DEPARTMENT OF DASH-CHEMISTRY
GE8291- ENVIRONMENTAL SCIENCE AND ENGINEERING

PART – A

UNIT - I / ECOSYSTEM AND BIO-DIVERSITY

1. Define ecosystem
2. Write the scope (or) sigficance of the environmental studies.
3. What is Biome of ecosystem?
4. Difference between food chain and food web.
5. Define ecological succession.
6. Define bio-diversity and its types.
7. What are hotspot biodiversity in India?
8. Define RED data book.
9. Define endemic and endangered species with examples.
10. What is an ecological pyramid?

UNIT - II / ENVIRONMENTAL POLLUTION

1. Define photochemical smog.
2. Write the sources of soil pollution.
3. What is noise pollution?
4. Name the causes and sources of marine pollution.
5. What are the effects of nuclear hazards (or) radioactive pollution?
6. Define thermal pollution.
7. Define $(BOD)_5$ and COD.
8. Define soil pollution.
9. What are landslides?
10. Define 3R.

UNIT - III / NATURAL RESOURCES

1. What are the effects of over exploitation of forest and water?
2. Define timber extraction.
3. What is mining and its types?
4. Define overgrazing.
5. What are renewable and non-renewable energy resources?
6. What is water logging?
7. Define hydrological cycle.
8. Write the composition of bio-gas.
9. Define soil erosion.
10. Define deforestation.

UNIT - IV / SOCIAL ISSUES AND ITS PROBLEMS

1. Define environmental ethics.
2. Define sustainable development.
3. What is wasteland reclamation? And its types.
4. Define consumerism.
5. Difference between nuclear accident and holocaust.
6. Define ECO MARK.
7. What is the bio-medical waste?
8. Write objectives of watershed management.
9. Define ozone layer depletion.
10. What are the urban problems related to the energy?

UNIT - V / HUMAN POPULATION AND THE ENVIRONMENT

1. What is population explosion?
2. Define doubling time of population.
3. What are objectives of family welfare program?
4. Define human rights.
5. Define NIMBY syndrome.
6. Define HIV and AIDS.
7. Write some women welfare program in India.
8. What is value education?
9. What is meant by GIS?
10. Mention any two child welfare program in India.

PART - B

UNIT - I / ECOSYSTEM AND BIO-DIVERSITY

1. Explain the structure, components and function of forest (or) terrestrial ecosystem.
2. Explain the structure, components and function of aquatic (or) river, pond ecosystem.
3. Discuss the various values of bio-diversity.
4. Explain the conservation bio-diversity with in-situ and ex - situ method.
5. Explain the threats (or) causes of bio-diversity.
6. India is a Mega diversity nation with national and global level.

UNIT - II / ENVIRONMENTAL POLLUTION

1. Write the causes effects and control measures of air pollution.
2. Write the causes effects and control measures of water pollution
3. Explain the sources effects and control measures of thermal pollution.
4. Write the causes effects and control measures of noise and marine pollution.
5. Discuss the solid waste management with suitable disposal methods.
6. Discuss the various disaster management (or) natural calamities.

UNIT - III / NATURAL RESOURCES

1. Write causes and ill effects of de-forestation.
2. Discuss the merits and de-merits of construction of big dams.
3. Discuss the effects of modern agriculture using fertilizers and pesticides.
4. Explain the causes and effects of using mineral resources (or) mining.
5. Discuss the any two renewable non-renewable energy resources. (Solar, wind, bio-gas)
6. Explain the individual role of conservation of natural resources.

UNIT - IV / SOCIAL ISSUES AND ITS PROBLEMS

1. Discuss the conservation of water by rainwater harvesting.
2. Explain the causes and effects green house effect and global warming.
3. Explain the causes and effects of acid rain.
4. Discuss with suitable case study of resettlement rehabilitation of environment.
5. Explain the environmental protection act (forest, air, wildlife, water)

UNIT - IV / SOCIAL ISSUES AND ITS PROBLEMS

1. Discuss the population exposition among the various nations.
2. Explain the value education for the betterment of social life.
3. Discuss the role IT in the environmental and human health.
4. Explain the origin and function of HIV/AIDS.
5. Write notes on the various programmes of family and child welfare.

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – **Introduction to biodiversity:** definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – **disaster management:** floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – **Mineral resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies – **Food resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – **Energy resources:** Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies –

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Benny Joseph, _Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, _Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, _Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, —Textbook of Environmental Studiesl, Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, _Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, —Environmental Sciencel, Cengage Learning India PVT, LTD, Delhi, 2014.

UNIT - I
ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

INTRODUCTION:

The word environment is derived from the French word 'environ' which means to encircle or surround'.
Environmental science is the study of nature and the facts about environment.

DEFINITIONS:

ENVIRONMENT

- The sum of total of all living and non-living things around us influencing one another.

ENVIRONMENTAL SCIENCE

- The study of the environment, its biotic (biological) and abiotic (non-biological) components and their interrelationship.

ENVIRONMENTAL ENGINEERING

- The application of engineering principles to the protection and enhancement of quality of the environment and to the enhancement and protection of public health and welfare.

ENVIRONMENTAL STUDIES (or) ENVIRONMENTAL EDUCATION

- The process of educating the people for preserving quality environment.

PRINCIPLES OF ENVIRONMENTAL EDUCATION:

- Examine the major environmental issues
- Discover the root cause
- Develop problem solving skills
- Promote co-operation in solving problems
- Emphasis active participation in prevention and solution to problems

Types of Environment

Environment can be divided into two categories

1. **Natural Environment** – It is characterized by natural components. All biotic and abiotic components are created through a natural process.

   Ex: Soil, water, air, trees, radiation etc.

2. **Man-made Environment**
   Man is the most powerful environmental agent. He modifies the environment using modern technologies.

   Ex: House, road, schools, railway lines, park etc.

Components of the Environment

The environment consists of the following three components

1. Abiotic or non-living components
2. Biotic or living components
3. Energy components

1. Abiotic or non-living components

Physical components

The non-living components of the environment are called abiotic components.

Ex: Air, water, soil and minerals.

These abiotic components enter the body of living organisms directly or indirectly, take part in metabolic activities and then return to the environment.

Types of abiotic components

Abiotic components are sub divided into three categories

i. Atmosphere
ii. Lithosphere
iii. Hydrosphere

i. Atmosphere

- The cover of air, that envelopes the earth, is known as the atmosphere. The atmosphere extends upto 500kms from the earth surface.
- The atmosphere is essential for all living organisms. It comprises 78% of nitrogen, 21% of oxygen and 1% of other gases.

Structure of Atmosphere

Atmosphere consists of following five concentric layers

a) **Troposphere (0-18kms):** It is the lower portion of the atmosphere and extends from 0 – 18kms. It contains 75% of the atmospheric air mass. The temperature of troposphere changes from 15°C to –56°C and the chemical constituents are O_2, CO_2, N_2 and Water (Clouds).

b) **Stratosphere (18 – 50kms):** It lies above the troposphere and extends from 18 – 50kms. The temperature of which changes from –56°C to –2°C and the main chemical constituent is ozone.

c) **Mesosphere (50 – 85kms):** It lies above the stratosphere and extends from 50 – 85kms. The temperature of which changes from –2°C to –92°C. The main chemical constituents are N_2, O_2, O_2^+ and NO^+.

d) **Thermosphere or Ionosphere (85 – 500kms):** It lies above the mesosphere and extends upto 500kms above the earth surface. The temperature of which raise upto 1200°C. It contains the charged particles like O_2^+, O^+, NO^+ etc.

e) **Exosphere:** It is upper most layer of the atmosphere and extends upto 1600km the temperature of which is very high due to direct solar radiation. The chemical constituents are only H_2 and He.

Region with temperature change and chemical species of atmosphere

S. No.	Region	Altitude in km	Temperature change in °C	Chemical species
1	Troposphere	0 – 18	15 to –56	N2, H_2O, CO_2 and O_2.
2	Stratosphere	18 – 50	–56 to –2	Ozone
3	Mesosphere	50 – 85	–2 to –92	N_2, O_2, O_2^+ and NO^+.
4	Thermosphere	85 – 500	–92 to 1200	O_2^+, O^+, NO^+ etc.

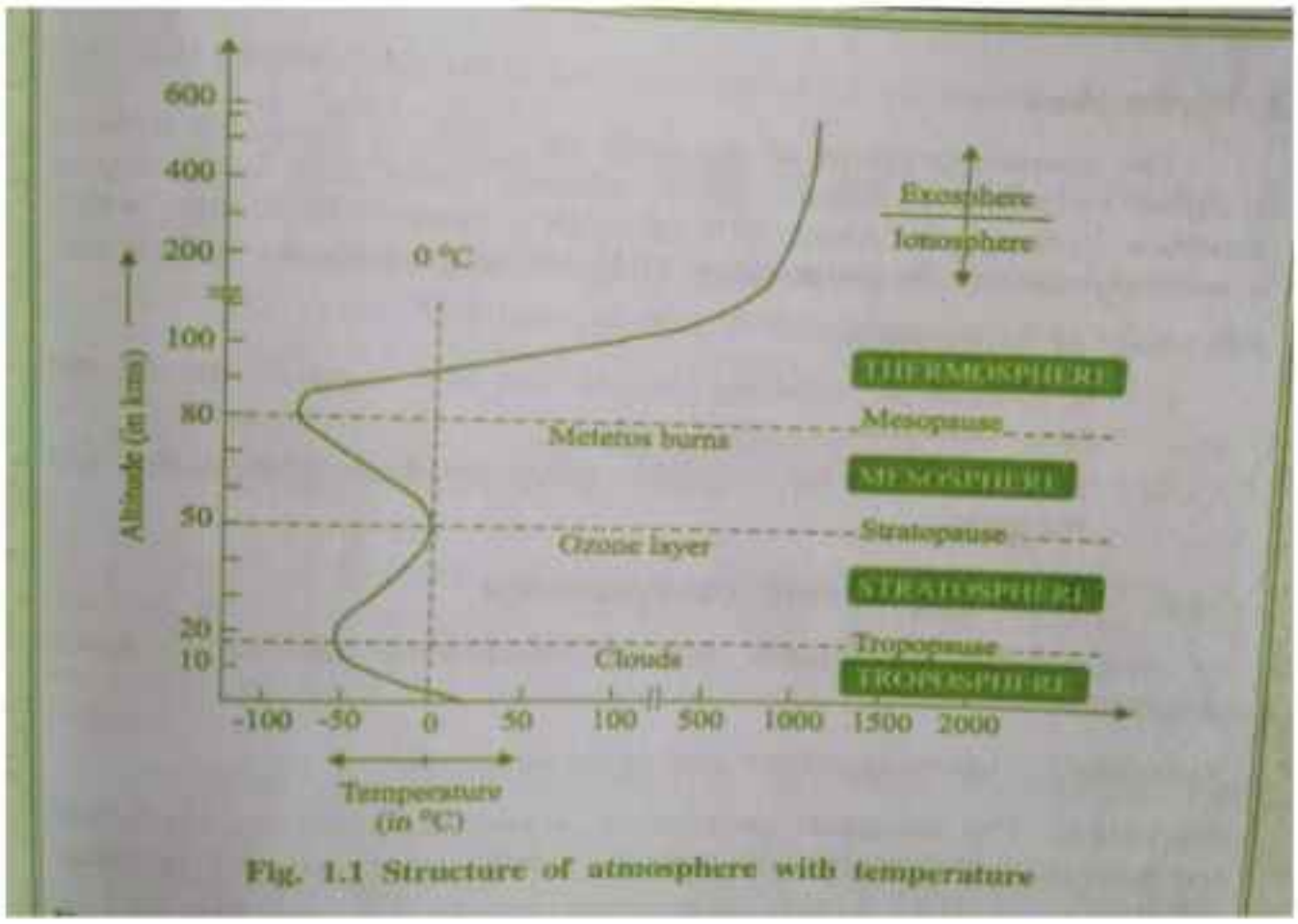


Fig. 1.1 Structure of atmosphere with temperature

Function of Atmosphere

- It maintains the heat balance on the earth by absorbing the IR radiations.
- The gaseous constituents play an important role in sustaining life on earth.

Ex:

- **Oxygen:** Supports life of living organisms.
- **Carbon-dioxide:** Essential for photosynthetic activity of plants.
- **Nitrogen:** Essential nutrient for plant growth.

ii. Lithosphere

The soil and rock component of the earth is called lithosphere.

Function of Lithosphere

- It is a home for human beings and wildlife.
- It is a storehouse of minerals and organic matters.

iii. Hydrosphere

The aqueous envelope of the earth (that is, 75% of the earth surface) is called hydrosphere. Oceans, lakes, streams, rivers and water vapour constitute hydrosphere. About 97% of earth water is in oceans, which is too salty and not fit for drinking. Only 3% is available as fresh water.

Function of Hydrosphere

- It is used for drinking purpose and also supports the aquatic life.
- It is also used for irrigation, power production, industries and transport.

2. Biotic or living components

- The living components of the environment are called biotic components.
- **Ex:** Animals, plants and micro-organisms.

3. Energy component

- The components of energy flow across biotic and abiotic components, which play an important role to maintain the life of living organisms.
- **Ex:** Solar energy, nuclear energy, chemical energy etc.

SCOPE OF ENVIRONMENTAL SCIENCE

- Studying the interrelationship between the components of environment.
- Carrying out impact analysis and Environmental Audit
- Preventing pollution from existing and new industries
- Stopping the use of biological and nuclear weapons
- Managing unpredictable disasters etc.

PUBLIC AWARENESS

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.

Public awareness of environmental issue is at infant stage

- 30-40% of public of developing country are aware of environmental problems, but they do not bother about it.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.
- Debates on environmental Issues are treated as anti-developmental.

ECOSYSTEM

- The term ***ecosystem*** is coined from a Greek word meaning **study of home.**
- It is the basic functional unit of ***ecology.***

Definition:

ECOLOGY

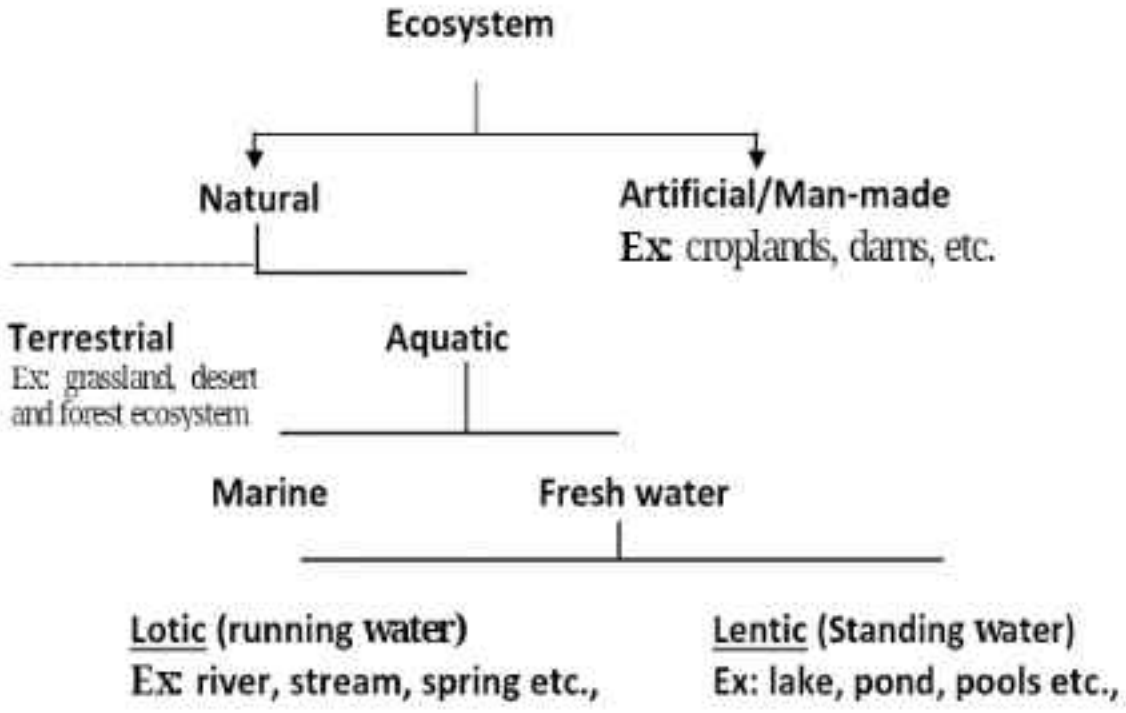
- Ecology is the study of interactions among organisms or group of organisms with their environment.

- Ecology means the **study of ecosystem**

ECOSYSTEM

- An ecosystem can be defined as **a group of organisms interacting among themselves and with their environment.**

TYPES OF ECOSYSTEM



NATURAL ECOSYSTEM

Operates themselves under natural conditions.
Based on their habitat types, it can be further classified into **two types.**

1) **Terrestrial ecosystem**

   Related to **land** vegetation

   Examples : *grassland ecosystem, forest ecosystem, desert ecosystem, etc.,*

2) **Aquatic ecosystem**

   Related to **water** and it is further sub classified into **2 types** based on their salt content.

(i) Fresh water ecosystem

a) Running water ecosystem

Examples : rivers, streams.

b) Standing water ecosystem

Examples : pond, lake.

(ii) Marine ecosystem

Examples : sea and sea shore.

