decomposition of buried plants, millions of years ago.

Crude oil is refined to produce petrol, diesel, kerosene, propane, gasoline, jet fuel, heating oil, motor oil, road tar, paraffin wax, petroleum jelly, etc. The chemicals present in oil are isolated and used for the production of **plastics, medicines**, etc.

### c. Natural Gas

**Natural gas** is a **fossil fuel**. It is a hydrocarbon. It is found together with oil. It accumulates above the oil. It is formed by the decomposition of buried plants, millions of years ago. **Methane** is a natural gas. It is used for domestic and industrial purpose.

## 3. Wind Energy

**Wind** is the **renewable** natural energy resource. Wind is an inexhaustible source of energy. It is a perennial source and is available day and night. It is used to generate **electric current**.



**Wind Mill**

The blow of wind is allowed to rotate the blades of a **windmill**. The windmill is coupled to a **turbine**. This generates electricity. The pioneer in generating electricity by using windmills is **Denmark**. Windmills are most abundant in Gujarat, Tamil Nadu and A.P. **Muppandal** (Tamilnadu) has the highest concentration of windmills in Asia and it ranks third in the World.

The windmill has a vertical **pillar** with three **blades**. The force of wind rotates the blades. The blades rotate a wheel. The wheel is connected to a generator to generate electricity. The speed of the wind should be 10 to 20 km/hour. In rural areas, small windmills are used for pumping water, threshing, winnowing, cutting woollen logs, battery charging, etc.

### **Role of Individuals in the Conservation of Natural Resources**

Land, water, forests, minerals and energy sources available to us from the earth's crust are known as **natural resources**. Over use of any of these natural resources results in scarcity of the resource in the near future. So, every individual should do his maximum to conserve the existing non-renewable resources today.

The following roles of individual people are very important in the conservation of natural resources.

1. Most people in the developed countries greed for material goods to ensure their prestige in the economic status. People in the developing countries also tend to collect material goods to keep their prestige among the people. It affects poor people of developing countries. Hence, rich people should collect material goods only to a limited amount.
2. Population explosion is a serious problem that brings about financial crisis, illiteracy and food shortage in a country. If population explosion is checked, then the rate of environmental degradation will be minimized successfully.
3. Economic development of people create many adverse effects in the environment because of changes in life style and behaviour.
4. Individuals are responsible for implementing the conservation programmes of the Government.
5. One of the main causes for land degradation is the conversion of cultivable land into housing plots. So, individuals should not try to build houses in cultivable lands.

6. Excessive surface run off is the main reason for floods in rivers during rainy season. If every individual develops a good raised bunds around their land, there would be minimum chance for surface run off and floods.
7. People should not cut down forest trees for fuel wood, which results in deforestation and depletion of forest covers.
8. Reduced water use and low discharge of used waters are major aspects of water conservation that can be done by individuals. Individuals should adopt **drip irrigation** to cut down 2/3 of water use for agriculture without reducing crop yield.
9. People can save electricity by -
  - Switching off of lights and fans when they are not required.
  - Using energy efficient bulbs.
  - Making use of pressure cookers that can save 75% of energy needs.
  - Reducing the use of refrigerators and air conditioners.

## UNIT III : ENVIRONMENTAL POLLUTION

### Pollutants

The substances or factors which affect the normal functioning of human life and domesticated species when introduced into the biosphere, are called pollutants. The important pollutants are as follows:

#### 1. Garbage

Domestic wastes, municipal wastes, etc.

#### 2. Deposited Matter

Smoke, soot, dust, tar, etc.

#### 3. Gases

CO, CO<sub>2</sub>, SO<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, FI<sub>2</sub>, Cl<sub>2</sub>, nitrogen oxide, methyl isocyanate, etc.

#### 4. Chemical Compounds

Aldehydes, arsines, hydrogen fluorides, phosgenes, detergents, etc.

#### 5. Metals

Lead, iron, zinc, mercury, etc.

#### 6. Biocides

Pesticides, insecticides, herbicides, fungicides, nematocides, rodenticides, etc

#### 7. Fertilizers

Urea, Ammonium sulphate, etc.

#### 8. Radioactive Substances

#### 9. Noise

#### 10. Heat

#### 11. Sewage

#### 12. Plastics

#### 13. Oils

Ecologically pollutants are classified into two main groups. They are **non-degradable** pollutants and **biodegradable** pollutants.

#### 1. Non-degradable Pollutants

The pollutants which cannot be decomposed are called **non-degradable pollutants**. Once they fall in an environment, they remain as such. Hence continuous use of these substances leads to their accumulation in the environment and in the organisms through biogeochemical cycles and food chain. This accumulation of pollutants in the organisms is called **biological magnification**. Eg. DDT, mercury salts, aluminium cans, etc.

#### 2. Biodegradable Pollutants

The pollutants which can be decomposed by natural process are called biodegradable pollutants. Eg. Sewage, heat, noise, etc.

On the basis of physical properties, pollutants are classified into four categories. They are **solid pollutants, liquid pollutants, gaseous pollutants** and **pollutants without weight**.

### **Types of Pollution**

Pollution is classified into the following types:

- |                    |                          |
|--------------------|--------------------------|
| 1. Air pollution   | 4. Noise pollution       |
| 2. Water pollution | 5. Thermal pollution and |
| 3. Land pollution  | 6. Marine pollution      |

### **Air Pollution**

Air pollution refers to the undesirable change occurring in air causing harmful effects on man and domesticated species.

#### **Air Pollutants**

The common air pollutants are the following:

1. Dust
2. Smoke
3. Carbon monoxide (CO)
4. CO<sub>2</sub>
5. Ammonia (NH<sub>3</sub>)
6. Sulphur di-oxide (SO<sub>2</sub>)
7. Hydrogen sulphide (H<sub>2</sub>S)
8. Nitrogen di-oxide (NO<sub>2</sub>)
9. Hydrogen cyanide

Air pollutants are of two types. They are **primary air pollutants** and **secondary air pollutants**.

#### **1. Primary Air Pollutants**

Air is polluted by poisonous gases and undesirable substances. They are released by burning fossil fuels. These substances are called **primary air pollutants**. The primary air pollutants are the following:

1. Soot released from unburned fuel
2. SO<sub>2</sub> (sulphur di-oxide)
3. Benzopyrene (hydrocarbon) released from cigarette smoke.
4. NH<sub>3</sub>
5. Oxides of nitrogen
6. CO (carbon monoxide)

#### **2. Secondary Air Pollutants**

Secondary air pollutants are poisonous substances formed from primary air pollutants. In bright sun light, nitrogen, nitrogen oxides, hydrocarbons and O<sub>2</sub> interact to produce more powerful

photochemical oxidants like Ozone (O<sub>3</sub>), Peroxy Acetyl Nitrate (PAN), aldehydes, sulphuric acid, peroxides, etc. All these constitute **photochemical smog**.

### Causes of Air Pollution

1. **Agriculture**

Hydrocarbons released by plants, pollen grains, insecticides etc. cause air pollution.

2. **Dust**

Dust in the air is increased by dust storms, wind, volcanoes, automobiles, etc.

3. **Industries**

Combustion of fossil fuels like coal, petroleum, etc. in industries is the main source of air pollution.

4. **Automobiles**

The combustion of petrol and diesel in automobiles releases harmful gases into the air. They also produce dust. Vehicles are the predominant source of air pollution.

5. **Ionizing Radiations**

Ionizing radiations include **alpha particles**, **beta particles** and **gamma rays**. They are released into the air from testing atomic weapons and atomic explosions.

6. **Freons**

Use of freons and other chloro-fluoro-carbons as refrigerants, coolants and as filling agents in aerosol packages cause pollution.

7. **Aerosols**

Aerosols are small particles of solid or liquid substances suspended in the air. They block the stomata of plants and prevent the gaseous exchange between plants and atmosphere. They may also change the climate of an area.

### Ecological Effects of Air Pollution

1. **Death**

When air is polluted with poisonous gases, death occurs immediately.

**Bhopal Episode** : On 2<sup>nd</sup> December 1984 about 3000 human beings died, about 5000 paralyzed and thousands of cattle, birds, dogs and cats died in one night at **Bhopal**. This mass death is due to the leakage of **methyl isocyanate** (toxic gas) into the air from an insecticide plant managed by Union Carbide.

2. **Chlorosis**

The disappearance of chlorophyll is called **chlorosis**. It is caused by SO<sub>2</sub> and fluorides present in the air.

3. **Necrosis**

The breakdown of cell is called **necrosis**. It is caused by SO<sub>2</sub>, nitrogen di-oxide, ozone and fluorides.



#### 4. Green House Effect

CO<sub>2</sub> is released into the air by the combustion of fuels. It is estimated that CO<sub>2</sub> content of the air is increasing at the rate of 0.4% per annum. This will result in an appreciable warming up of the earth. This is called **green house effect** causes the melting of polar ice caps resulting in a rise of nearly 60 feet on the sea level.

#### 5. Crop losses

Heavy loss of crop plants is caused by **smog**. Smog denotes a **combination of smoke and fog**. The important components of **smog** are **ozone** and **PAN** (Peroxy Acetyl Nitrate). They damage leafy vegetables, cereals, textile crops, ornamental plants, fruits and forest trees.

#### 6. Diseases

Excessive ethylene **accelerates respiration** causing premature **senescence** (old age) and **abscission** (accumulation of yellow fluid (pus) in the body). Aldehydes irritate nasal and respiratory tracts. Chlorine and phosgenes (carbonyl chloride) cause **pulmonary oedema**.

Air pollutants cause heart diseases, nausea, vomiting, jaundice, cough, pneumonia and even cancer.

#### 7. Oxygen Carrying Capacity

CO reduces O<sub>2</sub> carrying capacity of RBC by its permanent combination with haemoglobin.

#### 8. Mutation

Radioactive elements produce mutation. Ozone produces chromosomal aberrations.

#### 9. Depletion of Ozone Umbrella

In the atmosphere, about 30 km above the surface of the Earth, the ozone molecules (O<sub>3</sub>) form an umbrella. It prevents the penetration of harmful ultra violet radiation from the sun and thus protects the life of the Earth. It is now feared that there is danger of appearing holes on the ozone umbrella. This is caused by the use of **freons** and other **cholo-fluoro-carbons** as refrigerants, coolants in domestic refrigerators and other cold storage facilities and as filling agents in foam plastics and in aerosol packages. Reaching the ozone umbrella, they destroy ozone molecules as a result of photochemical reactions.

#### 10. Acid Rain

Acid rain is caused by air pollution. The rain water having pH as low as 5.6 is called acid rain. This lowering of pH is due to the dissolution of acids in the rain water. Precipitation of oxides of sulphur and nitrogen with rain is termed as **acid rain**. The primary cause of acid rain is **sulphur dioxide**.

Acid rain affects both materials and organisms. It attacks building materials mainly sandstone, limestone, marble, etc. and causes, stone leprasy. Acid rain increases the acidity of lakes

and rivers. Acidity kills fish, bacteria and algae and the aquatic ecosystem collapses into sterility leaving a crystal clear but ultimately a dead lake.

### Control of Air Pollution

1. The emission of exhaust from automobiles can be reduced by devices such as **positive crankcase ventilation valve** and **catalytic converter**.
2. **Electrostatic precipitators** can reduce smoke and dust from industries.
3. Gaseous pollutants arising from industries can be removed by **differential solubility** of gases in water.
4. A fine spray of water in the device called scrubber can separate many gases like  $\text{NH}_3$ ,  $\text{SO}_2$ , etc. from the emitted exhaust.
5. Certain gases can be removed by **filtration** or **absorption** through activated carbon.
6. Certain gases can be made chemically inert by **chemical conversion**.
7. At the Government level pollution can be controlled by framing **legislations**.

### Water Pollution

Water is the soul of nature; its pollution will perish the World.

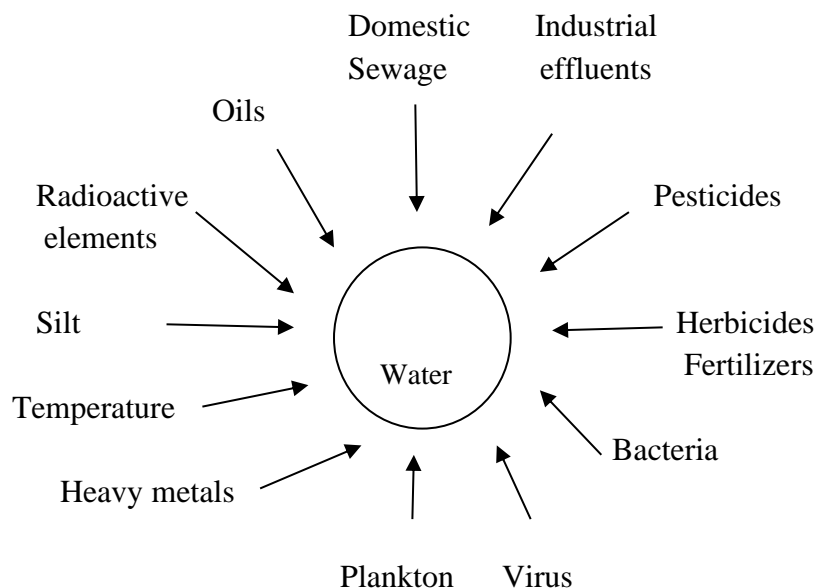
**Water pollution** refers to the undesirable change occurring in water which may harmfully affect the life activities of man and domesticated species.