MAN-MADE (OR) ARTIFICIAL ECOSYSTEMS

Operated or maintained by man himself.

Examples: Croplands, Gardens

STRUCTURE (OR) COMPONENTS OF AN ECOSYSTEM

An ecosystem has two major components,
1) Abiotic (non-living) components.
2) Biotic (living) components.

Abiotic (non-living) components

The non-living components of an ecosystem are called abiotic components.
Examples : Climate, soil, water, air, energy, nutrients *etc.*,

Abiotic components are mainly of **two factors.** They are,

1)Physical components **-** It include the energy, climate, raw materials and the living space which the biotic components (living organisms) needs.
Examples –air, water, soil, sunlight, *etc.*,

2)Chemical components **-** These are the sources of essential nutrients.
Examples :
a)Organic substances –Protein, lipids, carbohydrates, *etc.*,
b)Inorganic substances –All micro (Al, Co, Zn, Cu) and macro elements (C, H, O, P, N, K).

Biotic (living) components

The living organisms or the living members of an ecosystem are called biotic components.

Biotic components are classified into **3 main groups** based on their feeding habit.

(i) Producers
(ii) Consumers
(iii) Decomposers

Producers (Autotrophs)

- Synthesize their own food through photosynthesis .

Examples : All green plants, trees etc.

Photo synthesis

$$6CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyll}]{h^{\nu}} C_6H_{12}O_6 + 6O_2$$

Consumers (Heterotrophs)

- Depends on producers for their food

Types of consumers

Consumers are **three types.** They are,

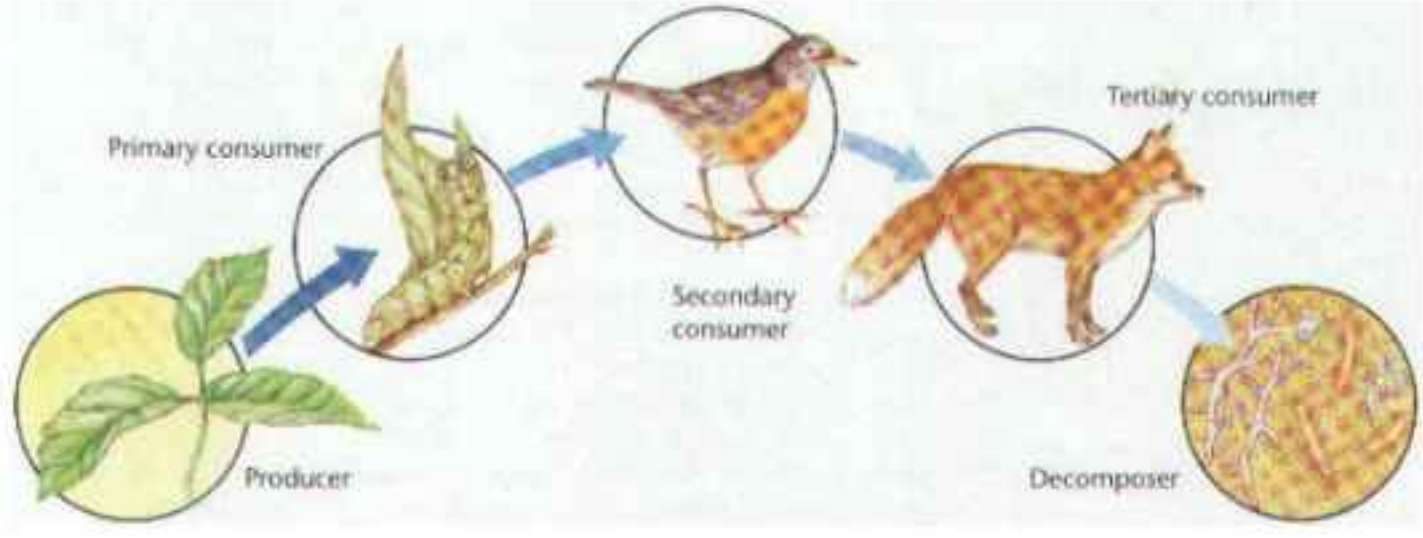
a)Primary consumers **(herbivores) (plant eaters)**
Depends on plants for their food
Examples : insects, rat, goat, horse, cow , etc.,

b) Secondary consumers **(primary carnivores) (meat eaters)**
Depends on primary consumers (herbivores) for their food
Examples : frog, cat, snakes, etc.,

***c) Tertiary consumers* (secondary carnivores) (meat eaters)**
Depends on secondary consumers (primary carnivores) for their food
Examples : tiger, lion, etc.,

Decomposers

- Feed on dead organisms and decompose them into simpler compounds.
- During this process inorganic nutrients are released which are then used by the producers along with other organic nutrients for preparing their own food
- **Examples:** Microorganisms like bacteria and fungi.



FUNCTION OF AN ECOSYSTEM

The function of an ecosystem is to allow flow of energy and cycling of nutrients

Functions of an ecosystem are of **3 types :**

1) Primary function of all ecosystem is manufacture of starch (photosynthesis) .

2) Secondary function is distributing energy in the form of food to all consumers.

3) Tertiary function includes decomposing the dead items and initiates the process of "cycling".

ENERGY FLOW IN THE ECOSYSTEM

- Energy is the most essential requirement for all living organisms.
- **Solar energy** is the only source to our planet earth.
- Of the solar radiations reached the earth's surface, some of which is absorbed by **producers** (plants) to produce organic matter through **photosynthesis.**
- The plants are used by the **herbivores** and the herbivores are used by the **carnivores** as their food.
- Thus the energy enters the ecosystem through photosynthesis and passes through the different tropic levels (feeding levels).
- The conversion of solar energy is governed by the ***law of thermodynamics.***

First Law of Thermodynamics

Energy can neither be created nor destroyed, but it can be converted from one form to another: That is, **solar energy** is converted into **chemical energy** through photosynthesis by plants.

Photo synthesis

$$6CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyll}]{h^r} C_6H_{12}O_6 + 6O_2$$

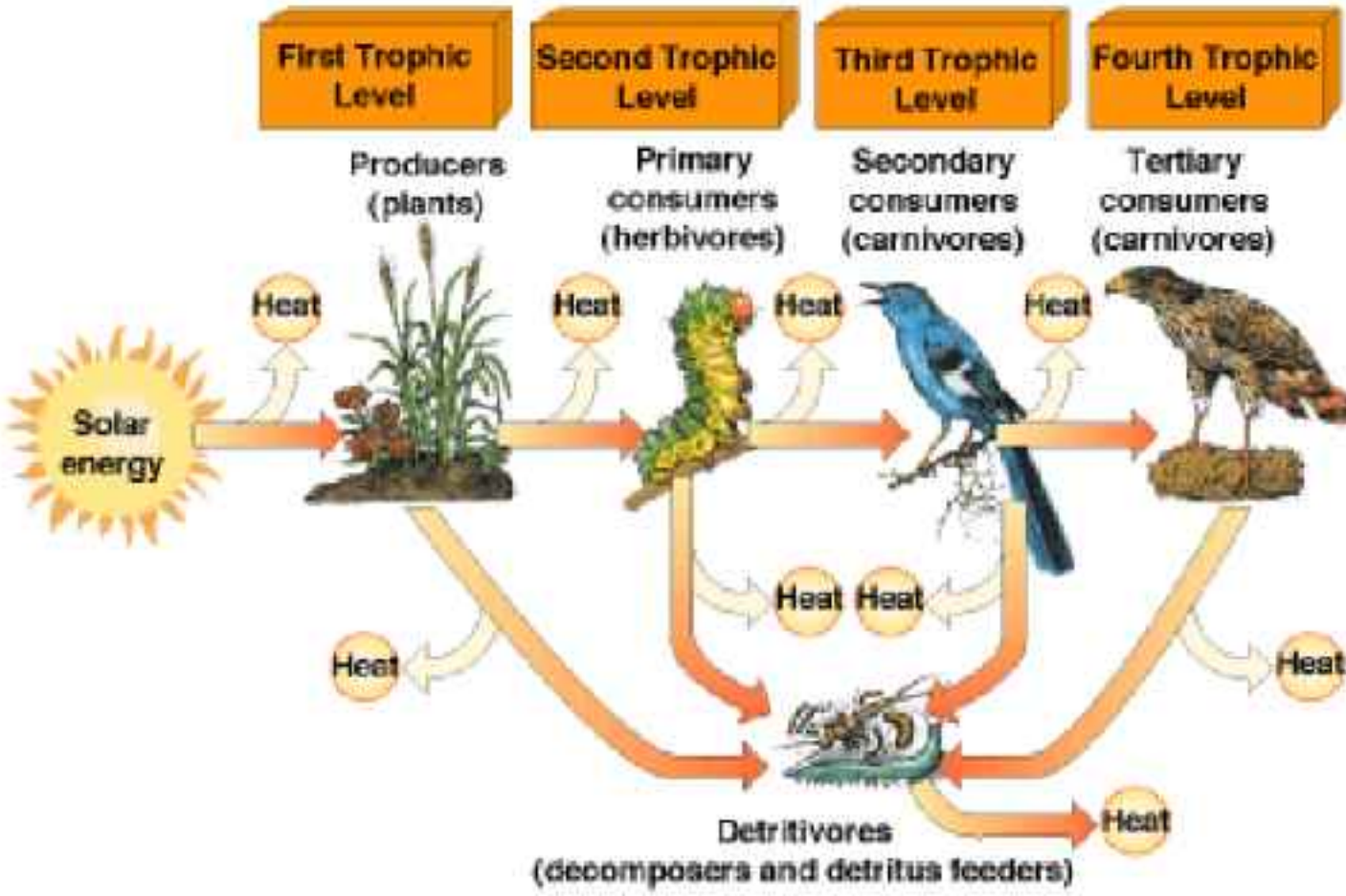
Second Law of Thermodynamics

Whenever energy is transformed, there is a loss of energy through the release of heat.

- This occurs when energy is transferred between tropic levels.
- The loss of energy takes place through respiration, running, hunting, etc.,
- Respiration equation

$$CH_2O + O_2 \longrightarrow CO_2 + H_2O$$

Carbohydrate + oxygen → carbondioxide + water



NUTRIENT FLOW (or) NUTRIENT CYCLING (or) BIOGEOCHEMICAL CYCLE IN THE ECOSYSTEM

Nutrients

Nutrients are the elements which are essential for the survival of both plants and animals.
They are **two types**

Macronutrients

elements needed in large amounts
Examples : C, H, O, N, P and K.

Micronutrients
elements needed in small amounts
Examples : Co, Zn, Cu, Boron & Strontium.

Nutrient cycles
The cyclic flow of nutrients between the biotic & abiotic components is known as **nutrient cycle** or **biogeochemical cycles.**

The major nutrients like C, H, O & N are cycled again & again between biotic & abiotic components of the ecosystem.

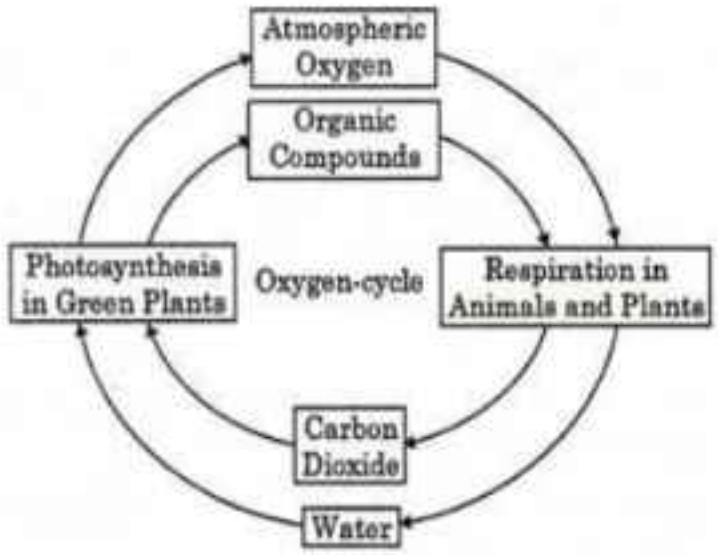
OXYGEN CYCLE

- Oxygen is required for respiration in plants and animals.
- Oxygen enters the body directly from the environment.

Ex: Photo synthesis in plants

- $6CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyll}]{h^{\gamma}} C_6H_{12}O_6 + 6O_2$

- **Cyanobacteria** are important autotroph (self feeder) increase the oxygen content of the atmosphere (21%).
- Oxygen returns to the environment in the form of CO_2 (or) water from living organisms.
- Thus plants "breathe" in CO_2 and "breathe" out oxygen.
- Animals and humans "breathe" in oxygen and "breathe" out CO_2.
- Thus the cycle is completed oxygen is released to the atmosphere by autotrophs during photosynthesis and taken up by both autotrophs and heterotrophs during respiration.



Oxygen-Cycle

- ***Photo synthesis***

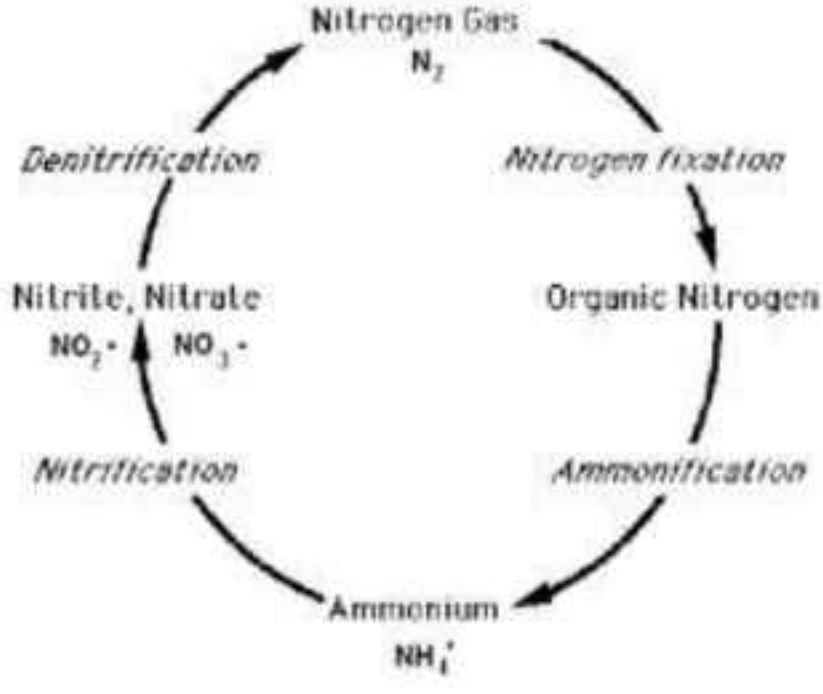
- $6CO_2 + 6\,H_2O \xrightarrow[\text{Chlorophyll}]{h^{\gamma}} C_6H_{12}O_6 + 6O_2$

- **Respiration**

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6\,H_2O + \text{Energy.}$

NITROGEN CYCLE

- Nitrogen is present in the atmosphere as N_2 in large amounts (78%).
- It is present in all biotic components in different forms such as *proteins, vitamins, aminoacids, etc.,*
- It is taken up by the green plants and these move through the food chain.
- After the death of the plants & animals, the organic nitrogen in dead tissues is decomposed by several *ammonifying & nitrifying bacteria* into *ammonia, nitrites & nitrates.*
- Nitrates again converted into molecular nitrogen (N_2) which are again used by the plants.



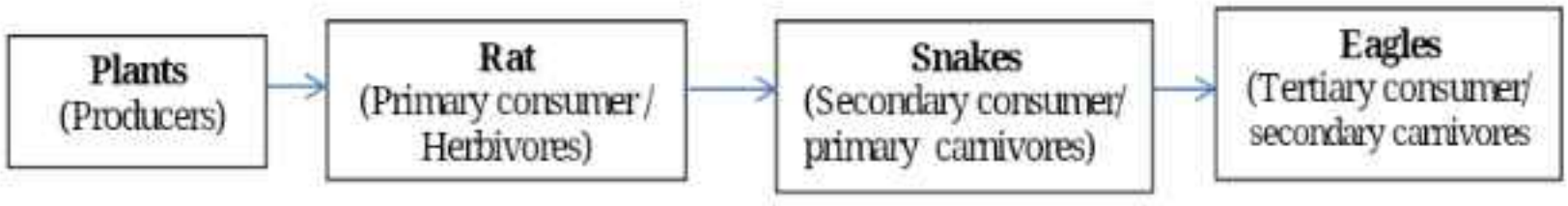
- ***Ammonification*** – conversion of molecular nitrogen into ammonia by *ammonifying bacteria* like *actinomycestes*
- ***Nitrification*** – conversion of *ammonia* into *nitrates* by *nitrifying bacteria* like *Nitrosomonas*
- ***Denitrification*** - conversion of *nitrates* into *nitrogen* by *denitrifying* bacteria like *Pseudomonas*

FOOD CHAIN

The transfer of food energy from one trophic level to next successive trophic level is called food chain.

Examples :

- Food chain in grass land ecosystem



- Food Chain in a forest: Plants →Deer →Tigers/Lions.
- Food Chain in a Pond: Phytoplankton → Zooplankton → Small fist → large fish → Man.

Types of Food Chain:

Grazing Food Chain → starts with green plants & goes to decomposer food chain.
Detritus food chain → starts with dead organic matter & goes to decomposer food chain.