### Water Pollutants

The common water pollutants are as follows:

- |                         |                              |
|-------------------------|------------------------------|
| 1. Domestic sewage      | 7. Plankton blooms           |
| 2. Industrial effluents | 8. Heavy metals like mercury |
| 3. Pesticides           | 9. Temperature               |
| 4. Herbicides           | 10. Silt                     |
| 5. Fertilizers          | 11. Radioactivity            |
| 6. Bacteria and viruses | 12. Oils, etc.               |

### Causes of Water Pollution



### **1. Domestic Sewage**

Domestic sewage consists of human faeces, urine and the dirty used-up water in houses. It contains a large number of pathogenic bacteria and virus.

### **2. Industrial Effluents**

All industrial plants produce organic and inorganic chemical wastes. Those non-usable chemicals are dumped in water as a means of getting rid of them. The industrial wastes include heavy metals (Hg, Cu, lead, zinc, etc.) detergents, petroleum, acids, alkalies, phenols, carbonate, alcohol, cyanides, arsenic, chlorine, etc.

### **3. Thermal Pollution**

Many industries use water for cooling. The consultant warm water is discharged into rivers. This brings about thermal pollution.

### **4. Fertilizers**

The fertilizers used for crops are washed into ponds and rivers.

### **5. Pesticides**

Pesticides are used to control pests in fields and house. They include DDT, BHC, endrin, etc.

### **6. Radioactive Wastes**

Liquid radioactive wastes are released into the sea around nuclear installations. The oceanic currents carry the radioactive contaminants everywhere.

### **7. Oil Pollution**

Oil is a source of pollution in sea-water. Oil pollution is due to ship accident, loading and discharging of oil at the harbour, oil refineries and off-shore oil production.

### **8. Retting**

The process of decaying coconut husk to get fibre for making coir is called **retting**. Retting releases  $H_2S$ . It makes water polluted.

## **Ecological Effects of Water Pollution**

### **1. Minamata Disease**

This disease is caused by **mercury poisoning**. It is characterized by crippling and death. This disease appeared in a coastal town, **Minamata**, in Japan. The primary cause for this disease was a plastic industry which was started on the sea coast of Japan in 1905. From this factory the byproduct mercury was disposed into the sea. This mercury accumulated in marine animals.

The accumulation of mercury leads to crippling and death. Their initial symptoms of minamata disease includes the numbness of limbs, lips and tongue, impairment of motor control

deafness and blurring of vision. Finally it affects and destroys the brain. As a result of the attack of minamata disease about 17 persons died and 23 became permanently disabled in the year 1953, in Japan.

## **2. Diarrhoea**

It is caused by mercury, cadmium and cobalt.

## **3. Reduction in Productivity**

Intensive agriculture increases the amount of silt in lakes and rivers. Silt prevents the penetration of light to depths and thus reduces primary production.

## **4. Siltation**

Siltation is phenomenon by which the gills of fishes are deposited with silt. This causes heavy mortality among fishes.

## **5. Poor Oxygenation**

Oil present on the surface of water prevents water oxygenation. This reduces respiration and metabolism in aquatic organisms.

## **6. Poor Photosynthesis**

Oil pollution prevents photosynthesis in phytoplankton.

## **7. Red Tide**

When coasted waters are enriched with nutrients of sewage, dinoflagellates multiply rapidly and form **bloom**. The dinoflagellates produced toxic metabolic by products which cause the mass death of marine fishes. This is called **red tide**.

## **8. Biochemical Oxygen Demand**

**Biochemical Oxygen Demand or Biological Oxygen Demand (BOD)** is the amount of oxygen required by the micro-organisms in water. BOD is higher in polluted water (sewage) and lesser in drinking water. Increased BOD lowers the contents of dissolved O<sub>2</sub> in water causing the suffocation and death of aquatic flora and fauna.

## **9. Water-borne Diseases**

Diseases like jaundice, cholera, typhoid, diarrhoea, etc. are transmitted through water contaminated with sewage.

## **10. Methaemoglobinemia**

The nitrate used in fertilizers enters the intestine of man through drinking water. In the intestine, it is converted into nitrite.

Nitrite is absorbed into the blood where it combines with haemoglobin to form methaemoglobin. Methaemoglobin cannot transport oxygen. This leads to suffocation and breathing troubles, especially in infants. This disease is called methaemoglobinemia.

## 11. Eutrophication

Domestic sewage and fertilizers add large quantities of nutrients such as nitrates and phosphates to the freshwater ecosystems. The rich supply of these nutrients make blue green algae, green algae and other phytoplankton to grow abundantly. This increased productivity of lakes and ponds brought about by nutrient enrichment is known as **eutrophication**.

As the algae use  $O_2$  of the water for respiration, the  $O_2$  is depleted from the water. The algae consume all the nutrients of the water. The depletion of  $O_2$  and nutrients lead to the death of algae and other phytoplankton.

As other organisms, such as zooplankton and fishes of the water, depend on the blue green algae and phytoplankton for their food, they also die. Thus eutrophication leads to the complete depletion of the fauna from the ecosystem.

## Control of Water Pollution

### 1. Sewage Treatment

Water pollution can be controlled by sewage treatment includes the following steps:

1. Sedimentation
2. Dilution and
3. Storage

- i. **Sedimentation:** When sewage is allowed to stand, the suspended particles settle at the bottom. So by sedimentation the suspended particles are removed from sewage.
- ii. **Dilution:** The sewage can be diluted with water. This increases the  $O_2$  contents and reduce BOD and  $CO_2$ .
- iii. **Storage:** The diluted sewages stored in a pond. This facilitates the growth of micro-organisms which renders further oxidation of sewage.

### 2. Waste Stabilization Pond or Oxidation Pond

The National Environmental Engineering Research Institute (NEERI) at Nagpur has devised a very economical method for the treatment of industrial and domestic effluents. Domestic and industrial wastes are stored in a dilute condition in shallow ponds called **waste stabilization pond or oxidation ponds**. After a few days micro-organisms and algae flourish. The micro-organisms decompose the organic wastes by **oxidation** and the water is purified. This water is rich in nitrogen, phosphorus, potassium and other nutrients. This water can be used for fish culture, agriculture, etc.

### 3. Recycling

Pollution can be prevented to a certain extent by reutilizing the wastes. This is called recycling. Eg. The dung of cows and buffaloes can be used for the production of gobar gas.

Certain pollutants from industrial effluents can be removed by **filtration** and **selective absorption**. Excessive use of **pesticides** and **herbicides** should be avoided. At the Government level, legislations should be framed to control water pollution.

## NOISE POLLUTION

### Definition

The unwanted high intensity sound dumped into the environment which hampers the normal speaking and causes irritation is called *noise pollution*.

### Sources of Noise pollution

1. **Transport noise** : Road traffic, rail traffic and air traffic are the major causes of noise.
2. **Industrial noise** : Industrial machineries (e.g. compressors, generators, grinding mills, drilling machines) produce noise which affects millions of people. This is known as occupational noise.
3. **Neighbour hood noise** : It includes noise from loud speakers, musical instruments (e.g. drum), radio, TV, washing machines, vacuum cleaners etc.

### Impact of Noise on man

1. Sudden sound raises blood pressure and increases heart beat. This results in hypertension and giddiness.
2. Noise causes nervous breakdown, anxiety, tension and frustration.
3. It causes head ache and aggravates peptic ulcer and asthma.
4. Noise leads to **auditory fatigue** which is characterised by whistling and buzzing in ears.
5. Prolonged exposure to noise leads to hearing loss (deafness).

### Measurement of Noise

Noise is usually measured by i) sound pressure or ii) sound intensity. The sound intensity is expressed in terms of a relative unit called Decibel (dB). It is one tenth of the unit Bel named after Alexander Graham Bell. The faintest sound, a human ear can hear is termed one dB. It is defined as the logarithmic scale relative to a reference sound intensity.

The acceptable noise level in an industrial area in India is 45 - 60 dB. Sound beyond 60 dB causes noise pollution.

### Control of Noise Pollution

1. Industrial workers should use ear protection aids such as soft plastic muffs, rubber ear plugs, headphones etc.
2. Sound absorbing materials like acoustic tiles, hair felt or perforated plywood should be fixed on walls, floors and ceilings of houses.

3. The machineries should be provided with vibration dampers and silencers.
4. Lead shields and barriers in buildings are good for controlling noise pollution.
5. Air horns in automobiles should be prohibited.
6. Use of loud speaker should be banned by law.
7. Low noise emitting vehicles should be designed and used.

### PLASTIC POLLUTION

The undesirable change in the environment caused by plastic is called **plastic pollution**. Plastic is a synthetic resinous substance. It becomes soft on heating . It can be moulded into any shape. Many plastics are **polymers** of simple units. Hence they have **poly** in their names. Eg. **Polyethylene**, commonly called **polythene**, **polyester**, **polystyrene**, **polypropylene**, etc.

Plastics are cheap.

They do not rust like iron.

They are light in weight.

They can be made into any shape or colour.

They do not conduct electricity.

Some plastics are transparent.

They can be drawn into fibres.

Plastics are of two types, namely **thermoplastics** and **thermosets**.

**Thermoplastic** can be remelted and moulded again and again. Eg. Buckets, jugs, etc.

**Thermosets** are hard and they cannot be remelted and remoulded . Eg. Polyester.

### Plastic Articles

In modern days, plastic becomes part and parcel of human life. It becomes an inevitable item. it is used in many fields: Pen , Bangles, Note cover ,Comb, Hair pins, Nylon wire ,Bucket, Polyester cloths Telephone cables, Jug, Water bottles, Chairs, Milk packet, Pencil box, Bags, cover, Soap box, Remote Toys, TV cabinet, Surgical instruments, Carry bag, Switches, Packing materials, Rain coat, Wire insulation, Shoes, Cell phone etc.

### Effects of Plastic Pollution

Plastics are very popular because of their **durability**. A plastic carry bag is handy and very cheap. We use and throw it recklessly. This leads to the accumulation of tremendous quantity of trash (waste) in the environment. Plastic **never decompose**. They remain for a long time in the environment. This leads to ecological degradation and ill effects. High energy ultra violet rays are needed to break down plastic.

The following are the ill effects.

1. When plastics are burnt, they release toxic fumes containing fluoro-carbons. They induce carcinoma (cancer).
2. When plastics are buried, they block the natural supply of **air** and **water** to the soil. This affects plant life.

3. Plastic bags clog the sewage pipes and cause stagnation of sewage. This breeds disease producing germs.
4. They prevent the percolation of water in the soil and this lowers the **water table**.
5. Millions of mammals, birds, reptiles and fish are killed every year by the ingestion of plastic bags.
6. When animals consume plastic bags, alimentary canals get blocked and the stomach becomes bloated. The animal stops eating and dies of starvation.
7. Plastics dumped into the sea kills millions of marine animals and birds.
8. Marine animals often get entangled in the old fishing nets thrown away into the sea.
9. Several species of birds are known to swallow plastic.

### **Control of Plastic Pollution**

1. **Recyclable** plastic should be used.
2. Minimal use of plastics should be encouraged.
3. Used plastics should not be thrown in the garbage. They should be stored separately for disposal.
4. The used plastics should be collected and reused. In India nearly 60% of used plastics has been recycled every year.
5. **Ecofriendly** and **Photodegradable** products should be used. Photodegradable plastics undergo **photolysis** in 3 months when exposed to sunlight. They crumble into powder form.
6. **Biodegradable** plastic can be used. It undergoes biolysis by the action of microbes. The **Biopak Corporation** of Australia has developed a biodegradable plastic called **cambio**.
7. **Legislation** should be framed to control plastic pollution.
8. **Awareness** should be created among the people.

## **GLOBAL WARMING AND CLIMATE CHANGE**

### **Global Warming**

The term “global warming” refers to the increase in the average temperature of global surface air and oceans since about 1950, and to continuing increase in those temperatures. That is, Global Warming is the increase of Earth’s average surface temperature due to effect of greenhouse gases, such as carbon dioxide emissions from burning fossil fuels or from deforestation, which trap heat that would otherwise escape from Earth. This is a type of greenhouse effect.

Earth’s climate is mostly influenced by the first 6 miles or so of the atmosphere which contains most of the matter making up the atmosphere. Global warming is primarily a problem of too much carbon dioxide (CO<sub>2</sub>) in the atmosphere – which acts as a blanket, trapping heat and warming the planet.

As we burn fossil fuels like coal, oil and natural gas for energy or cut down and burn forests to create pastures and plantations, carbon accumulates and overloads our atmosphere. Certain waste management and agricultural practices aggravate the problem by releasing other potent global warming gases, such as methane and nitrous oxide. Carbon dioxide and other air pollution that is



collecting in the atmosphere like a thickening blanket, trapping the sun's heat and causing the planet to warm up.

Over the last century, global average temperature has increased by more than 1°F (0.7°C). The 2001-2010 decade is the warmest since 1880-the earliest year for which comprehensive global temperature records were available. In fact, nine of the warmest years on record have occurred in just the last 10 years. This warming has been accompanied by a decrease in very cold days and nights and an increase in extremely hot days and warm nights.