Tropic Levels:

The various steps through which food energy passes in an ecosystem is called as tropic level.

$$T_1 \rightarrow T_2 \rightarrow T_3 \rightarrow T_4 \rightarrow T_5$$

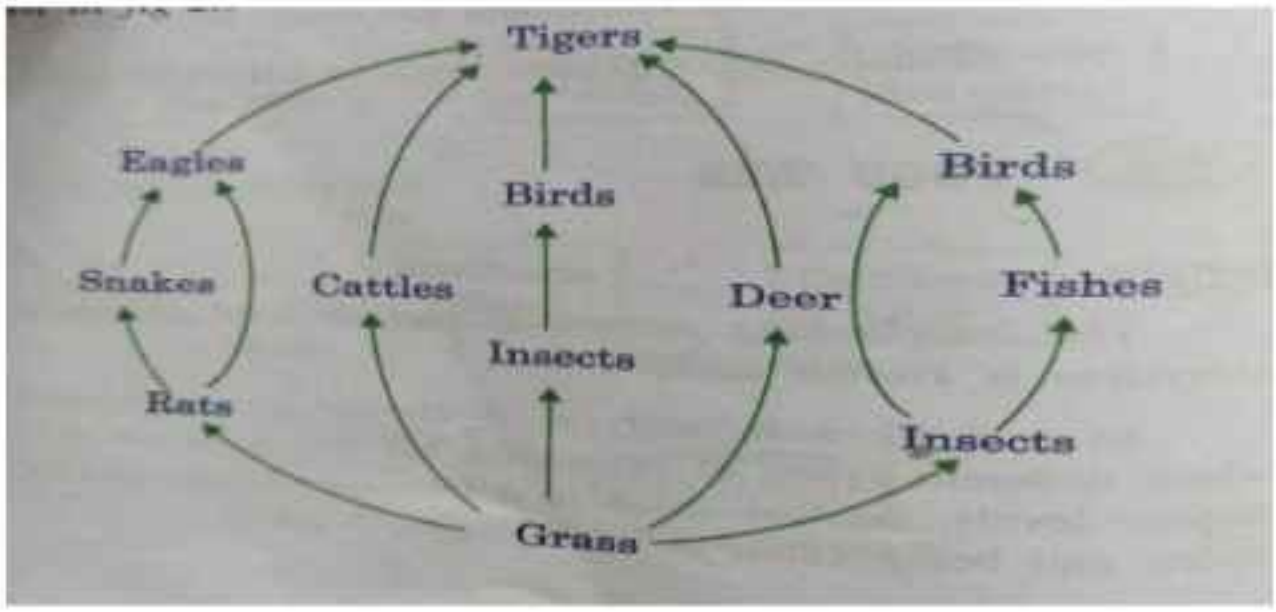
- **T_1 = Producers, T_2 = Primary consumers, T_3 = Secondary consumers, T_4 = Tertiary consumers, T_5= decomposers**

FOOD WEB

The interlocking pattern of various food chains in an ecosystem is called food web. Many food chains are interconnected.

Energy Flow in Food web:

Grass → insects → fishes → birds → tigers
Grass → insects → birds → tigers
Grass → rats→ snakes → eagles → tigers
Grass → rats → eagles → tiger.



Difference between food chain & food web:

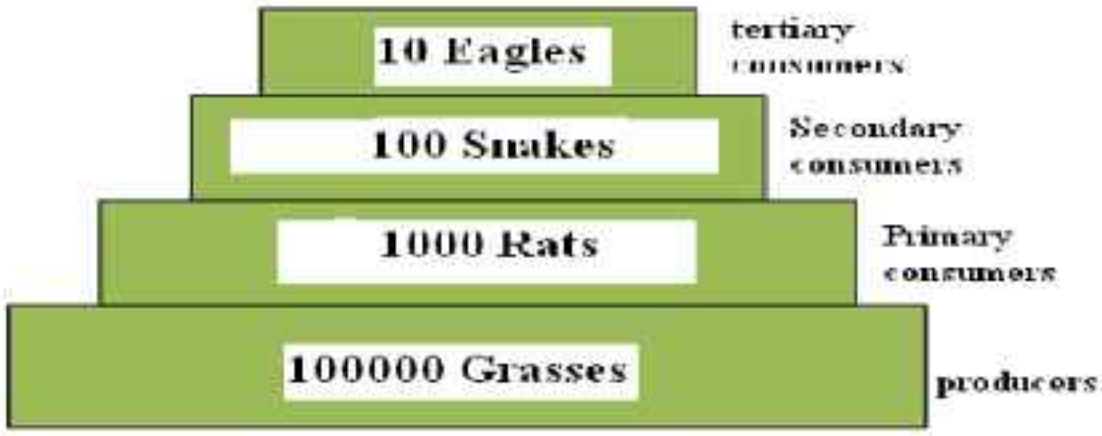
- In food chain, if one species gets affected, then species in all tropic levels are also affected. But in food web if one species gets affected, it does not affect other tropic levels.

ECOLOGICAL PYRAMIDS

Graphical representation of structure and function of tropic levels of an ecosystem is called ecological pyramid.

Types:

Pyramid of Numbers → It represents the number of individual organisms present in each tropic levels.
Ex: A grassland ecosystem



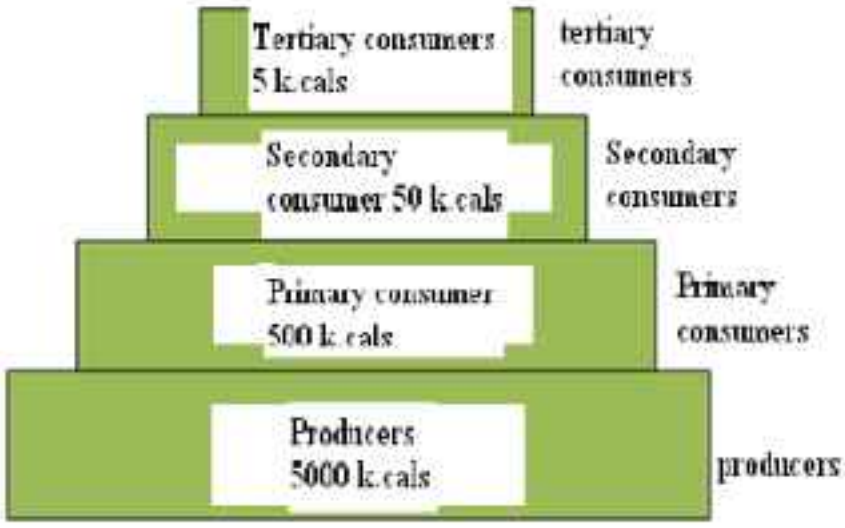
Producer – occupy first tropic level

Primary consumer - occupy second tropic level because number of rats are lower than number of grasses.

Secondary consumer - occupy third tropic level because number of snakes are lower than number of rats

Tertiary consumer - occupy fourth tropic level Number & size is very low.

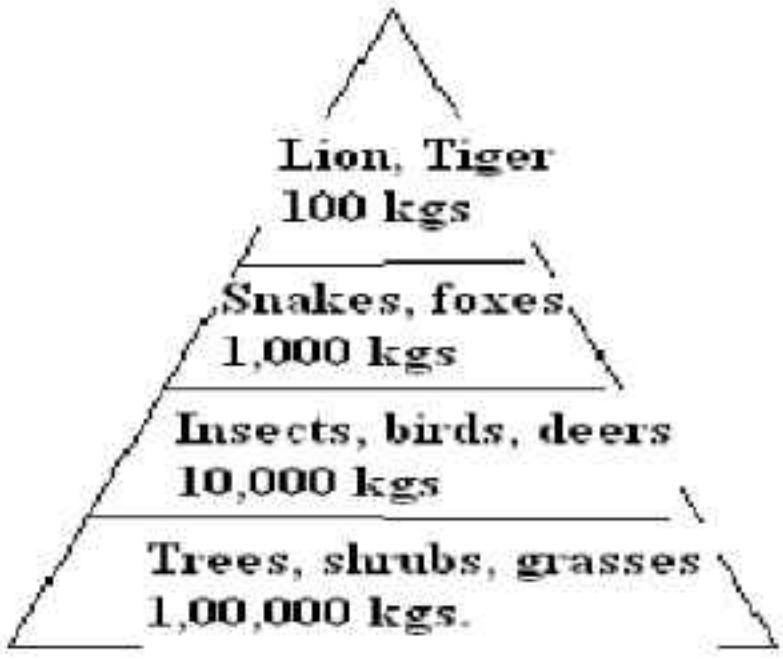
Pyramid of Energy: It represents the amount of energy present in each tropic level.



- At each tropic level there is a heavy loss of energy
- Hence there is a sharp decrease in energy at all level as we move from producers to top carnivores

Pyramid of Biomass

- The amount of living or organic matter present in a particular environment is called biomass.
- There is a decrease in the biomass from the lower tropic level to the higher tropic level



TYPES OF ECOSYSTEMS

FOREST ECOSYSTEM

Introduction: A forest ecosystem is the one in which a tall & dense trees grow which support many animals & birds. In India 19% occupies forest of total land area.

Types of Forest ecosystem:

Tropical rain forests → *found near the equator, high temperature, have broad leaf trees like sandal and the animals like lion, tiger.*

Tropical deciduous forest → *Found away from equator, warm climate, deciduous trees like maple, oak and the animals like deer, fox, rabbit etc.*

Temperate rain forests → *adequate rainfall areas, coniferous trees like pines, firs and the animals like squirrels, fox, cats, bear etc.*

Temperate deciduous forest → *found in moderate temp., trees like oak, hickory and animals like deer, bear etc.*

Tropical scrub forests → *dry climate for longer time, small deciduous trees & shrubs and animals like deer, fox etc.*

Characteristics of forest ecosystem:

- Characterized by warm temperature, adequate rainfall
- Maintain climate & rainfall
- Support many wild animals & protect biodiversity
- Soil is rich in minerals, so support growth of trees
- Penetration of light is poor so conversion of organic matter is very fast

Structure and Function of Forest Ecosystem

I. Abiotic Components → *abiotic components are physical components present in soil & atmosphere*
Ex: *tempereature, light, rainfall, minerals etc.*

II. Biotic Components

1. **Producers** → plants absorbs sunlight & produce food by photosynthesis.
Ex: trees, shrubs, plants

2. **Consumers**

Primary consumers → Called herbivores/plant eaters. → depend on plants for food.
Ex. Insects, flies, mice, deer, squirrels, ant etc.,

Secondary consumers → Called primary carnivores/meat eaters →Depend on herbivores for food
Ex. Birds, snakes, foxes etc.

Tertiary consumers → Called Secondary carnivores → feed on secondary consumers.
Ex. Tigers, lions etc.,

3. **Decomposers** → They decompose the dead plants and animals matter.
Ex. *bacteria & fungi.*



Producers: Different tree species





Consumers in a Forest Ecosystem


Decomposers in a Forest ecosystem

GRASSLAND ECOSYSTEM

Introduction: Occupies 20% of earth's surface. Grass species, shrubs, trees are present.

Types:

Tropical grassland → *High temperature, moderate rainfall, known as Savanna-type. Animal - zebra, giraffe*

Temperate grassland → *found in centers of continents, very cold winters, hot summers, summer fires, no trees or shrubs*

Polar grassland → severe cold, strong wind with ice & snow. Animals -Arctic wolf, fox , small plants grow.

Characteristic of grassland ecosystems

- Plain land occupied by grasses.
- Soil is very rich in nutrients and organic matter.
- Ideal place for grazing animals
- Low or uneven rainfall.

Structure and functions of Grassland Ecosystems

Abiotic Components

Ex. Nutrients in the soil which includes C, H, N, P, S, H_2O, CO_2, Nitrates, phosphates and Sulphates, soil pH, Temperature etc.

Biotic Components

1. **Producers** → They produce food

   Ex: Grasses, shrubs and few trees

2. **Consumers**

   Primary consumers → depend on grasses for their food.

   Ex. Cow, rabbits, sheep, deer,buffaloes etc.,

   Secondary consumers → Depend on herbivores for food

   Ex. Birds, snakes, frogs, foxes etc.

   Tertiary consumers → feed on secondary consumers.

   Ex. Hawks and Eagles etc.,

3. **Decomposers** → They decompose the dead plants and animals matter.

   Ex. *bacteria & fungi.*

Producers: Different grass species

Consumers of Grassland ecosystem

Decomposers in a Grassland ecosystem

DESERT ECOSYSTEM

Introduction : Occupies 35% of our worlds land area.

Types:

1. tropical desert-found in **Africa**-Sahara and **Rajasthan** –Thar
2. temperate desert-**south California**-Majave
3. cold desert-**China**-Gobi desert

Characteristics:

1. Air is dry and climate is hot.
2. Soil is very poor in nutrients and organic matter.
3. Annual rainfall is less than 25 cm.
4. Vegetation is poor.

Structure and functions of Desert Ecosystems

Abiotic Components → Due to high temperature & very low rainfall, the organic substances are poorly present in the soil.

Ex. High temperature & very low rainfall, dry soil etc.

Biotic Components

1. **Producers** → They produce food

   Ex: shrubs/bushes; some grasses & a few trees.

2. **Consumers**

   Primary consumers → depend on grasses for their food.

Ex. Insects, mice, rabbits, and reptile.

Secondary consumers → Depend on herbivores for food

Ex. Lizards and Darkling beetle.

Tertiary consumers → feed on secondary consumers.

Ex. Owls and Eagles etc.,

3. **Decomposers** → They decompose the dead plants and animals matter.

Ex. *bacteria & fungi.*

Producers

Consumers

AQUATIC ECOSYSTEMS

Introduction: Aquatic ecosystem deals with water bodies.

Types: 1. Fresh water life zones → (ex) Ponds, streams, lakes, rivers

2. Salt water life zones → (ex) oceans, estuaries

	FRESH WATER ECOSYSTEMS			**SALT WATER ECOSYSTEMS**	
Factors	pond ecosystem	Lake ecosystem	Stream (or) river	Marine (or) Ocean	Estuarine ecosystem
Introduction	*Small fresh water ecosystem.* Receive enough water during raining season.	*Big fresh water ecosystem.* Receive water during rainfall, melting snow etc.,	*Moving water system.* Usually well oxygenated, because it absorbs oxygen from air.	*It covers about 71% of earth surface.* High concentration of salt and minerals.	*Partially enclosed coastal area at the mouth of a river, where river joins the sea.* Strongly affected by tidal action.
Characteristic	*Pond is temporary, only seasonal.* Water is stagnant. *Polluted easily due to limited amount of water.*	*Shallow fresh water body.* Permanent water body with large water resources. *Helps in irrigation & drinking.*	*Fresh water and free flowing water systems.* Dissolved oxygen content is high. *Deposits large amount of nutrients.*	*Saline water ecosystem.* Occupies large surface area. *Rich in biodiversity.* Low dissolved oxygen content.	*Transition zone strongly affected by tides of the sea.* Water characteristics are periodically change. *The organism have wide tolerance.* Salinity is high in summer and low in winter.
Structure **Abiotic Components**	Temperature, light, pH, water, Organic and Inorganic compounds.	Temperature, light, pH, water, Organic and Inorganic compounds.	Temperature, light, pH, water, Organic and Inorganic compounds.	Temperature, light, NaCl, K, Ca and Mg salts, alkalinity.	Temperature, pH, Na and K salts and various nutrients.

Biotic components					
i) Producers	Rooted plants, floating and suspended lower plants. Phytoplankton (algae, volvox etc. and microphytes (hydrilla, demna etc.)	Phytoplankton, Algae, rooted plants and floating plants.	Green algae, aquatic grasses, aquatic masses, etc.	Phytoplankton, microscopic algae, marine plants etc.	Marsh grasses, seaweeds, sea grasses like algae, phytoplankton etc.,
ii) Consumers					
a) Primary consumers	Zooplankton like protozoans, ciliates, very small fish etc.	Zooplankton like protozoans, ciliates, etc.	Water insects, floating algae etc.	Crustaceans, moiluscs, fish etc.	Oysters, crabs shrimps etc.
b) Secondary consumers	Insects like water beetles and small fish.	Insects and small fish.	Small fish and zooplankton	Herring sahd, mackerel etc.	Sea birds and small fish.
c) Tertiary consumers	Large fish like game fish.	Large fish like game fish.	Larger fishes, fish hunting animals fish hunting birds.	Cod, haddocks etc.	Migratory species like Eels and salomon.
iii) Decomposer	Bacteria, Fungi and actinomycetes.	Bacteria, Fungi and actinomycetes.	Bacteria and fungi.	Bacteria and fungi.	Bacteria, Fungi and actinomycetes.

Ocean ecosystem

ECOLOGICAL SUCCESSION

The progressive replacement of one community by another till the development of stable community in a particular area is called ecological succession.

Stages of ecological succession:

Pioneer community → first group of organism in an area

Seral stage → various developmental stages of community

Types of ecological succession:

Primary succession → involves gradual establishment of biotic communities on a lifeless ground

Hudrarch / Hydrosere → establishment starts in watery area like pond and lake

Xerarch / Xerosere → establishment starts in a dry area like desert and rock

Secondary succession → Involves establishment of biotic communities in an area, where biotic community already present there.

PROCESS OF ECOLOGICAL SUCCESSION

➢ ***Nudation***: development of bare area without any life form.