The continental United States has seen record daily highs twice as often as record daily lows from 2000 to 2009. Of course, land and ocean temperature is only one way to measure the effects of climate change. A warming world also has the potential to change rainfall and snow patterns, increase droughts and severe storms, reduce lake ice cover, melt glaciers, increase sea levels, and change plant and animal behaviour.

## **Climate Change**

Climate change is a reality. Today, our world is hotter than it has been in two thousand years, by the end of the century, if current trends continue, the global temperature will likely climb higher than at any time in the past two million years. Climate change is the single biggest environmental and humanitarian crisis of our time. The Earth's atmosphere is overloaded with heat-trapping carbon dioxide, which threatens large-scale disruptions in climate with disastrous consequences.

We must act now to spur the adoption of cleaner energy sources at home and abroad. Climate change is one of the most serious public health threats facing the nation, but few people are aware of how it can affect them. Children, the elderly, and communities living in poverty are the most vulnerable. Explore our interactive maps to see climate-health threats in your state, actions that are being taken to prepare communities from climate change's serious health threats, and what you can do about them.

Climate change will have a significant impact on the sustainability of water supplies in the coming decades. Climate change is changing our economy, health and communities in diverse ways. Scientists warn that if we do not aggressively curb climate change now, the results will likely be disastrous. Carbon dioxide and other global warming pollutants are collecting in the atmosphere like a thickening blanket, trapping the sun's heat and causing the planet to warm up.

Climate change is a complex phenomenon, and its full-scale impacts are hard to predict far in advance. But each year scientists learn more about how climate change is affecting the planet and our communities, and most agree that certain consequences are likely to occur if current trends continue. In addition to impacting our water resources, energy supply, transportation, agriculture, and ecosystems, the United States Global Change Research Program concludes that climate change also poses unique challenges to human health, such as:

- Significant increases in the risk of illness and death related to extreme heat and heat waves are very likely.
- Some diseases transmitted by food, water, and insects are likely to increase.

- Certain groups, including children, the elderly, and the poor, are most vulnerable to a range of climate-related health effects.

Technologies exist today to make cars that run cleaner and burn less gas, modernize power plants and generate electricity from non-polluting sources, and cut our electricity use through energy efficiency.

## UNIT IV : HUMAN POPULATION AND ENVIRONMENT

Human population is a group of men and women living in a particular area at a given time. The human beings of the World are connected biologically by the act of marriage and interbreeding.

Human population is the most powerful factor which brings about much **changes** in the environment. Because of **Cultural Evolution**, man has acquired certain characters which enable him to alter his environment. Some of his activities disturb the environment.

The over population in cities creates an ecological imbalance which leads to severe environmental crisis and short fall of resources and environmental disturbances. This is not likely for maintaining sustainable environment.

### Effect of Human Population on Environment

The human population has been increasing tremendously in the past few decades. Man has been interfering with the environment and making it worst in some way and at the same time he tries to upgrade the environment. Thus he is doing a **double role** on the environment.

### Problems Related to Population Explosion

The high population density interferes with the environment in the following ways:

**Over Population:** Because of overpopulation, man has occupied a large area of land to build houses for their own use. In urban area, he is building houses at any available space. Further, he has been converting the natural forests into productive forests and agricultural lands to meet his food requirements. Therefore, the total area available for natural vegetation and wild life has been decreasing every year.

Overpopulation leads to **over exploitation** of available **natural resources**, which leads to severe **environmental crisis**.

The human population harvests more timber from the forest. It leads to a **reduction** of the total **forest cover**.

Man creates **roads** and **rails** through agricultural fields, forests, barren areas for **communication** and **transport**. It further reduces the areas available for **production purposes**.

Man has been installing new **industries** to upgrade their **standard** of living. These industries emit **pollutants** in the air, **effluents** in water bodies and **solid wastes** on the land. Thus he takes part in the cause of population.

Man has been burning firewood, coal, cowdung and petroleum oils for cooking, water heating and for generating heat for the industries. These activities release more carbon dioxide in the atmosphere, which results in **green house effect**.

Man is now using **mines** to have enough minerals and coals. As the basic need increase every year, the resources come down year by year. Thus he interferes with **sustainability** of minerals in mines.

Indiscriminate **hunting** of wild animals will lead to **wild life depletion**.

In cities and towns, automobiles emit much sulphur dioxide, which results in **acid rain** that affects land, water, plants and animals.

Development activities of human population cause **noise pollution, thermal pollution, oil**

**pollution, pesticide pollution and radioactive pollution.** Destruction of ecological balance by the willful activity of man is called **ecoterrorism**. This is an **offensive activity** of man that ruins the environment of enemy's country. The ruined environment causes **health hazards** to the people and their **living conditions**. The economy of the country is **crippled**.

### **Involvement of Population in Conservation of Environment**

In recent years, man has understood the various **problems** on the environment due to human activities and their impact on our land, water, oil and wild life. He has been taking steps to **conserve** the **natural resources** and the **environment** for the **future** generations.

The conservation of natural resources and environment involves-

- **Protection of natural resources from over exploitation** to save the life on the earth.
- **Preservation of all the natural resources and the environment** for future.
- **Management** of the natural resources.
- Regulated and limited use of resources so that these resources can be made available for the successive generations.

In recent years, man has been taking the following attempts to conserve the environment:

#### **1. Detection of Threats**

By using **Satellite Remote Sensing** technique, the Nations detect the approaching cyclones, damage due to earthquakes, forest cover, global warming and others. After identification, proper steps are taken to monitor the problem. Man has launched special satellites for remote sensing.

#### **2. Clean Technology**

Clean technology is collection of wastes from the point of origin and treatment of the wastes in a faraway place. It prevents pollution in the first place (point of origin).

#### **3. Pollution Control Equipments**

Pollution control equipments are installed at industrial plants to reduce the exit of smoke, effluents, oils and solid wastes.

#### **4. Rain water Harvesting**

Man has been collecting **rain water** in suitable places to **reduce drought** and shortage of drinking water. Eg. Construction of dams, river bank protection, percolation pits in houses, etc.

#### **5. Data Bases**

Data bases provide readymade information on environment and its conservation when it is required.

#### **6. Afforestation**

**New forests** are created in new areas to increase the forest cover.

#### **7. Biotechnological Inventions**

Many biotechnological inventions make it possible for man to monitor environmental hazards.

## Population Explosion

The rapid increase of human population in a country is called **population explosion**. It results in **higher population density** and rapid **deterioration** of natural resources available in a country. Therefore, human population explosion is said to be the main cause for **environmental degradation**.

According to 1991 census, the population of India was 843.4 million and its growth rate was 23.50%. The census 2018 says that the current population of the country is over 1357 million.

The main reasons for population explosion are the following:

- **High birth rate** in the existing population.
- **Low infant mortality** due to well equipped clinical facilities.
- **Suitable climate** for maximum natality.
- **Poor knowledge about family planning** among the people.

Population explosion can only be prevented by adopting proper **family planning method** that avoids child birth.

## Measures Adopted by the Government to control population Growth

Population explosion is a crucial problem faced by the Nation today. In India population is increasing at the rate of 160 lakhs every year. This population growth is not good for social and economic development of the country. Our Government has adopted several measures to control population growth in our country.

The Government has adopted policies that are aiming at reducing the population growth. The important policies are given below:

- The age of marriage is raised from 15 to 19 for girls and from 18 to 21 for boys. It reduces the reproductive periods of people for decreasing birth rate.
- Population education is arranged for all people, including school children.
- Women's education is arranged via adult education to create awareness about population growth and available measures to control it.
- Awareness is created among people through TV, radio, posters, NGOs and voluntary health workers.
- All methods of contraception are promoted through primary health centres.
- All aspects of family planning and mother and child care are promoted in each blocks:
- All sections of society are made to involve in the population control programmes.
- The **National family welfare programme** was launched in 1952 for reducing birth rate in our country. Oral contraceptives and condoms have been issued to public. In addition to it, sterilization of male and female by vasectomy and tubectomy has been done at free of cost in Primary health centres. Copper-T has also been kept in women as a measure to prevent conception.

## Family Welfare Programme of India

- Family welfare programme is the modern name for **Family Planning Programme**.

- It was started in India in 1949 to perform birth control via oral drugs and surgical methods. In India family planning was officially adopted in the year 1952. India is the first country to take up family planning at national level. India launched the **National Family Welfare Programme** in 1951 under Five Year Plan.
- The aim of family welfare programme is to have a limited family.
- One couple should have only one child.
- This will check human population explosion at the global level.
- When a couple has only one child, the care will be more. The child will get nutritious food, better education, etc.
- Family welfare programme involves the following **contraceptive** methods:
  1. Total abstinence (avoiding sexual contact)
  2. Abstinence during fertile period
  3. Withdrawl
  4. Douching
  5. Condom
  6. Copper T
  7. Tubectomy
  8. Vasectomy
  9. Oral contraceptives

#### **Need for Human Welfare Programme**

1. To check population explosion
2. To have a limited family
3. To maintain an economic standard
4. To limit the number of pregnancies
5. Temporary postponement of pregnancies for the health of the mother.

#### **Environment and Human Health**

Human health is directly related to the environment to which the people get constantly exposed. If the environment is pure and clean, the people living there are safe and healthier. If the environment is not clean and have intensive pollutants, the people being exposed to it will suffer many health problems.

The environment affects human health in two ways-

1. Impacts of pollutants on man
2. Impacts of quality of working environment on man.

#### **1. Impacts of Pollutants on Man**

These are direct effects of environment on human beings. The health hazards are caused by **environmental pollutants** discharged by industries into air and water. In urban areas, the **disease pattern** is mainly linked with deterioration of air and water.

The following are due to environmental pollutants on man:

1. **Mercury** pollution causes Minamata disease.

2. **Acid rain** causes pollution of drinking water.
3. **Ozone depletion** causes **skin cancer**.
4. CO<sub>2</sub> increase leads to **global warming**.
5. Burning of **plastic** causes **cancer**.
6. Atomic explosion causes burning of human beings, livestock and plants.
7. Stagnant pools in villages and cities provide fertile grounds for breeding of vectors that transmit disease causing germs. Eg. Malaria
8. Overcrowding and unhygienic living in cities are the main cause for communicable diseases like **tuberculosis** and **cholera**.
9. By drinking water, polluted with mercury, cadmium and cobalt, the persons acquire severe diarrhoea.
10. Water, polluted with fertilizers, causes **methaemoglobinemia** (breathing troubles in infants)
11. By drinking water, contaminated with DDT, the person suffers from **cancer**, **infertility** and **congenital birth defects**.
12. Noise pollution increases the **blood pressure**, **headache**, **mental stress** and **emotional upsets**. It also reduces the **power of hearing**.
13. Radioactive pollutants cause **genetic defects** and **malformations**.
14. Breathing too much of cadmium particles causes **high blood pressure** and **heart diseases**.
15. Smelling SO<sub>2</sub> cause **vomiting**.

## 2. Impacts of quality of working environment on man

The quality of working environment affects the human health to a considerable extent. Workers in certain occupation suffer from certain diseases very frequently. These diseases are known as **occupational diseases**.

The following are some important occupational diseases prevalent in India:

### **Silicosis**

Thar desert is rich in sandstone which consists of crystalline **silica**. Workers engaged in tunnelling, mining, quarrying or chiselling are exposed to silica dust about 40-48 hours a week. This continuous exposure to silica dust causes **silicosis**.

Silica particles accumulate in the alveoli of lung and cause **suffocation** (difficult to breath). Dust particles enter the cell cytoplasm and causes **cell death**. The disease continues even after the person has stopped working in quarries which leads to **Early disability** and **death**.

### **Petrol Pump Workers**

The people working in petrol pump work for over 8 hours every day and inhale **petrol fumes**. It causes headache, throat congestion, red and tearful eyes, dental decay and suffocation.

### **Persons Working in Pesticide Plants**

Protective equipments such as nose stripe, masks, gloves, coveralls, goggles and boots are

provided to people working in pesticide plants. These people however possess the following symptoms due to poisonous chemicals: Itching and headache, eye irritation, vomiting, sleepiness, fever and stomach cramps.

### **Persons Working in X-ray Department**

People working in X-ray department frequently suffer cataract, bone marrow damage, leukemia, cancer and infertility.

### **Control of Environmental Health Hazards**

In India, the **National Institute of Occupational Health (NIOH)** is constituted in Ahmadabad. By a series of studies this institute recognized the following steps to prevent occupational diseases-

- **Physical conditions** of the working environment such as temperature, humidity, noise, light, radiation, etc. must be suitably adjusted to reduce the particle emission.
- **The Factories Act, 1948** should strictly be followed while inspecting the factories.
- The **habitat** should be **improved** to reduce diseases due to environmental pollutants.



## UNIT V : DISASTER MANAGEMENT

**Disaster** is a sudden or great accident due to flood, earth quake, etc. It leads to heavy loss of money, property and life. Disaster is a natural Phenomenon. It is a natural hazard.

Disaster Management is the handling of the impacts of the natural disasters. It includes:-

- Prediction of the occurrence of natural disasters.
- Prevention
- Protection
- Resettlement
- Rehabilitation, etc.

The following are the natural disasters.

### 1. Flood

Unusual great quantity of water flowing in an area is called **flood**. Flood is a **natural disaster** or natural calamity. Flood is caused by intense and continuous rains, cyclones, failing of dams, melting of ice, high tides, etc. The magnitude of a flood is called **recurrence interval**. The area of low lying ground adjacent to the river subject to flooding is called **flood plain**.