➢ ***Invasion***: establishment of one or more species on a bare area through migration followed by establishment .

a) Migration: migration of seeds brought about by wind, water or birds.

b) Establishment: the seeds then germinate & grow on the land & establishes their pioneer communities.

➢ ***Competition***: as the number of individual species grow there will be competition between them for space, water & nutrients

➢ ***Reaction***: living organisms take water, nutrients & grow & modify the environment is known as reaction. This becomes unsuitable for some & favour for some species-leads to seral communities

➢ ***Stabilizations***: it leads to stable community, which is in equilibrium with the environment.

BIODIVERSITY

Definition: *The variety and variability among all groups of living organisms and the ecosystem in which they occur.*

Levels /Types / Classification of Biodiversity:

1) Genetic diversity

Diversity within the species is genetic diversity.

Ex: teak wood varieties → Indian teak, Burma teak, malasian teak etc.

2) Species diversity

Diversity between different species.

Ex: Plant species → apple, mango, grapes etc.

Animal species → lion, tiger, elephant etc.

3) Community/Ecosystem diversity → Diversity at the ecological or habitat level is ecosystem diversity.

Ex: River ecosystem. It includes fish, aquatic insects, mussels and variety of plants etc.

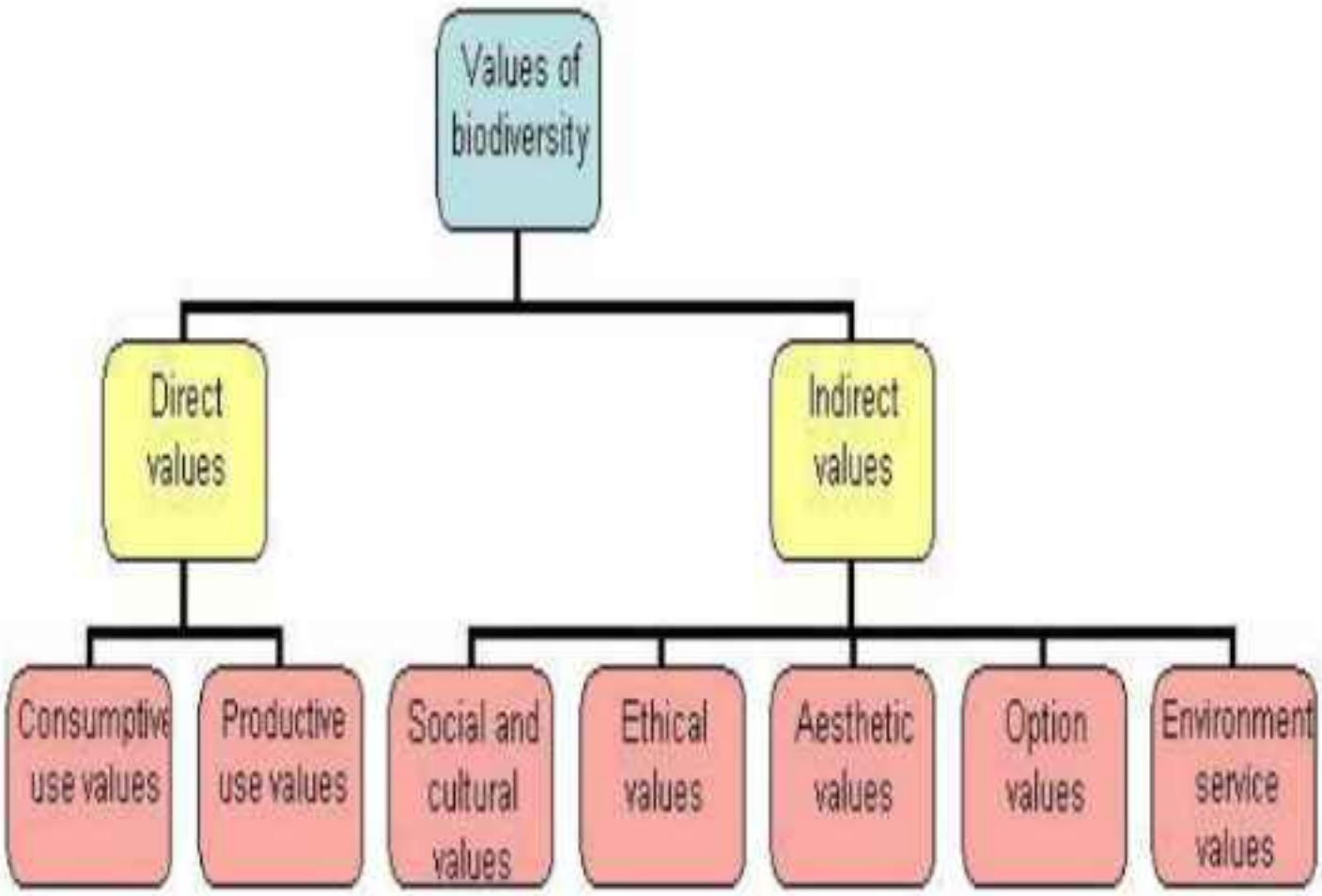
Significance (or) importance of biodiversity

- It provides food, fuel, medicine and industrial products to the human beings.
- Provides fresh air, clean water and productive land.
- Loss of biodiversity leads to poor economy for any nation.

VALUES OF BIODIVERSITY

Few parameters are used to assess the values of biodiversity. They are,

(I) Direct use values and
(II) Indirect use value.



(I) Direct use values of Biodiversity

There are two types

1) Consumptive use values
2) Productive use values

1. Consumptive use values

The biodiversity products are harvested and consumed directly.

Ex: food, drug, fuel etc.

Drugs:

- Many plants are used in primary health care.
- 70% of modern medicines are derived from plant and plant extracts.

Ex: Penicillin – fungus is the source – used as Antibiotic
Quinine – Chincona bark is the source – used in Malaria treatment.
Morphine – Poppy bark – used as Analgesic.

Fuels:
Fire woods are directly consumed by villagers.

Food:
A large number of wild plants and wild animals are consumed by human beings as food.

2. **Productive use:**

- Biodiversity products have commercial value.
- These products are marketed and sold.
- These are derived from animals and plants.

Animal products:

- Silk from silk worm
- Wool from sheep
- Musk from musk deer
- Leather from animals.

Plant Products:

- Wood for paper and Plywood
- Cotton for textile industry
- Pearl for pearl industry.

(II) Indirect use values of biodiversity

1) Social value

- It refers to the manner in which the bio-resources are used in the society.
- These are associated with the social life, religion and spiritual aspects of the people.

Ex: Holy plants : Tulsi, Lotus, Neem trees
Holy animals : Cow, snake, bull, peacock.

2) Ethical value

It means that a species may or may not be used but its existence in nature gives us pleasure.
Ex: Holy river: River Ganga.

Holy tree: Tulsi, Vengai, etc.

3) Aesthetic value

The beautiful nature of plants and animals insists us to protect the biodiversity.
Ex: eco-tourism, colour of butterfly, flowers etc.

4) Optional value

The optional value of biodiversity suggests that any species may be proved to be a valuable species after someday.

Ex: searching species of causing the diseases of cancers and AIDS.

THREATS TO BIODIVERSITY

Any disturbance in a natural ecosystem tends to reduce its biodiversity.
Various threats to biodiversity are:

1. Habitat loss 2. Poaching of wildlife 3. Man – wild animal conflicts.

1. Habitat loss

Loss of population of interbreeding organism is caused by habitat loss.

Factors influencing Habitat Loss:

Deforestation:

- Forest & grasslands are cleared for agricultural lands or developmental projects.
- Many species disintegrate due to loss of natural habitat.

Destruction of wetlands:

- Wetlands are destroyed due to pollution, draining etc.

Developmental activities:

- Construction of dams in forest area and discharge of industrial effluents kill birds & aquatic organisms.

Habitat fragmentation:

- Habitat is divided into small & scattered
- So, many animal & birds are vanishing.

Raw materials:

- For the production of hybrid seeds, wild plants are used as raw materials.

Production of Drugs:

- Pharmaceutical companies collect wild plants for drugs production.
- So, number of medicinal plants is on the verge of extinction.

Illegal Trade:

- Trade on wild life reduces bio-diversity.

2. Poaching of Wildlife :

Killing / Hunting of animals is called poaching.

Types:

Subsistence Poaching- killing animals for surviving.
Commercial Poaching- hunting animals for selling

Factors influencing Poaching:

Human Population: increase in population increases pressure on forest resources.

Commercial activities: Smuggling of wild life products for high profit.

Wildlife products: some wildlife product has high profit. So poachers smuggle it to other countries.

Examples:

- Male gorilla for its body parts
- Blue morpho butterfly – making attractive trays
- Elephant feet – for making Ash trays
- Elephant – for ivory
- Bengal tiger – soled for $1,00,000 in foreign market
- Tribal people hunt for their own survival.

Remedy measures

- Illegal hunting and trade of animals should be stopped immediately.
- Not purchase purse or bag or items made of crocodile skin or python skin.
- Biodiversity laws should be strengthened.

3. **Man-Wildlife conflicts:**

Man and wild animal conflicts arise, when wild life starts causing immense damage and danger to the man.

Examples:

Sambalpur – orissa:

195 humans were killed by elephants.
In retaliation- 98 elephants were killed, 30 injured by villagers.

Kote – Chamrajanagar –Mysore:

Several elephants were killed because of the massive damage done by the elephants to farmers Sugarcane & cotton crops.

Royal Chitwan National Park – Kathmandu

Man-eating tiger killed 16 Nepalese, 4 years child

Sanjay Gandhi National Park – Mumbai

Leopards killed– 14 persons.

Powai – Mumbai

Very recently two men were killed by leopards.

Factors Influencing man-animal conflicts:

- Shrinking of forest compels wildlife to move outside the forest
- Villagers put electric wiring around crops field. This result, Animals suffer pain and attack humans
- Female wildlife attack human if she feels that her new born cubs are in danger.
- Forest department don't cultivate foods for wild animals.
- Cash compensate paid by Government for the damage caused by the wild animals is not enough.
- Garbage near human settlement attracts wild animals.

Remedy measures

- Compensation schemes must be started.
- Agricultural activities should be avoided near the forest area.
- Basic facilities for animals should be arranged within the forest.
- Avoid the developmental activities in the forest area.

CONSERVATION OF BIODIVERSITY

Definition : The management of biodiversity of the biosphere so that maximum benefits are derived by the present generation and substantial potential is preserved for the future generation.

Advantages or Need of Biodiversity:

- Provides benefits to the society such as recreation, tourism etc.
- Drugs, herbs, food and important raw materials can be derived from plants and animals.
- Preserves plants & animals, hence leads to life supporting systems.

Types of conservation of Biodiversity:

- In-situ conservation (within habitat)
- Ex-situ conservation (outside habitat)

IN-SITU CONSERVATION:

- Involves protection of fauna & flora within its natural habitat.
- At present 7 biospheres, 80 National parks and 497 wildlife sanctuaries are available in India.
- These are used for in-situ conservation.

1. Biosphere Reserves:

- Covers area of more than 5000 sq. km.
- Protect species for long time

Ex :	Nanda devi	U.P
	Nilgiri	Kerala, TN, Karnataka
	Manas	Assam etc.

Role of Biosphere reserves:

- Protects endangered species
- Site of recreation & tourism
- Useful for education & research purpose
- Gives long term survival.

Restriction:

- No tourism & explosives are permitted.

2. National Park:

- Covers area of about 100 to 500 sq.kms
- Conserves wildlife & environment

Examples :

Gir National Park	Gujarat
Periyar	Kerala
Sariska	Rajasthan
Ranthambore	Rajasthan
Kaziranga	Assam

Role of National Park:

- For tourism without affecting environment
- Protect, propagate & develop wild life.

Restrictions

- Grazing of domestic animals inside the national park is prohibited.
- All private rights and forestry activities are prohibited within the national park.

3. <u>Wildlife Sanctuaries:</u>

- Conserve animals & Birds only.

Examples :

Mudumalai wildlife sanctuary	Tamil Nadu
Vedanthangal Bird sanctuary	Tamil Nadu
Sultanpur Bird sanctuary	Haryana
Wild Ass sanctuary	Gurajat

Role of wildlife Sanctuaries:

- Protects animals only
- Harvesting of timber
- Collection of forest products.

Restriction : Killing, shooting of wildlife is prohibited.

<u>Merits of In-situ conservation:</u>

- Very cheap & convenient method
- Species adjust to floods, drought, forest fires etc.

<u>Demerits</u>

- Large area is needed.
- Maintenance is not proper due to pollution and lack of staff.

<u>EX-SITU CONSERVATION:</u>

Involves protection of fauna & flora outside the natural habitats.

Role of Ex-situ conservation:

- Maintenance of endangered plant & animal species under controlled conditions
- Preserves more important species.

<u>Methods of Ex-situ conservation:</u>

1. NBPGR

National Bureau of Plant Genetic Resources → uses cryo technique

Cryo Technique: Preservation of seeds, vegetables, fruits, crops, etc by using liquid nitrogen at -196°C.

2.NBAGR :

National Burea of Animal Genetic Resources → preserves semen of bovine animals

3.NFPRCR:

National Facility for Plants Tissue Culture Repository → preserves crops or trees by tissue culture

Merits

- Survival / life span of species increase by special care.
- Species are assured for food, water, shelter etc.
- Endangered species are preserved.

Demerits:

- Expensive method.
- Freedom of wildlife is lost.
- Animal cannot survive in natural environment.
- It can be adopted only for few selected species.

BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVELS

Global Level:

Total living species in the world are about ten million species, but if estimates for insects are correct then it could be around 30 million species. Of which only 1.4 million species are found and given scientific names.

It includes among others about 98% birds, 95% reptiles and amphibians, 90% fish and about 85% higher plants known to exist on this Earth.

Terrestrial Biodiversity

Largest ecological units present in different geographic areas
Ex: Tropical rain forests savannas, desert etc.

Tropical rain forests

- Earths largest storehouse of biodiversity.
- Consists millions of species of plants, insects, birds, amphibians and mammals.
- About 50 – 75 % of global biodiversity lies in these area.
- More than 25% of the world prescription drugs are extracted form plants growing in tropical forest.
- About 70% of cancer fighting chemicals are derived from tropical rain forest area.
- It has been estimated that nearly 1,30,000 flowering plant species are found available. But, till now we know only 1-3%of these plant species.

Temperate forests

- Less biodiversity
- 1,70,000 flowering plants
- 30,000 vertebrates and 2,50,000 other group of species.

Marine diversity

Marine diversity is much higher than terrestrial biodiversity, but it is less known and described.

BIODIVERSITY AT NATIONAL LEVEL (or) INDIA AS A MEGA-DIVERSITY NATION

- India has rich biological diversity of flora and fauna.
- India is second largest nation containing 5% of world's biodiversity and 2% of the earth surface.

Rank of India in biodiversity

India has

- 10th rank among the plant rich countries of the world
- 11th rank among the endemic species of higher vertebrates
- 6th rank among the centres of biodiversity
- 10th rank in diversity of mammals

Mega – diversity

- There are nearly 170 countries in the world and 12 of them contain 70% of our plant's biodiversity
- India is one of the 12 mega diversity countries in the world
- India has 47,000 plants species and 89,500 animal species which is 7% and 6.5% of global flora and fauna respectively
- The loss of biodiversity or endemim is about 33%.

Salient features of Indian biodiversity

- A number of rare species such as the royal Bengal Tiger, Indian elephant, Asian lion of Gir, White tiger of Rewa etc. are exclusively found in the India.
- India has 50,000 known species of insects, including 13,000 butterflies and moths.
- 18% of Indian plants are endemic and 50% of lizards are endemic.
- Number of species of leopards, antelopes, bears and birds are found in India.
- India has a rich endemic flora and fauna. Nearly 33% of the flowering plants, 53% of fresh water fishes, 60% amphibians, 36% reptiles and 10% of mammalian are endemic species in India.
- Several species of mangrove plants and sea grasses are also found in our country.
- India is considered to the centre of origin of 30,000 to 50,000 varieties of rice, mango, turmeric etc.
- More than 2000 medicinal plants are cultivated in India, which can cure many disease
- Indian sandal wood has high commercial value, if it is sold in abroad.
- Indian tobacco has high nicotine content when compared to other tobacco.
- India has 40 breeds of sheep, 22 breeds of goats and 8 breeds of buffalos.
- India consists of more than 80 National parks and 497 Sanctuaries and 7 Biosphere reserves.
- **Example:**

Biosphere Reserve	**Nation**
Nilgiri	Tamil Nadu, Kerala, Karnataka
Nanda devi	Uttar Pradesh
Gulf of mannar	Tamil Nadu etc.

Distribution of species in some Flora and Fauna in India

Bacteria	850
Fungi	23,000
Algae	2500
Fishes	2546
Reptiles	428
Birds	1228 etc.

BIODIVERSITY AT TAMIL NADU (OR) LOCAL LEVEL

- The total geographical areas of Tamil Nadu is 13 millions.
- Average rain fall varies between 900 to 1200mm per annum.

- Rain fall in the range of 3000 – 5000mm per annum occurs in the Western Ghats while the Coimbatore and adjacent areas receive less than 600mm.
- Tamil Nadu has a rich biodiversity which consists of 5 National parks, 20 wildlife Sanctuaries and 2 Biosphere reserves.