### Types of Flood

Flood is of the following 4 types.

1. River flood
2. Coastal flood
3. Urban flood
4. Ice jam

**River flood** is caused by the overflowing of rivers. It is brought out by continuous and intense and intense rains, hurricanes, etc.

**Coastal flood** is the intrusion of seawater. It is caused by **storms** and **hurricanes** in the sea and also by tidal waves caused by earthquake and volcanoes.

**Urban flood** is due to urbanization. Fields and wood lands are converted into dwelling places, factories, roads, etc. This prevents the normal absorbance of rain water. Hence streets and roads become swift moving rivers.

**Ice jams** block natural running water causing flood.

### Causes of Flood

Flood is caused by the following factors.

1. Prolonged rain
2. Intense rain
3. Ice or debris jam in the river
4. Melting snow
5. Thunder storm
6. Cyclones

7. Landslide
8. Levee (a well built to stop a river from overflowing) failure
9. Urbanization – conversion of fields and woodlands into dwelling places, factories, roads, etc.
10. Dam failure
11. Earthquake
12. Volcanoes

### **Damages caused by Floods**

1. Death of human beings, domestic and pet animals by drowning.
2. Collapse of buildings.
3. Road transport is disrupted.
4. Rails are dislodged.
5. Electric supply is cut off
6. Telecommunication goes off.
7. Soil erosion & landslides.
8. Drainage system fails.
9. Croplands are damaged.
10. Drinking water becomes contaminated.

### **Protective Steps**

1. When there is flood across your way, **stop, turn around and go another way.**
2. Stay away from flooded areas.
3. Move to high grounds.
4. Never try to walk, swim, drive or play in flood water.
5. If you are in a vehicle and become surrounded by water, get out safely and immediately.
6. Beware of snakes, as flood waters wash out snake from their homes.
7. Discuss floods with your family members.
8. Keep certificates, insurance policies, ID cards, documents, etc. in safe-deposit box.
9. Avoid construction of buildings in low lying lands.
10. If your area is flood-borne, raise your furnace, water heater, electric panel to higher floor.
11. Construct levees to stop water entering the buildings.
12. Listen to weather in Radio or TV news during flood times.
13. Store clean water in bottles.
14. Switch off the electric lines.

### **What to Do After a Flood**

1. Seek necessary medical care at the nearest hospital.
2. Help neighbours who may require special assistance.
3. Avoid disaster areas.

4. Continue to listen to weather in radio.
5. Stay out of flooded buildings.
6. Avoid smoking inside the building
7. Wear shoes.
8. Check drainage & water lines.

## 2. Drought

**Drought** is a period of abnormally dry weather. It is period of persistent dry weather causing water scarcity and crop damage. It occurs when annual rainfall is less than **180 mm**. Drought occurs due to change in **climate**. It is a natural **disaster** or natural **hazard**.

### Types:

The drought may be of four types, namely Meteorological drought, Agricultural drought, Hydrological drought and Socio economic drought.

**Meteorological drought** is caused by the failure of precipitation. (rain fall)

**Agricultural drought** refers to the insufficient moisture which results in lack of plant growth and production.

**Hydrological drought** occurs when surface and sub-surface water supplies are below normal.

**Socio economic drought** refers to the situation that occurs when physical water shortages begin to affect people.

### Causes of Drought

1. Failure of monsoon.
2. Deforestation
3. Over exploitation of water.
4. Unequal distribution of water.
5. Total abandonment of traditional water harvesting techniques.
6. Increased pressures of population.

### Impacts of Drought

1. Agriculture is affected.
2. Crops are damaged and food products is affected.
3. Famine.
4. Death of human beings and livestock.
5. Scarcity for drinking water.
6. Conflicts between States in water sharing. Eg. Cauvery river issue.

### Drought Management

1. Construction of dams.
2. Improved forecasting.
3. Drought monitoring.

4. Reducing deforestation.
5. Desilting and deepening of ponds and lakes.
6. Shifting the cropping pattern from high water intensive crops to low water intensive crops.
7. Implementation of water harvesting techniques.
8. Watershed management.
9. Making awareness regarding conservation of water resources.
10. Implementing **drip irrigation** and **sprinklers**.
11. Recharging ground water.

### 3. Earthquake

An earthquake is a sudden shaking of the Earth. Natural earthquakes are caused by **sudden disturbances** in the **tectonic movement** of the **earth's crust**. It is a series of vibrations on the Earth's surface caused by the generation of elastic (seismic) waves due to sudden rupture within the Earth during the release of accumulated strain energy.

The study of earthquake is called **seismology**. The instrument used to record the earthquake is called **seismograph**.

**Richter** is the unit of measurement which shows the intensity of earthquake. The point of origin of earthquake inside the Earth is called **epicenter**. The point on the surface of the Earth vertically above the origin place is called **hypocenter**. **Indian Meteorological Department (IMD)** is concerned with detecting and locating earthquake. Earthquake prediction is not yet scientifically possible. The earthquakes are normally accompanied by volcanoes. **Tsunami** (large wave) is caused by tidal waves due to the **sea bed earthquake**.

#### Do's during Earthquake

- Take shelter under a desk, table, bed or doorway during an earthquake.
- Shut off kitchen gas.
- Keep stock of drinking water, food stuff and first aid arrangements.
- If you are in a moving vehicle, stop and stay in vehicle.
- Heavy objects, glasses should be kept on lower shelf.
- Turn on Radio or TV to get latest information.
- Make plan and preparation for emergency relief.

#### Don't's during Earthquake

- Do not get panic.
- Do not use candles, matches, etc. and do not switch off any electric, mains immediately after an earthquake.
- Do not spread and believe in rumours.
- Do not run through or near buildings during an earthquake.

## Richter Scale

The magnitude of an earthquake is measured by Richter scale. It was devised by **Charles F. Richter** of California. The Richter scale works on the principle of a **pendulum**.

When the Richter is less than 4.9 the effect is **less**.

When the Richter is between 5 and 6.9, the effect is **moderate**.

The effect will be **great** when the Richter is from 7 to 7.9.

When it is 8 and more the effect is **very great**.

The Richter scale measures the forces involved and the effects of the earthquake.

## Destruction Caused by Earthquake

1. Death of **human beings** and **livestock**
2. **Injury** to human beings and domestic animals.
3. **Collapse** of buildings.
4. Damage of **roads, railway lines**, etc.
5. Damage to **electric lines**.
6. Disruption of **telecommunication**.
7. Failure of **dams**.

## 4. Cyclones

**Cyclone** is violent and destructive whirl wind moving round a clam central area. The word 'cyclone' is derived from a Greek word '**cyclos**' meaning coils of a snake. A cyclone is also named as **Tornado, Hurricane, Depression** and **Storm** etc. It is a natural **hazard** or natural calamity. It is an intense **whirl** in the atmosphere with very strong winds circulating around it. It is circulating in **anticlockwise** direction in the Northern hemisphere and in **clockwise** direction in the Southern hemisphere.