Some of the important biodiversity location in Tamil Nadu

1. Anamalai wildlife Sanctuary
2. Mudumalai wildlife Sanctuary
3. Vedanthangal Birds wildlife Sanctuary
4. Guindy National Park
5. Viralimalai Peacock Sanctuary
6. Gulf of Mannar National Park etc.

Details of Biosphere reserves

Nilgiri Biosphere reserves

- Total area : 5520 sq. km.
- Total Plant species : 3475
- Animal species : 530 (100 mammals, 350 birds, 80 reptiles and amphibians)
- Butterflies types : 300 types.

The Gulf of Mannar Biosphere

- First marine Biosphere reserve in Ease Asia
- It has 21 small islands along the west.
- It support over 3600 species of plants and animals etc.

HOT SPOT OF BIODIVERSITY

- **The hot spots are the geographic areas which possess high endemic species.**
- **An area is designated as a hot spot when it contains at least 0.5% of plant species as endemic.**
- There are 25 such hot spots of biodiversity on a global level, out of which **two** are present in India.
- **These are: Indo- Burma (earlier The Eastern Himalayas), The western Ghats & Sri Lanka.**
- These hot spots covering less than 2% of the world's land area are found to have about 50% of the terrestrial biodiversity.

Criteria for determining hot-spots

- The richness of the endemic species is the primary criterion for recognizing hot spots.
- It contain significant percentage of specialized species (0.5% of the global total).
- The site is under threat.
- It should contain important gene pools of plants of potentially useful plants.

Reason for rich biodiversity in the tropics

- The tropics have a more stable climate.
- Warm temperatures and high humidity in the tropical area provide favorable conditions.

E.g. Eastern Himalayas Hotspot

- Geographically these are comprises Nepal, Bhutan and Indo-Burma region.

- Nearly 35,000 plant species are found in Himalayas, of which 30% are endemic species
- The Eastern Himalayas are also rich in wild plants of economic value.
  Examples : Rice, banana, citrus ginger chilli, jute and sugarcane.

The taxol yielding plant is also sparsely distributed in the region.

- 63% mammals are from Eastern Himalayas and
- 60% of the Indian birds are from North East.
- Huge wealth of fungi, insects, mammals, birds have been found in this region.

Western Ghats

- The area comprises Maharastra, Karnataka, Tamil Nadu and kerela.
- Nearly 1500 endemic species are found.
- 62% amphibians and 50% lizards are endemic in Western Ghats.
- Only 6.8% of the original forests are existing today while rest has been deforested or degraded.
- **Some common plants :** Temstroemia japonics, hypericum etc.
- **Some common animals :** Blue bird, lizard, hawk etc.

ENDANGERED & ENDEMIC SPECIES OF INDIA:

Species are classified into various types:

Extinct species → No longer found in the world

Endangered species → A species is said to be endangered when its number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

Vulnerable species → when its population is facing continuous decline due to habitat loss.

Rare species → when it is localized within restricted area.

ENDANGERED SPECIES OF INDIA:

A species is said to be endangered when its number has been reduced to a critical level. Unless it is protected and conserved, it is in immediate danger of extinction.

No of threatened species of India:

Plants	250
Birds	70
Mammals	86
Reptiles	25
Amphibians	3
Fishes	3
Molluscs	2
Insects	50

Important Endangered Species:

Reptiles → Tortoise, green sea turtle, gharial, python
Birds → Peacock, Siberian white crane, pelican, Indian Bustard
Mammals → Indian wolf, red fox, tiger, Indian lion, golden cat, desert cat.
Primates → lion tailed monkey, capped monkey, golden monkey
Plants → medicinal plants, sandal wood tree

RED-data Book = Data book which contains the list of endangered species of plants and animals are called RED-data book.

Factors affecting Endangered Species:

- *Pollution:* Human disposal in nature, which travel through food chain and leads to death
- *Over-exploitation:* over usage of natural resources & poaching leads to extinct of wild life
- *Climate change:* ozone depletion, flood etc., threatens organisms and ecosystem

Remedial Measures:

- CITES – Convention on International Trade in Endangered Species is signed
- 2900 and other 900 endangered species are restricted for trade.

ENDEMIC SPECIES:

- The species, which are found only in a particular region are known as endemic species.
- In India among 47000 species of plants 7000 are endemic.
- Nearly 62% of endemic species are found in Himalayas and Western Ghats

Fauna:

- Animals present in a particular region or period.
- 62% amphibians & 50% lizards are endemic to Western Ghats.
- **Ex:** Monitor lizards, reticulated python, Indian salamander, viviparous toad.

Flora:

- Plants present in a particular region or period
- **Ex:** Sapria himalayana, ovaria lurida, pteridophyta, angiosperms etc.

Factors affecting endemic species:

- Habitat loss, fragmentation and pollution

BIOGEOGRAPHIC CLASSIFICATION OF INDIA

- Our country can be divided into ten major regions based on the geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibians, insects and other invertebrates that live in them.
- Each of these regions contain a variety of ecosystems such as forests, grass lands, lakes, rivers, mountains and hills which have specific plant and animals species.

India's Biogeographic Zones:

- The cold mountainous snow covered Trans-Himalayan region of ladakh
- The Himalayan ranges and valleys of Kashmir, Himachal Pradesh, Uttatkhand, Assam and other North-eastern States.
- The Terrain, the low land where the Himalayan rivers flow into the plains
- The Gangetic and Brahmaputra plains.
- The Thar Desert of Rajastan
- The semi- arid grassland region of the Deccan plateau, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamilnadu
- The North eastern States of India
- The Western Ghats in Maharastra, Karnataka and Kerala
- The Andaman and Nicobar Islands
- The long western and eastern coastal belt with sandy beaches, forests and mangroves.

IMPORTANT UNIVERSITY QUESTIONS

1. ECOLOGICAL SUCESSION – STAGES, TYPES, PROCESS.
2. FOOD CHAIN, FOODWEB AND ECOLOGICAL PYRAMID
3. STRUCTURE AND FUNCTION OF AN ECOSYSTEM
4. ECOSYSTEM – CHARACTERISTIC, STRUCTURE AND FUNCTION OF GRASSLAND, FOREST, DESERT AND AQUATIC ECOSYSTEM.
5. VALUES OF BIODIVERSITY.
6. THREATS TO BIODIVERSITY.
7. CONSERVATION TO BIODIVERSITY.
8. HOTSPOTS OF BIODIVERSITY.
9. INDIA AS A MEGA DIVERSITY NATION
10. TYPES OF BIO DIVERSITY
11. ENERGY FLOW IN THE ECOSYSTEM

Unit II ENVIRONMENTAL POLLUTION

Introduction

- Environmental pollution may be defined as, "***the unfavorable alteration of our surroundings***".
- It is also defined as "The process if discharging unwanted matters into the environment which causes harmful effect to living beings".
- It changes the quality of air, water & land which interferes with the health of humans & other life on earth.
- Pollution may be local, regional, trans-boundary or global. **The agent which causes pollution is called pollutant.**
- Pollutants are of 2 types
- **Biodegradable pollutants**–decompose rapidly by natural processes.
- **Non-degradable pollutants**–do not decompose or decompose slowly in the environment. *The slowly decomposed materials are more dangerous because it is more difficult to remove them.*

Source of pollution

Natural sources
Volcanic eruptions, Forest fire, Decomposition of organic matter etc.
Man – made sources
Industrialization, Over population, Urbanization, Deforestation, Automobiles etc.

Classification of Pollution

The different kinds of pollution that affects the environment are,

1) Air Pollution 2) Water Pollution 3) Soil Pollution 4) Marine Pollution
5) Noise Pollution 6) Thermal Pollution 7) Nuclear hazards.

AIR POLLUTION

Air pollution may be defined as, "***the presence of one or more contaminants like dust, smoke, mist & odour in the atmosphere which are injurious to human beings, plants & animals***".

Sources of Air Pollution

The sources of air pollution are of 2 types,

Natural sources

Volcanic eruptions, Forest fires, Biological decay, Wind dust blown etc.

Man – made sources

- Industries – emit various gases like SO_2 NO_2 etc.
- Automobiles – emit hazardous pollutants
- Advanced agricultural technique, Thermal power plant, Fossil fuel burning etc.

Classification of Air Pollutants

1. **Primary air pollutants** - emitted directly in the atmosphere in harmful form of ***CO, NO, SO_2, etc.,***

Indoor air pollutants - *They are primary air pollutants.* The most important indoor air pollutant is ***radon gas.***

2. **Secondary air pollutants** - Some of the primary air pollutants may react with one another or with the basic components of air to form new pollutants. They are called as ***secondary air pollutants.***

Common air pollutants, sources & their effects:

Substance	Sources	Health effects	Environmental effects
Carbon monoxide (CO)	Cigarette smoking, incomplete burning of fuels, motor vehicle exhaust	Causes headaches, anemia, coma, irreversible brain cell damage & death	Increases the globe temperature
Nitrogen dioxide (NO_2)	Fuels burning in vehicles, industrial plants	Lung irritation & damage	HNO_3 acid deposition damage trees, soils, & aquatic life. It corrode metals, stones on buildings, statues, monuments etc.
Sulphur dioxide (SO_2)	Burning of coal, industrial process	Breathing problems	Reduce visibility, acid deposition on trees, soils & aquatic life
Suspended particulate matter (SPM)	Burning coal in industries, diesel in vehicles, agriculture, unpaved roads, etc.	Nose & throat irritation, lung damage, bronchitis, asthma, cancer	Reduce visibility, acid deposition, H_2SO_4 droplets damage trees, soils & aquatic life
Ozone (O_3)	Nitrogen oxides, chemical reaction with volatile organic compounds	-	Moderates the climate
Photochemical smog	Formed due to chemical reaction among nitrogen oxides & hydrocarbon	Breathing problems, cough, eye, nose & throat irritation, heart diseases, etc.	Damage plants & trees. Smog reduce visibility
Lead (Pb)	Paint, smelters, lead manufacture, storage batteries, leaded petrol	Brain & nervous system damage, mental retardation in children, digestive & other health problems, cause cancer	Can harm wild life
Chromium	Paint, smelters, chromium manufacture, chromium plating.	Perforation of nasal septum, chrome holes, ulcer, central nervous system disease, cancer.	

Effect of air pollution on Plants

- SO_2 bleaches the leaf surface and cause chlorosis (That is, loss of chlorophyll and yellowing of the leaf especially in leaf vegetables).
- NO_2 causes premature leaf fall and suppresses the growth of plants resulting in reduced yields of crop plants.
- PAN causing premature fall of leaves, decolouration and curling of sepals.

Effect of air pollution on materials : Corrosion, abrasion, chemical attack etc.

Effect of air pollution on climate : Acid rain, Greenhouse effect, Ozone layer depletion etc.

Control Measures

Source control

- Use only unleaded petrol
- Use fuels that have low sulphur and ash content
- Plant trees along busy streets because they remove particulates and carbon monoxide and absorb noise.
- Industries and waste disposal sites should be situated outside the city Centre.
- Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.
- Houses, schools, restaurants & park should not be located on busy street.
- Reduce the number of private vehicles on the road & encourage people to walk or use cycles.

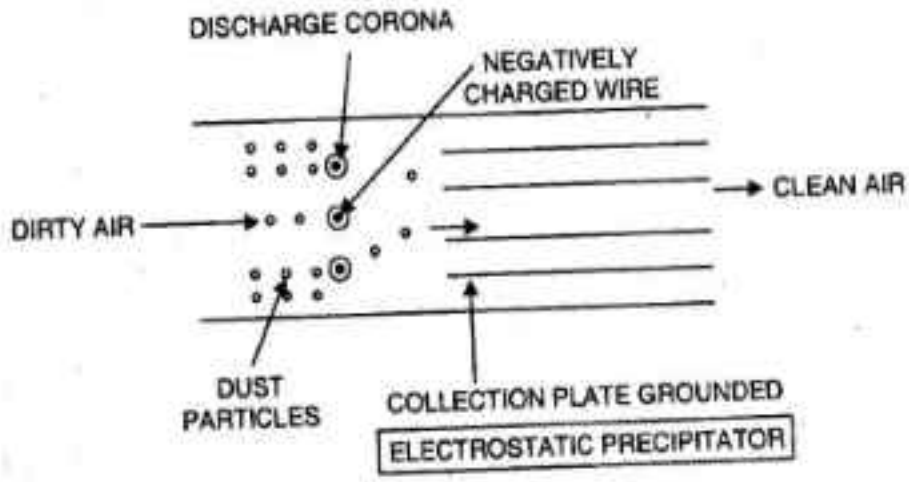
Control measures in Industrial centers

- Emission rates should be restricted to permissible levels.
- Air pollution control equipment's must be made mandatory.
- Continuous monitoring of the atmosphere to know the emission level.

***Equipment's used to control air* pollution:**

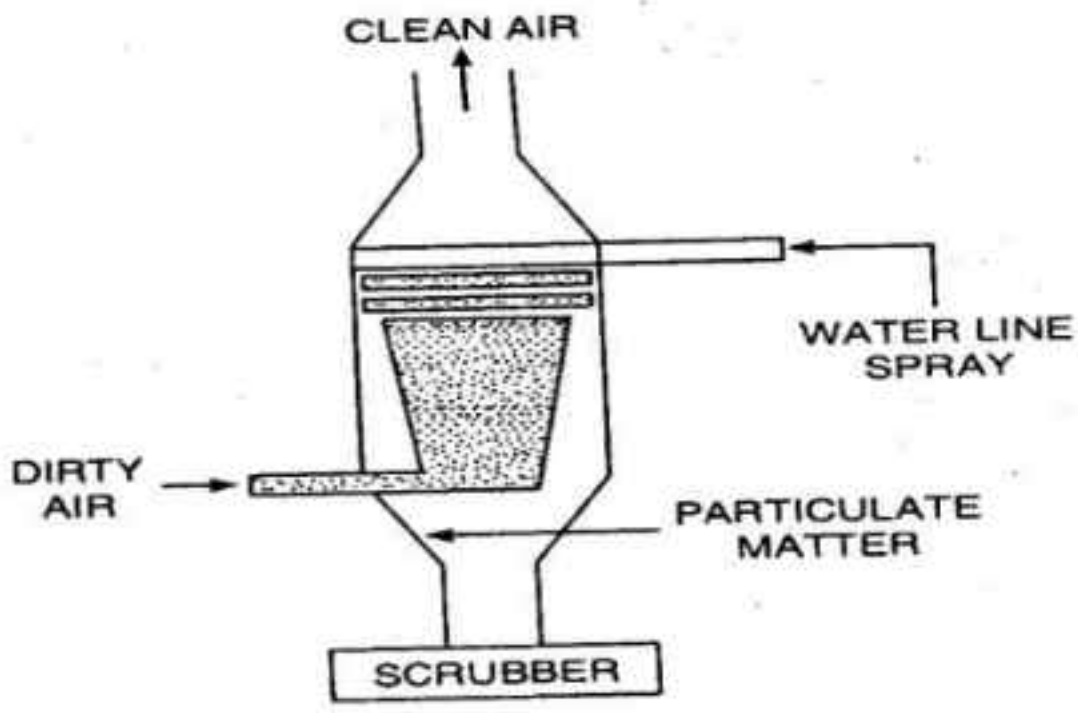
- To ensure sufficient supply of oxygen to the combustion chamber & adequate temperature so that combustion is complete, eliminating much of the smoke consisting of partly burnt ashes & dust.
- To use mechanical devices such as (i) Scrubbers, (ii) Cyclones, (iii) Bag houses and (iv) Electrostatic precipitators are reducing particulate pollutants.
- The above four methods are commonly used control methods for removing particulates from the exhaust gases of electric power & industrial plants.
- All these methods retain hazardous materials that must be disposed of safely.
- The wet scrubber can also reduce SO_2 emissions.
- The disposal of the collected air pollutants is equally important for successful control of air pollution.
- **Catalytic converter:** Automobiles need to be well maintained so that they do not emit much pollutants. Catalytic converters, having expensive metals namely platinum-palladium and rhodium as the catalysts, are fitted into automobiles for reducing emission of gases.

- **An electrostatic precipitator:** It removes over 99% particulate matter present in the exhaust from a thermal power plant. It has electrode wires and a stage of collecting plates. The electrode wires are maintained at several thousand volts, which produce a corona that releases electrons. These electrons attach to dust particles and give them a net negative charge within a very small fraction of a second. The collecting plates are grounded and attract the charged dust particles. The velocity of air between the plates must be low enough to allow the dust to fall.



Electrostatic precipitator

Scrubber: A scrubber can remove gases like sulphur dioxide. In a scrubber, the exhaust is passed through a spray of water or lime. Water dissolves gases and lime reacts with sulphur dioxide to form a precipitate of calcium sulphate or suiphite.



CHEMICAL COMPOSITION OF ATMOSPHERIC AIR

- The air that covers the earth is called atmosphere.
- It contains 21% of O_2 which is essential for living organism.

Constituent's	%
Nitrogen	78
Oxygen	21
Argon	<1
CO_2	0.032
Water vapour	remaining
O_3, He, NH_3	Trace amount.

WATER POLLUTION

It may be defined as "the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on human and aquatic life.

Types, Effects and Sources of Water pollution.

1. ***Infectious agents:***

Example: Bacteria, viruses, protozoa and parasitic worms.