The cyclone has a **central low pressure** area. From the centre, the pressure increases outwards. The amount of the pressure drop in the centre and the rate at which it increases outward gives the intensity of the cyclones and the strength of winds. A full grown cyclone has a diameter of 150 to 1000 km and 10 to 15 km high.

The control calm region of the cyclone is called '**eye**'. The diameter of the eye varies from 30 to 50 km. The eye is free from clouds and has light winds. It is a calm area. Around the eye, there is a violent area called **wall cloud region**. The wall cloud region has **gale** (strong winds), thick **clouds, strong rains,, thunder** and **lightening**. Away from the wall cloud region, the wind speed gradually decreases.

The **gale** produced by the cyclone causes confused sea with waves as high as 209 metres. Torrential rains, thunder and lightning join with gale. The sea and the atmosphere are in **chaos** (confusion). The cyclone moves 300 to 500 km in a day. The speed may be 31 to 222 km/hour. The speed of cyclone is usually denoted in knots. One knot is equal to 1.85 km/hour. The sea

becomes turbulent and it surges as high as 12 metres. When the cyclone hits the coast, the sea splashes upto 30 km inland causing heavy destructions.

### **Destructions caused by Cyclones**

1. Cyclones produce strong winds. These generate storm surges. This causes abnormal rise of sea level. Seawater inundates low lying areas of coastal regions.
2. Drowning of human beings and livestock.
3. Erosion of beaches.
4. Destruction of vegetation and soil fertility
5. Damage of roads, buildings, villages and communication system.
6. Loss of property and crops.
7. Disconnection of electricity.
8. River floods.
9. Submergence of low lying areas. In 1964, Thanuskody was swallowed by the sea. The cyclone of 1573 caused the submergence of land between Rameswaram and Tamilnadu.
10. Pollution of drinking water.
11. Formation of fog and problems in air traffic.

## **5. LANDSLIDE**

A landslide is a sudden flow down of a large mass of Earth, rock, mud and debris along the side of a slope. It is a serious **geological hazard**. It is a **natural calamity**.

### **Causes of Landslide**

The landslide is caused by natural and man-made factors.

1. Earthquake
2. Excessive rainfall
3. Snow melt
4. Rapid change in temperature. This can cause alternate shrinking and expansion of soil formations.
5. Deforestation
6. Forest fires – They take away slope vegetation making erosion easier.
7. Mining and Excavation
8. Pumping and draining ground water
9. Over developing hillsides
10. Rapid snow melt.
11. Erosion by rivers
12. Ocean waves and tides
13. Saturation of rock and soil slopes by heavy rains.
14. Excess weight from accumulation of rain.
15. Floods.

16. Steep slopes.
17. Undercutting of banks by rivers.
18. Absence of adequate surface drainage.

### **Types of Landslides**

The landslides are of three types, namely **slides, falls and flows**.

In **slides**, materials move as a coherent block of Earth material. Eg. Rock slip

**Falls** include free fall of materials. Eg. Soil slip.

In **flows**, there is mixing of materials within the moving mass. Eg. Flow of mud, debris.

### **Prevention of Landslides**

1. Drainage facility.
2. Construction of retaining walls.
3. Rearing vegetation.
4. Removing unstable slopes.
5. Slopes should not be overloaded.
6. Sensitive slopes should not be cut out.

### **Damages Caused by Landslides**

1. Drowning and death of human beings.
2. Blocking roads, rails and transport.
3. Blocking of rivers, channels, etc. resulting in floods.
4. Damage to vegetation.
5. Damage to buildings.

### **Tsunami**

Tsunami is a series of water waves caused by the displacement of a large volume of water body. The term Tsunami comes from the Japanese word meaning Harbour Wave. They are also called Seismic Sea Waves.

- In December 26<sup>th</sup> 2004, Indian ocean Tsunami killed approximately 2,30,210 people.
- Earth quake produced Tsunami in Japan's North eastern coast on 11<sup>th</sup> March 2011.

### **Causes:**

1. Earthquake
2. Volcanic eruption under the ocean
3. Underwater explosions
4. Landslides in the ocean
5. Movement of tectonic plates.

### **Effects**

1. Flooding of water.
2. Loss of lives and properties.

3. Uprooting of trees & wipe out of coastal towns.
4. Cause contagious diseases like Malaria & Cholera etc.
5. Contamination of water.
6. Tsunami victims suffer psychological problems.
7. Fishing boats and fish nets are damaged.
8. Corals are damaged.

**Prevention**

1. Forecasting and warning.
2. Tsunami prone area should be identified.
3. Stay away from low lying area and coastal area.
4. Stay out of buildings.
5. Be careful about the electrical system.
6. First aid must be provided to the injured people.
7. Plantation of mangroves and coastal forests along the line.
8. Making the sea wall and flood gate.



## ABOUT THE BOOK

The *Rural Economics: Programs and Policies* is a great book that provides a thorough and understandable explanation of the principles of rural development and the economy in India. The concepts of and approaches to rural development in India, the status of the rural sector, rural credit, rural marketing, theories of rural development, the significance of rural industrialization, the function of industries in rural economies, the characteristics of rural industries, the types of rural industries, the difficulties of rural industrialization, the promotion of rural industries, the issues of rural economic development, and the interdependence between rural and urban areas are all covered in the book. The chapters discuss a range of topics, including the value and significance of rural marketing, rural development plans and programmes, science and technology for rural development, the importance, function, and contribution of scientific and technological inputs, including spatial technologies like the Geographic Information System (GIS), Global Positioning System (GPS), and Remote Sensing (RS), and rural entrepreneurship. 37 chapters make up its structure. The book is hoped to be very helpful to researchers, graduate and postgraduate economics students, rural development students, government executives involved in formulating and implementing policies for rural development, parliamentarians and legislators, researchers, industrialists, and general readers interested in rural development. Additionally, it will help applicants taking a variety of competitive tests, including the I.A.S., I.E.S., C.A., and N.E.T. exams. For the convenience of the students, the essential question bank is given at the end of this textbook. Any suggestions for how to further enhance its operations are highly appreciated.

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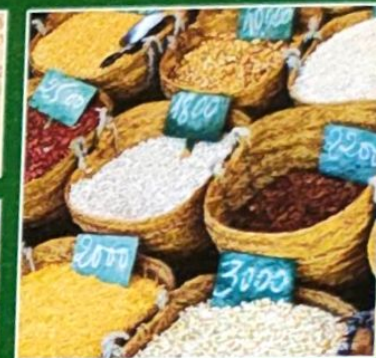
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