Sources: Human and animal wastes.

Effects: Variety of diseases.

2. ***Oxygen demanding wastes:***

Example: Animal manure and plant debris that can be decomposed by aerobic bacteria.

Sources: Sewage, paper mills, and food processing facilities.

Effects: Wastes can degrade quality by depleting water of dissolved oxygen, make aquatic life to die.

3 .In organic Chemicals:

Example: Water soluble inorganic chemicals.

(i) ***Acids***

(ii) Compounds of toxic metals such as lead, arsenic and selenium.

(iii) Salts such as NaCl in water.

Sources: Surface runoff, industrial effluents, household cleansers

Effects:

- Skin cancers & neck damage
- Damage nervous system, liver & kidneys
- Lower crop yields

- Harm fish & other aquatic life
- Accelerate corrosion of metals

4. Organic Chemicals:

Examples: Oil, gasoline, plastics, pesticides, cleaning solvents and detergents.

Sources: Industrial effluents, household cleansers and runoff from farms.

Effects: Causes nervous system damage, cancer, harm fish & wild life.

5. Radio active materials:

Example: radioactive isotopes of iodine, radon, uranium,cesium,and thorium

Sources: Nuclear power plants, mining and nuclear weapons production.

Effects; genetic mutation, birth defects, and certain cancers.

6.Heat (Thermal Pollution)

Examples: Excessive heat

Source: Water cooling of electric power plant, Industrial plants etc.,

Effects: Lower the Dissolved Oxygen, affect the fish and other aquatic organism due to thermal shock.

7. ***Point and non-point sources of water pollution***

Point sources: These are discharged pollutants at specific locations through pipes, ditches orsewers into bodies of surface water.

Ex: factories, sewage treatment plants, underground mines and oil tankers.

Non-point sources: They are usually large areas or air shed that pollutes water by runoff. Location of which cannot be easily identified.

Ex: runoff of chemical from cropland to surface water.

Control measures of water pollution

- The administration of water pollution control should be in the hand of state or central government.
- Scientific techniques are needed to control pollution in river, ponds or streams.
- Industrial plants should be based on recycling operations.
- The national goal should be "conservation of forests" and campaign should be "plant more trees".
- Wastewater should be properly treated to reduce the BOD, COD levels up to the permissible levels for discharge.
- Awareness to public through radio, TV, etc.,
- Limited use of agrochemicals like pesticides and fertilizers can be reducing the runoff and leaching.

- The possible of reuse or recycling of waste material should be encouraged.
- Companies should not discharge any type of waste either treated or untreated into rivers, lakes, ponds etc.
- Suitable laws, standards and practices should be framed to regulate pollution.

Testing of river water:

Dissolved oxygen (DO) = It is the amount of oxygen dissolved in a given quantity of water at a particular pressure & temperature.

Biochemical Oxygen Demand (BOD) = It is the amount of oxygen required for the biological decomposition of organic matter present in the water

Chemical Oxygen Demand (COD) = It is the amount of oxygen required for chemical oxidation of organic matter using oxidizing agent like $K_2Cr_2O_7$ & $KMnO_4$

REQUIREMENTS OF DRINKING WATER

- It should be colourless and odourless.
- It should be pleasant taste
- Not turbid
- Free from dissolved gases like H_2S, CO_2 and NH_3.
- Free from toxic substances like Pb, Ar, Cr, and Mn salts.
- Total dissolved solids should be less than 500 ppm.
- Free from harmful pathogenic bacteria and suspended impurities.
- Less alkaline in nature
- pH is 6.5 – 8.5.

WATER TREATMENT PROCESS

WASTE WATER (OR) SEWAGE WATER TREATMENT

The main **objectives** of waste water treatments are,

1) to convert harmful compounds into harmless compounds.

2) to eliminate the offensive smell.

3) to remove the solid content of the sewage.

4) to destroy the disease producing microorganisms.

The sewage (or) waste water treatment process involves the following steps,

- Preliminary Treatment
- Primary Treatment (or) Settling process
- Secondary (or) Biological treatment
  a)Trickling filter process
  b)Activated sludge process

- Tertiary treatment
- Disposal of sludge

Preliminary treatment

- Coarse solids & suspended impurities are removed by passing the waste water through bar and mesh screens.

Primary treatment (or) settling process

- Greater proportion of the suspended inorganic & organic solids are removed from the liquid sewage by settling.
- To promote quick settling coagulants like alum, ferrous sulphate are added.
- These produce large gelatinous precipitates, which entrap finely divided organic matter & settle rapidly.
- $Al_2(SO_4)_3 + 6H_2O$ ----------> $2Al(OH)_3 + 3H_2SO_4$

Secondary (or) Biological treatment

- Biodegradable organic impurities are removed by aerobic bacteria.
- It removes upto90%of the O_2 demanding wastes.
- This is done by *trickling filter (*or) *activated sludge process.*

Trickling filter process

- It is a circular tank & is filled with either coarse or crushed rock.
- Sewage is sprayed over this bed by means of slowly rotating arms.
- When sewage starts percolating downwards, microorganisms present in the sewage will grow on the surface of the filtering media, using organic material of the sewage as food.
- After completion of aerobic oxidation, the treated sewage is taken to the settling tank & the sludge is removed.
- This process removes about 80-85% of BOD.

Activated sludge process

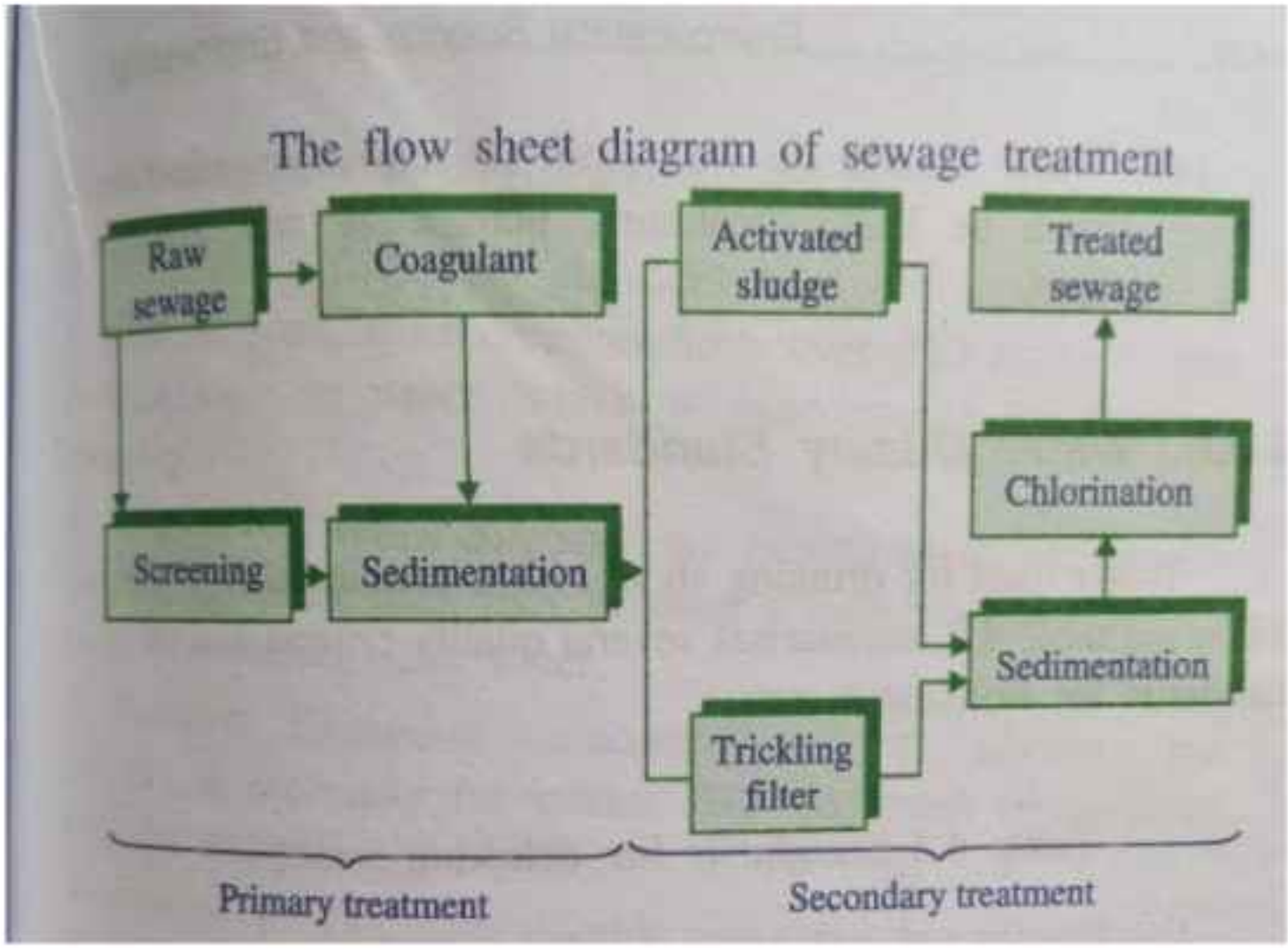
- Activated sludge is biologically active sewage & it has a large number of aerobic bacteria's, which can easily oxidise the organic impurities.
- The sewage effluent from primary treatment is mixed with the required amount of activated sludge.
- Then the mixture is aerated in the aeration tank.
- Under these condition, organic impurities of the sewage get oxidized rapidly by the microorganisms.
- After aeration, the sewage is taken to the sedimentation tank.
- Sludge's settle down in this tank, called activated sludge.
- A portion of it was used for seeding fresh batch of the sewage.
- This process removes about 90-95% of BOD.

Tertiary treatment

- The effluent is introduced into a flocculation tank, where lime is added to remove phosphates.
- From here, the effluent is led to ammonia stripping tower, where pH is maintained to 11 & the NH_4 ions is converted to gaseous NH_3.
- Then the effluent is allowed to pass through activated charcoal column, where minute organic wastes are adsorbed by charcoal.
- Finally the effluent water is treated with disinfectant (chlorine).

Disposal of sludge

- This is the last stage in the sewage treatment.
- Sludge formed from different steps can be disposed by,
  1) Dumping into low-lying areas
  2) Burning of sludge (incineration)
  3) Dumping into the sea
  4) Using it as low grade fertilizers.



SOIL POLLUTION

It may be defined as "the contamination of soil by human and natural activities which may cause harmful effects on living beings".

Sources and effect of soil pollution

1. Industrial wastes

Sources: Pulp and paper mills, chemical industries, oil refineries, sugar factories, tanneries, textile, steel, fertilizers etc.

Effects: * Affect and alter the chemical and biological properties of soil.
* Hazardous chemicals enter into human food chain from the soil and finally lead to serious effects.

2. Urban wastes

Sources and effects: Plastics, Glasses, metallic cans, fibers, papers, rubbers, street sweepings, and other discarded manufactured products. These are also dangerous.

3. Agricultural practices

Sources and effects: Huge quantities of fertilizers, pesticides, herbicides, and weedicides are added to increase the crop yield. Apart from these farm wastes, manure, slurry, are reported to cause soil pollution.

4. Radioactive pollutants

Sources and effects: These are resulting from explosions of nuclear dust and radio active wastes penetrate the soil and accumulate there by creating land pollution.

5. Biological agents

Sources and effects: Soil gets large quantities of human, animal and birds excreta which constitute the major source of land pollution by biological agents.

Other Effects of Soil Pollution

- Food shortage
- Desertification
- Decrease in the extent of agricultural land
- Top soil erosion
- Excess use of irrigation leads to waterlogging and soil salinization.

Control measures of soil pollution

- Forestry and farm practices are used to control the soil erosion
- Trees may be planned on barren slopes
- Reducing deforestation and substituting chemical manures by animals waste would help to increase the soil productivity.
- Proper dumping of unwanted materials

- Production of natural fertilizers
- Proper Hygienic condition
- Public awareness
- Recycling and Reuse of wastes
- Ban on Toxic chemicals like DDT, BHC etc.,
- Biodegradable organic waste should be used for the generation of biogas.

SOLID WASTE MANAGEMENT:-

Any material that is thrown away or discarded as unwanted is considered as solid waste.

Types and sources of Solid waste

(i) Urban (or) municipal waste

Sources

- Domestic waste – Food waste, Cloth, waste paper etc.
- Commercial waste – waste paper, Packing material, Can Bottle etc.
- Construction waste – wood, Concrete etc.
- Biomedical waste – Infectious waste etc.

(ii) Industrial waste

- **Sources** – Nuclear Power Plant, Chemical Industries, Other industries like rubbish, paints, dyes etc.

(iii)Hazardous waste

- **Sources** – Petroleum refineries, paper mils, radioactive substance etc.

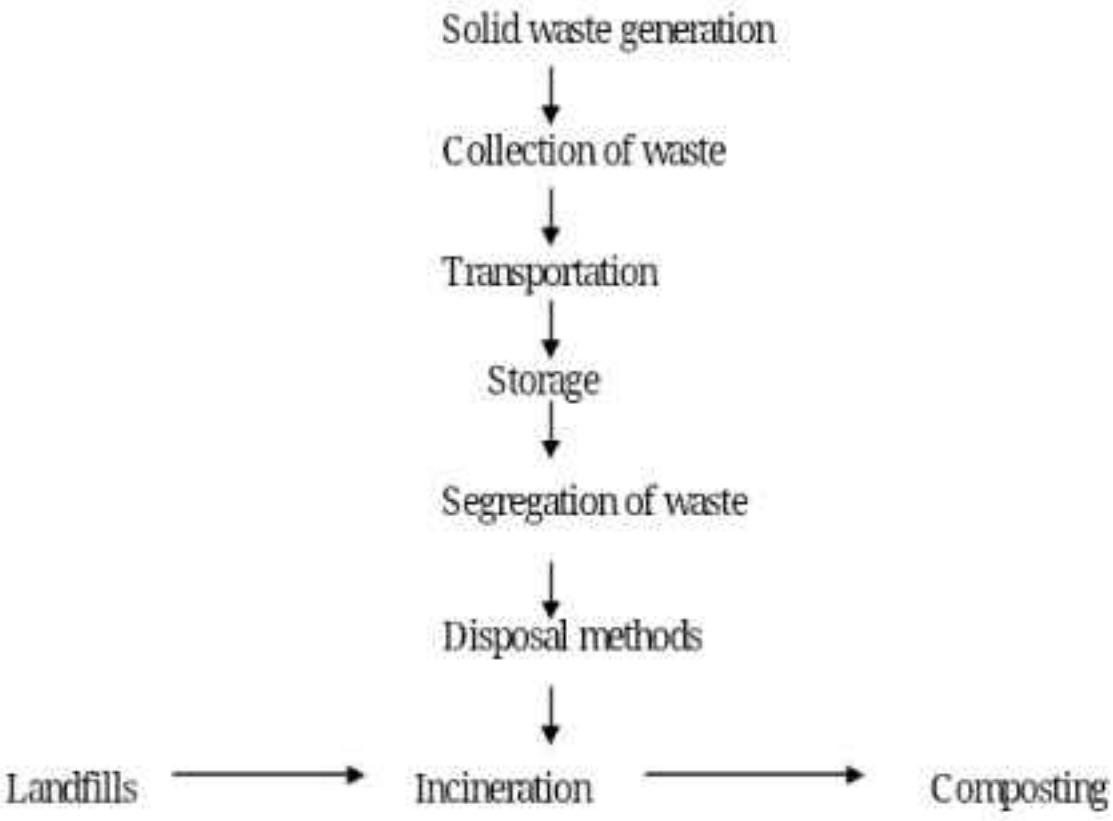
(iv)Agricultural waste

- **Source** – Agricultural field, farm manure etc.

Effects of Solid waste

- Due to improper disposal of municipal solid waste, biodegradable materials undergo decomposition. It produces foul smell and breeds various types of insects which cause dangerous problems to human beings.
- Industrial solid wastes affect the soil characteristics and the productivity of soils when they are dumped on the soil.
- Toxic substance may percolate through the soil and contaminate the ground water.

Control of Solid waste (or) process of Solid waste Management



Steps Involved

I ***Reduce, Reuse, Recycling (3R)***

a) Reduce the usage of raw materials:

- Usage of raw materials is reduced.

b) Reuse:

- Refillable container which is discarded after using can be reused.
- Throwing rubber ring from cycle tubes can be used again in the manufacture of rubber bands.

c) Recycling:

- Recycling of discarded materials into new products.

Examples:

i) Preparation of new cans and bottles from old aluminum cans and glass bottles.
ii) Preparation of fuel pellets from kitchen waste.

II ***Discarding wastes:***

- Methods: a) Land fill b) Incineration c) Composting

a) Land fill:

- Solid wastes are placed in sanitary landfill system in alternate layers of 80 cm thickness of refuse
- Covered with selected earth fill of 20 cm thickness
- After 2 or 3 years solid wastes volume shrinks by 25-30%
- Then the land is used for parks, roads, small buildings etc.

Advantages

- Simple and economical.
- Segregation is not required
- Landfill areas can be used for other purposes
- Natural resources are retained to the soil.

Disadvantages:

- Large area is required
- Transportations cost is heavy.
- Bad odors, if landfill is not properly managed
- Insecticides, pesticides should be applied at regular intervals
- Causes of fire hazards due to formation of methane

b) Incineration (or) Thermal process

- In this method combustible substances (rubbish, garbage, dead organisms) & non-combustible substances (glass, porcelain, metals) are separated first.
- The combustible waste substances are first dried in a preheater
- Then it is taken in a large incinerating furnace which incinerate about 100 to 150 tonnes per hour
- The temperature is maintained between 700°C to 1000°C
- The left out ashes & clinkers from the furnace is further disposal by sanitary landfill method
- The heat produced in the incinerator is used for generation of electricity.
- The non-combustible substances are left out for recycling and reuse.

Advantages:

- Require little space
- Cost of transportation is not high
- Safest and hygienic
- Capacity 300 tonnes per day and can generate 3MV of power.

Disadvantages:

- Capital and operating cost is high
- Need skilled persons
- Formation of smokes, dusts, and ashes needs further disposal.

c) Composting:

- In this method the bulk organic waste is converted into fertilizer by biological action
- The separated compostable waste is dumped in underground trenches (1.5m)
- Covered with earth of 20 cm and left over for decomposition
- Microorganism (actinomycetes) is introduced to start decomposition.
- After 2 or 3 days the organic waste are destroyed by microorganism and produce heat
- Composting will happen at 75°C

- Finally the refuse can convert to powdery brown colored odorless mass called Humus (fertilizer).
- It contains lots of nitrogen, plants growth phosphates and other minerals.

Advantages:

- Increase of water retention and ion exchange character of soil
- Number of industrial waste can also be treated by this method
- It can be used as fertilizer there by reducing the cost of disposal.
- Recycling occurs.

Disadvantages:

- Non-biodegradable materials cannot be disposed by this method.
- No assured market.

MARINE POLLUTION

It may be defined as "the discharge of waste substances into the sea resulting in harm to living resources, hazards to human health, hindrance to fishery and impairment of quality for use of sea water".

Source of marine pollution

The main source of marine pollution are,

(i) Rivers
(ii) Catchment area where human settlements in the form of hotels industries, agricultural activities etc.
(iii) Oil drilling and shipments.

They are discussed as follows:

- The river passing through big cities receive huge amounts of sewage, garbage, agricultural discharge, pesticides and heavy metals. These all are added to sea.
- Huge quantity of plastics are dumped in sea.
- The industrial effluents are discharged into the sea through river.
- The oil pollution is mainly due to petroleum and its products. For example, oil enters water from cracks of oil tankers, accidental spillage, cleaning of fuel tanks etc.
- The contamination of marine water due to thermal power plants, petroleum refineries and nuclear power reactors causes thermal pollution. That is, they produce excess of heat and increase the temperature of water bodies.

Effect of Marine Pollution

- Disturb entire aquatic or marine ecosystem. Oil has suffocation effect on most aquatic animals
- So many marine birds are affected by gastro-intestinal disorders.
- Presence of heavy metals in marine water affects the birds through thinning of eggshell and tissue damage of egg.

- Oil spilling causes low body temperature in birds resulting in hypothermia.
- Oil films decreases the rate of oxygen uptake by water.
- Oil pollution affect the marine fauna & flora including algae, fish, birds and invertebrates
- Oil films inhibit photosynthesis & inhibit the growth of the plants
- Hydrocarbon & benzpyrene accumulate in fish & consumption of fish by man cause cancer.
- Thermal Pollution may increase the temperature of water and DO may be depleted which causes danger.

Control measures of marine pollution

- Toxic pollutants from industries and sewage water should not be discharged in coastal waters.
- The industrial units on the coastal lines should be equipped with pollution control instruments and efficient treatment facilities.
- The oil pollution in the marine water has to be protected.
- Runoff from non-point sources should be prevented to reach coastal areas.
- Dumping of toxic, hazardous waste and sewage sludge should be banned.
- Development activities on coastal area should be minimized.
- Oil present in the marine water can be removed by dispersion (or) emulsification methods.
- People should be educated about marine ecosystems and the benefits offered by them.
- Local communities must be involved in protecting and managing their coastal resources.
- Social and economic incentives must be offered for conserving and sustainable use of marine resources.

NOISE POLLUTION

- It may be defined as "the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings". Sound intensity is measured in decibel (dB).

Types and source of noise

- Industrial noise (drilling sound, mechanical saws)
- Transport noise (bus, trucks, motors, scooters, rail traffic etc. leads to noise)
- Neighborhood noise (Musical instruments, TV, VCR, Radios, telephones, loudspeakers etc.)
- Festivals (Firecrackers during festivals time also create the noise)

Effects of Noise pollution

- This affects human health, comfort and efficiency.
- It causes muscles to contract leading to nervous breakdown, tension.
- It affects health efficiency and behavior.
- Loss of hearing due to excessive noise.
- Impulsive noise also causes psychological and pathological disorders.
- Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise.

- Ultrasonic sound can affect the digestive, respiratory, cardio vascular system.
- Rate of heart beat decrease or increase depending on the type of noise
- Blood is also thickened by excessive noises
- Optical system is also affected by noise pollution & lead to colour perception & loss of night vision
- Excessive sound disturbs sleep and proper rest.
- A sound of high decibels (about 160 dB) create headache.

Control and preventing measures

- ***Source control*** – acoustic treatment to machine surface, design changes, limiting the operational timings and so on.
- Noise making machine should be kept in containers with sound absorbing media.
- Uses of sound absorbing silencers can reduce the noise by absorbing sound.
- ***Oiling*** – Proper oiling will reduce the noise from the machines.
- ***Receptor control:*** Protection of the receiver by altering the work schedule, by using ear plugs etc.
- Planting trees on road sides and around houses can reduce the noise pollution.
- Legalization can ensure that sound production is minimized at various social function.
- Unnecessary horn blowing should be restricted especially in vehicle congested areas.

THERMAL POLLUTION

It may be defined as the "addition of excess of undesirable heat to water that makes it harmful to man, animal or aquatic life or otherwise causes significant departures from the normal activities of aquatic communities inwater".

Sources of thermal pollution

1. ***Nuclear power plants***

- It include drainage from hospitals, research institutes, nuclear experiments & explosions, emission from nuclear reactors.
- They discharge lot of unutilized heat and trace of toxic radio nuclides into nearby water streams.

2. ***Coal fired power plants***

- Coal fired power plants utilize the water for cooling the condenser coil.
- This plants discharge the hot water back to the nearby lake (or) river.
- It increase temperature of the nearby water body up to 15°C.

3. ***Industrial effluents***

- Textile, paper, pulp, sugar industries are discharge wastes and increase heat in water.

4. ***Domestic sewage***

- Municipal sewage discharge in lake or river has higher temperature.
- This increases the temperature of water bodies and decrease the dissolved oxygen content.

5. ***Hydro – electric power:***

Effects of thermal pollution

- Reduction in dissolved oxygen
- Increase in Toxicity
- Interference with biological activities
- Interference with reproduction
- Direct mortality
- Alter the Physical, Chemical and Biological properties of water.
- Food storage for fish.

Control measures of thermal pollution

- Thermal pollution is controlled by using the popular cooling systems like Cooling Ponds, Spray Ponds (or) Cooling Towers. This are absorb the excess heat and cool the water.
- Recycling of heat energy
- Maintaining the heat requirement process optionally hence overheating, wastage of heat, fuel consumption etc. can be minimized.
- Artificial lakes – The heated effluents can be discharged into the lake at one end and the water for cooling purposes from the other end.

NUCLEAR HAZARD (OR) RADIOACTIVE POLLUTION

- The physical pollution of air, water and soil by radioactive materials are called nuclear pollution.
- The radiation hazard in the environment comes from ultraviolet, visible, cosmic rays & microwave radiation which produce genetic mutations in man

Sources of Nuclear Hazards:

Natural sources:

- Space, volcano, earthquake etc. are emits cosmic rays.
- Soil, rocks, air, water, etc. also contain one or more radioactive substances.
- Solar rays and radio nuclides in earth's crust.

Man-made sources:

- Nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits etc.

Effects of Nuclear Hazards:

- Causes delirium, convulsions & death within hours or days with brain exposure
- Eye cell die, forming cataracts with eye exposure
- Vomiting, bleeding of the gums, mouth ulcers etc.
- Blood vessel damage is indicated by red spots on the skin
- Nausea, vomiting & Infection of the intestinal wall can kill weeks afterwards
- Unborn children are affected by mental retardation or brain damage.
- Genetic damage

Control measures from Nuclear Hazards:

- Nuclear devices should never be exploded in air.
- In nuclear reactor coolants may be used to prevent extraneous activation products
- Tightly sealed boxes & closed cycle system can be used to decrease the radioactive emissions
- Production of radioisotopes should be minimized
- Minimum number of nuclear installations should be commissioned
- Fission reactions should be minimized
- The use of radio isotopes may be carried under jet of soil or water instead of gaseous forms
- Wet drilling may be employed along with underground drainage
- Proper disposal of radioactive waste
- Use of high chimneys & ventilations at the working place for dispersing radio-pollutants
- Nuclear devices should be exploded only underground.

Disposal of Radioactive wastes:

High level wastes(HLW) = They are dangerous & so converted them into inert solids & then buried deep into earth or stored in deep salt mines. Ex. Spent nuclear fuel

Medium level wastes (MLW) = MLW are solidified & are mixed with concrete in steel drums before buried in deep mines

Low level wastes (LLW)= LLW are disposed off in steel drums in concrete lined trenches

ROLE OF AN INDIVIDUAL IN PREVENTION OF POLLUTION

- Plant more trees
- Help more in pollution prevention than pollution control
- Use water, energy and other resources efficiently
- Purchase recyclable, recycled and environmentally safe products
- Reduce deforestation
- Remove NO from motor vehicular exhaust
- Use of eco-friendly products.
- Use CFC free refrigerators
- Use natural gas than coal
- Use machines in well ventilated areas
- Use less polluting substances for cleaning agents, paints & other products
- Increase use of renewable resources
- Don't use polystyrene cups that have chloro fluoro carbon (CFC) which destroy ozone
- Use rechargeable batteries which will reduce metal pollution
- Use organic manure instead of inorganic fertilizers
- Reduce garbage by recycling & reuse
- Slow population growth

POLLUTION CASE STUDIES:-

1. BHOPAL GAS TRAGEDY:

- On night of 3rd December 1984 in Bhopal city of Madhya Pradesh
- At Union carbide India Ltd, which manufactures carbonate pesticides using methyl isocyanate (MIC).
- Due to failure of coolant, the reactor got exploded & 40 tons of MIC leaked over 40 sq.km area.

Nature of MIC: It is a toxic gas, affects lungs, eyes & causes irritation in skin. Remove oxygen from lungs & cause death.

Effects in Bhopal: About 5000 persons died, 1000 became blind, 65,000 people suffered from eye, respiratory and neuromuscular problems.

2. CHERNOBYL NUCLEAR DISASTER: (Nuclear pollution)

In 26th April 1986, melt down of the Chernobyl nuclear reactor in Russia, has leaked out the radioactive rays & radioactive materials.

Effects: about 2000 persons died. More suffered due to degeneration of cells, severe bleeding, anaemia, skin cancer. Animals and plants was also affected more.

3. GULF WAR: (MARINE POLLUTION)

Gulf war was fought between Iraq and US at a Period of 6 weeks in 1991. The American fighters dropped a lakh of bombs, and force the Iraq army to withdraw from Kuwait. During the retreat of Iraqi, they burning of 700 oil wells which are present near the sea shore and the oil from well spills out into the sea. The floating oil oversea water nearly 80 km long and 25 km wide area. The burning of oil wells continued nearly 10 months and they released huge amounts of pollutants like CO_2 and SO_2 into the atmosphere.

Effects

- Nearly one million birds have been killed due to the oil slick.
- The oil slick in the sea made the desalination plants ineffective.

4. MINAMATA DISEASE :(MARINE POLLUTION)

Minamata is a Small hostel village in Japan – Chicago. The Chemical company produces Vinyl polymer plastics and it release its effluent into Minamata sea. This effluent containing mercury ions which converted into methyl mercury. This methyl mercury is highly toxic consumed by fishes and affect human being through food chain. This result damage central nervous system and loss of vision and hearing, loss of muscular coordination, severe headache and nervous disorders.

DISASTER MANAGEMENT

- Disaster is a situation arising from natural forces where large scale disruption of infrastructure, services, etc. causing a serious effect on human life, economy and environment.

Types

Natural disasters – refers to those disasters that are generated by natural phenomena.
Ex: cyclones, floods, earthquakes, landslides, etc.

Man-made disasters – refers to the disasters resulting from man- made hazards.
Ex: Accidents, pollution, fire etc.

Important disaster

Floods, Earthquakes, Cyclones, landslides, Tsunami, Drought, etc.

FLOODS

- Whenever the magnitude of water flow exceeds the carrying capacity of the channel within its banks the excess of water overflows on the surroundings causes floods.

Causes of floods

- Heavy rain, rainfall during cyclone causes floods
- Sudden snow melt also raises the quantity of water in streams and causes flood
- Reduction in carrying capacity of the channels due to the accumulation of sediments causes floods.
- Deforestation, overgrazing, mining increases runoff from rains & hence the level of flood raises.
- Sudden and excess release of impounded water behind dams
- Clearing of forests for agriculture has also increased severity of floods.

Effects of Flood

- Floods cause heavy suffering to people living in low lying areas because the houses and the properties are washed away.
- Floods damage standing crops and livestock.
- Floods cause a great economic loss and health related problems due to widespread contamination.

Flood Management

- Encroachment of flood ways should be banned.
- Building walls prevent spilling out the flood water over flood plains.
- Diverting excess water through channels or canals to areas like lake, rivers where water is not sufficient.
- Build check-dams on small streams
- River – networking in the country also reduce flood.
- Optical and microwave data from IRS is also used for flood management.

- Flood forecasts and flood warning are also given by the central water commission.
- Reduction of runoff by increasing infiltration through appropriate afforestation.

CASE STUDIES

Flood in Bangladesh – 1974

- Every year, in Bangladesh, large areas are submerged during the monsoon season. In 1974, flooding extended nearly one-half of the country and stagnated for more than one month.
- Nearly 1500 people died in the floods and 2,80,000 people died from subsequent disease and starvation.
- Approximately 4,50,000 houses were destroyed and a total of 35 million people have lost their belongings due to floods.

EARTHQUAKE

An earthquake is a sudden vibration caused on the earth surface due to the sudden release of tremendous amount of energy stored in the rocks under the earth's crust.

Causes

1. Disequilibrium in any part of the earth crust
2. Underground nuclear testing
3. Decrease of underground water level.
4. Deep well disposal of liquid waste.

Severity of an earthquake: Generally it is measured by its magnitude on Richter scale.

Richter Scale	Severity of earthquake
Less than 4	Insignificant
4 – 4.9	Minor
5 – 5.9	Damaging
6 – 6.9	Destructive
7 – 7.9	Major
More than 8	Great

Effect

- Damage the settlements and transport systems
- Collapses houses and their structures
- It kills the thousands of people
- Deformation of ground surface
- Tsunami

Earthquake Management

- Damage to property and life can be prevented by constructing earthquake resistant buildings in the earthquake prone areas.
- Wooden houses are preferred in earthquake prone areas as in Japan
- Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes. Seismologist should analyse the pattern of micro seismicity and indicate the possibility of occurrence of earthquakes in a potential area.

CYCLONE

- It is a meteorological process, intense depressions forming over the open oceans and moving towards the land. On reaching the shores, it move into the interior of the land or along the shore lines.
- Cyclone is measured by Saffir-Simpson scale.
- The main requirement of formation of cyclone is that the sea surface temperature is below 25° C. the tropical cyclone move like a spinning top at the speed of 10 – 30 Km/hr.
- In India, cyclones originate from Bay of Bengal. It occurs during October – December or April – May.

Effect

- The damage depends on the intensity of cyclone. The damage to human life, crops, roads, transport, communications, tanks, livestock could be heavy.
- Cyclone occurrence slows down the developmental activities of the area.

Cyclone management

- Satellite images are used by meteorological departments for forecasting the weather conditions which reveal the strength and intensity of the storm.
- Radar system is used to detect the cyclone and is being used for cyclone warning.
- The exact location of cyclone at a given time can be analysed by satellite pictures.
- The effect of cyclone is decreases by planting more trees, construction of dams and wind breaks.

CASE STUDY

Cyclone in Orissa – 1999

- Two cyclones in Orissa occurred on 18^{th} and 29^{th} of October 1999. In the coastal area of Orissa, powerful cyclone storm hit with a wind velocity of about 260 Km/hrs.
- Nearly 14 of 30 districts of Orissa were in severe damage.
- It has been reported that nearly 15millions people were affected and 90 – 95% of the crop yield was affected. About 11,500 local schools have been damaged.

LANDSLIDES

- The movement of earthy materials like coherent rock, mud, soil and debris from higher region to lower region to gravitational pull is called landslides.

Causes

- Movement of heavy vehicles on the unstable sloppy regions create landslides
- Earthquake, shocks, vibrations and cyclone create landslides
- Downhill movement of earth is mainly caused by rain.
- Soil erosion due to surface runoff during the rain leads to landslides.
- Underground mining is also leads to landslides.

Effects of landslides

- It blocks roads and diverts the passage.
- Soil erosion increases.
- Sudden landslides cause damages to houses, crops and livestock.
- It totally damages the houses and other infrastructures.

Landslides management

It is difficult to control the landslides. However these can be minimized by stabilizing the slope by

- Draining the surface and subsurface water.
- Providing slope support like gabions.
- Concentrate support at the base of slope.
- Soil stabilization is done by using quick lime.
- Improving cultivation in the sloppy region which restricts the soil erosion.
- Unloading of the upper parts of the slope.

CASE STUDY

Landslides in UP – 1998

Due to landslide in Malpa village, pithoragarh district UP, on 18th August 1998, nearly 180 people including 60 kailash – Mansarovar pilgrims and eight Indo – Tibet Border police personnel were killed.

TSUNAMI

A tsunami is a large wave that is generated in a water body when the seafloor is deformed by seismic activity. This activity displaces the overlying water in the ocean.

Causes of tsunami

- Seismic activities like earthquakes, landslides, volcanic eruptions, explosions, can generate tsunami.
- Deformation of the sea floor due to the movement of plates.

Concept of Tsunami

- A tsunami is not a single wave but a series of waves like the ordinary waves which we see on seas.

Effects on Tsunami

- Tsunami attacks mostly the coastlines, causing devastating property, damage and loss of life.
- Tsunami can kill lot of human beings, livestock's.
- Tsunami may also spread lot of water borne diseases.

Tsunami Management

- Earthquakes under the water are monitored by sensors on the floor of the sea.
- The sensors send the information of floating buoys on the surface, whenever they detect any changes in pressure of the sea.
- The information is then relayed to satellites, which passes it on to the earth stations.
- Finally the country make the people alert through the media to take all necessary precautions.

Important questions

1. CAUSES (OR SOURCES), EFFECTS, REMEDIAL MEASURES (CONTROL) OF
- AIR POLLUTION.
- WATER POLLUTION.
- SOIL POLLUTION.
- THERMAL POLLUTION.
- NOISE POLLUTION.
- MARINE POLLUTION AND
- NUCLEAR POLLUTION.

2. SOLID WASTE MANAGEMENT (MUNICIPAL SOLID WASTE).
3. ROLE OF INDIVIDUAL FOR THE PREVENTION OF POLLUTION.
4. POLLUTION CASE STUDIES.
5. WHAT IS AN EARTHQUAKE? ENUMERATE ITS EFFECTS. WHAT MEASURES SHOULD BE TAKEN TO MITIGATE THIS DISASTER?
6. WHAT IS FLOOD? DISCUSS THE CAUSES, EFFECTS AND CONTROL MEASURES OF FLOOD.
7. WRITE SHORT NOTE ON (I) LANDSLIDE (II) CYCLONE.

UNIT III NATURAL RESOURCES

Natural resources are the sources which are useful to man or can be transformed into a useful product.

Types of Natural Resource

1. Renewable Resources
2. Non-renewable Resources

Renewable Resources

Resources that are capable of being regenerated by ecological processes within a reasonable time period are called renewable resources.
Examples : Soil, Water, Air, Natural vegetation etc.

Non-renewable Resources

Resources that are not capable of being regenerated by ecological processes are called non-renewable resources.
Examples : Minerals, Coal, Oil, Natural gas etc.

MAJOR NATURAL RESOURCES

Forest resources, Water resources, Food resources, Mineral resources, Energy resources and Land resources.

FOREST RESOURCES

- Forests are one of the most important renewable natural resources on this earth.
- About one-third of the world's land surface is covered with forest.

TYPES OF FORESTS

1) Evergreen forests
2) Deciduous forests
3) Coniferous forests

Evergreen forests

- Found in the equatorial regions, where the temperature & rainfall is very high.
- Due to heavy rainfall throughout the year these forests are evergreen.
- Example: The silent valley in Kerala.
- Important trees : Teak, rosewood.

Deciduous forests

- These forests are of 2 types,

1) Tropical deciduous forests
2) Temperate deciduous forests

Tropical deciduous forests

- Found in the tropical monsoon.
- They receive only seasonal rainfall & hence they shed their leaves during the summer season.
- Important trees : Teak, sandalwood

Temperate deciduous forests

- Due to severe winter with heavy snowfall the trees shed their leaves just before the winter season.

Coniferous forests

- The snow slides down the sloping sides of the trees.
- The needle typed leaves preserve the moisture.
- Important trees: Pine tree, spruce tree.

FUNCTIONS OF FORESTS

- Forests are habitats to millions of plants, animals & wildlife.
- They recycle rainwater & remove pollutants from air.
- They control water quality & quantity.
- They moderate temperature & weather and help to maintain humidity.
- They prevent soil erosion & perform watershed functions.
- They promote tourism & contribute aesthetic beauty.

USES (OR) BENEFITS OF FORESTS

➢ **Commercial uses**

S.No.	Name of the Products	Uses
1.	Forests supply wood	Used as fuel.
2.	Forests supply wood for various industries	Used as raw materials as pulp, paper, timber etc.,
3.	Forests supply minor forest products	Gives products like gums, resins, dyes, etc.,
4.	Many plants	These are utilized in preparing medicines & drugs.
5.	Forest produces variety of animal products	Gives Honey, ivory, etc.,
6.	Many forest lands are used for	Mining, grazing, recreation & for dams.

➢ **Ecological uses**

- Production of oxygen
- Reducing global warming
- Soil conservation
- Regulation of hydrological cycle
- Pollution moderators
- Wildlife habitat

- **Aesthetic value**

- Tribal utilize bamboo & wild grass for erecting the huts to reside & for making other product like mats, basket, cots, etc.,
- Some of the forest plants are used as food by the tribal people.

- **Touristic value**

- Ecotourism provides a growing income for those who have facilitated it.
- Several countries are now attracting the tourists.

OVER EXPLOITATION OF FOREST:

- Due to overpopulation, the forest materials like food, medicine, shelter, wood & fuel are not sufficient to meet the people's demand. Hence exploitation of forest increases day by day.

Reason for over exploitation in India:

- In India forest area required to maintain good ecological balance is 33% but at present is only 22% there. Hence over exploitation of forest occur.

Causes of over exploitation:

- Increasing agricultural production
- Increasing industrial activities
- Increase in demand of wood resources

Effects of over exploitation:

- Led to migration of the farmers
- Environment damage is heavy
- Tropical forests are destroyed very fastly
- Countless plants and animal species are endangered
- Marine population will go into extinction
- Dumping of wastes into land, water, & air is a severe problem.

DEFORESTATION

Deforestation means destruction or removal of forests due to natural or man-made activities.

Deforestation in India:

- Deforestation is a continuous process in India.
- About 1.3 hectares of forest land has been lost.
- The presence of waste land is a sign of deforestation in India.

Causes of Deforestation

1. Developmental projects *(Ex) Big dams, hydroelectric projects, road construction etc.*
2. Mining operations *(Ex) Mica, coal, manganese, limestone etc.*
3. Raw materials for industries *(Ex) for making boxes, furniture's, plywood, Match boxes, pulp etc.*
4. Fuel requirements *(Ex) Both rural & tribal population depend on forests for fuel*
5. Shifting cultivation - *Replacement of natural forest ecosystem lead to loss of plants & animal species*
6. Forest Fires - *Due to human interruption & increase in temperature forest fire happens often nowadays*

Effects or Consequences of deforestation:

1. Global Warming

Cutting & burning of forest trees increase CO_2 content in atmosphere.
This causes global warming and depletion of ozone layer.

2. Soil erosion

Forest trees act as natural barrier to reduce the wind velocity & reduce soil erosion.
Deforestation causes soil erosion, floods, landslides, and drought.

3. Loss of genetic diversity

The destruction of our forest destroys the genetic diversity on earth which provides food & medicines for entire world.

4. Loss of Biodiversity

When plants do not exist, animals that depend on them for food & habitat become extinct.

5. Loss of Food grains

Due to soil erosion, the countries loose the food grains.

6. Flood & land slides

Frequent floods, landslides in hilly areas and wind speed are heavy.

7. Unemployment Problems

People living around forest areas losses their livelihood.

Preventive measures of conservation of forests

- Planting trees to replace the cut down trees
- Use of wood for fuel should be discouraged
- Controlling forest pest by spraying pesticides using aeroplanes
- Controlling forest fire by modern techniques

- Controlling over grazing by cattle
- Discouraging migration of tribal people by the government.
- Conducting education & awareness programmes
- Strict implementation of law of forest conservation act.

➢ **Case studies**

Deforestation in the Himalaya region

Deforestation in Himalaya region, involves clearing of natural forests and plantation of monocultures like eucalyptus, camadulensis etc. Due to this, nutrient cycling has become poor and the soil is losing their fertility. Thus the entire west Khasihill, Himalayas, Ladakh, Garhwal are now facing the serious problems of deforestation.

Disappearing Tea gardens in Chhota Nagpur

Deforestation activities in the hilly region of Chhota Nagpur declines the rainfall to such an extent that tea-gardens are disappeared from the region.

TIMBER EXTRACTION

Due to population growth & lack of alternative fuels, people living nearby forest area are mostly using wood as fuel.

Uses of timber

1) The timber is used as raw materials for various wood based industries like paper, furniture, etc.,
2) Used for various developmental activities like railways, boats, road construction etc.,

Consequences (or) effects of timber extraction

1) Large scale timber extraction causes deforestation.
2) Soil erosion, loss of fertility, landslides & loss of biodiversity.
3) Loss of tribal culture & extinction of tribal people.
4) Reduces the thickness of the forest.

Indian scenario

- In India, industries consume about 28 million cu.mts/year of wood.
- But, annual forest growth is only about 12 million cu.mts/year.

MINING

- Mining is the process of extracting mineral resources & fossil fuels like coal from the earth.
- These deposits are found in the forest region & any operation of mining will naturally affect the forest.
- Mining operation requires removal of vegetation along with underlying soil mantle.

Types of mining

a) Surface mining – Extraction of minerals or fossil fuels from shallow deposits.
b) Underground mining – Extraction of minerals or fossil fuels from deep deposits.

Steps involved in mining

a) Exploration (investigation & searching of minerals)
b) Development
c) Exploitation (extraction of minerals)
d) Ore processing (separation of ore)
e) Extraction & purification of minerals

Effects of mining

- Mining activity not only destroys trees, it also pollutes Soil, Water & Air with heavy metal toxins that are almost impossible to remove.
- Destruction of natural habitat at the mine & waste disposal sites.
- Due to continuous removal of minerals, forest covers, the trenches are formed on the ground, leading to water logged area, which in turn contaminates the ground water.
- During mining operations, the vibrations are developed, which leads to earthquake.
- Noise pollution is another major problem from mining operations.
- Mining reduces the shape & size of the forest areas.
- Landslides may also occur as a result of continuous mining in forest area.
- Pollution of surface & ground water resources due to the discharge of waste minerals in water.
- Migration of tribal people from mining areas to other areas for searching land & food.

DAMS & THEIR EFFECTS ON FORESTS & TRIBAL PEOPLE:

- **Dams are the massive artificial structures built across the river to create a reservoir in order to store water for many beneficial purpose.**
- However, these dams are also responsible for the destruction of vast areas of forest & displacement of local people.
- India has more than 1600 large dams.

States	Number of Dams
Maharastra	More than 600 dams
Gujarat	More than 250 dams
Madhya Pradesh	More than 130 dams

- Tehri dam is the highest built across the river Bhagirathi in the state of Uttaranchal.

Effects of dam on forest:

1) Thousands of hectares of forest are cleared for river valley projects.
2) Forest is also cleared for residential, office, buildings, storing materials, laying roads etc.

3) Hydroelectric projects also have led to widespread loss of forest in recent years.
4) Dam construction kills wild animals & aquatic life.
5) Hydroelectric projects provide opportunities for the spread of water borne diseases.
6) The big river valley projects also cause water logging which leads to salinity & intum reduces the fertility of the land.

- ***Examples***

✓ **Narmada sagar project** : submerged 3.5 lakh hectares of forest comprising teak & bamboo trees.
✓ **Tehri dam** : submerged 1000 hectares of forest affecting about 430 species of plants.

Effects of dam on tribal people:

1) Displacement of tribal people, due to the loss of biodiversity.
2) The displacement & cultural change affects the tribal people both mentally & physically. They do not accommodate the modern food habits & life styles.
3) Tribal people are ill-treated by the modern society.
4) Many of the displaced people were not recognized & resettled or compensated.
5) Tribal people's culture are totally destroyed.
6) Generally, the body conditions of the tribal people will not suit with the new areas & hence they will be affected by many diseases.

WATER RESOURCES

- Water is an important constituent of all the living beings.
- All organisms are made up of mostly by water.

Examples :

- *A tree is made up of 60% by weight of water.*
- *Animals are made up of 50-65% of water.*

Forms of water:

- Water exists in 3 phases, *solid, liquid & gas.*
- It is circulated in accordance with the hydrological cycle.

HYDROLOGICAL CYCLE

Evaporation

- Heat energy from the sun constantly causes evaporation from all the water surfaces.
- Oceans, rivers, streams, lakes, ponds & the surfaces of terrestrial organisms lose water due to evaporation.
- The evaporated water in the form of water vapour forms clouds.

Condensation & precipitation

- The water in the gaseous form (water vapor) now gets condensed by means of condensation.
- Once water condenses, it is pulled into the ground by gravity.

- The process by which the condensed water falls to the earth is known as precipitation (rainfall).

Transpiration & respiration:

- Plants absorb water through their roots & loose water through their leaves to the atmosphere & this process is transpiration.
- Animals & plants break down sugars and produce energy with liberation of CO_2 & H_2O is respiration.
- **Thus the process of evaporation, condensation & transpiration is called hydrological cycle.**

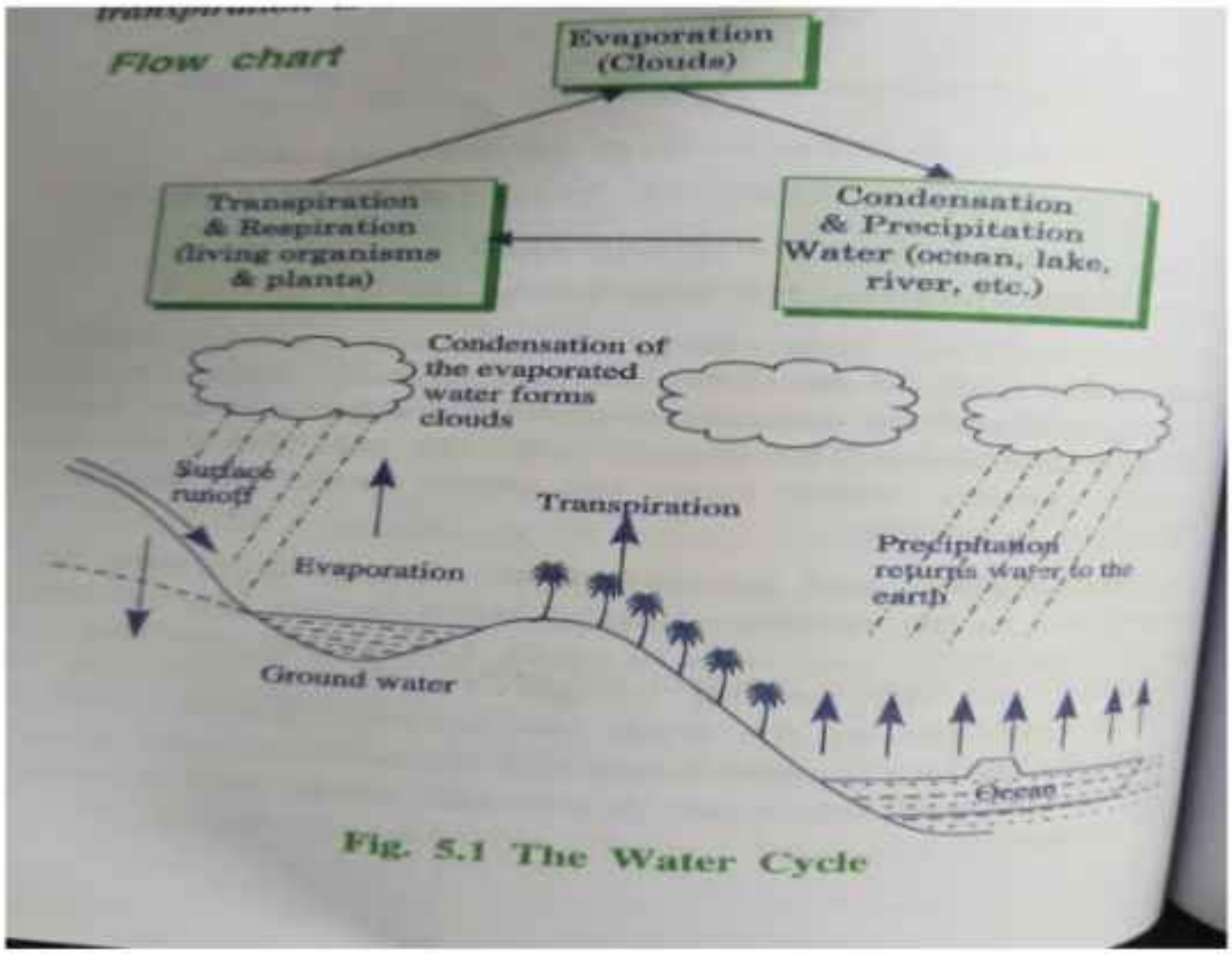


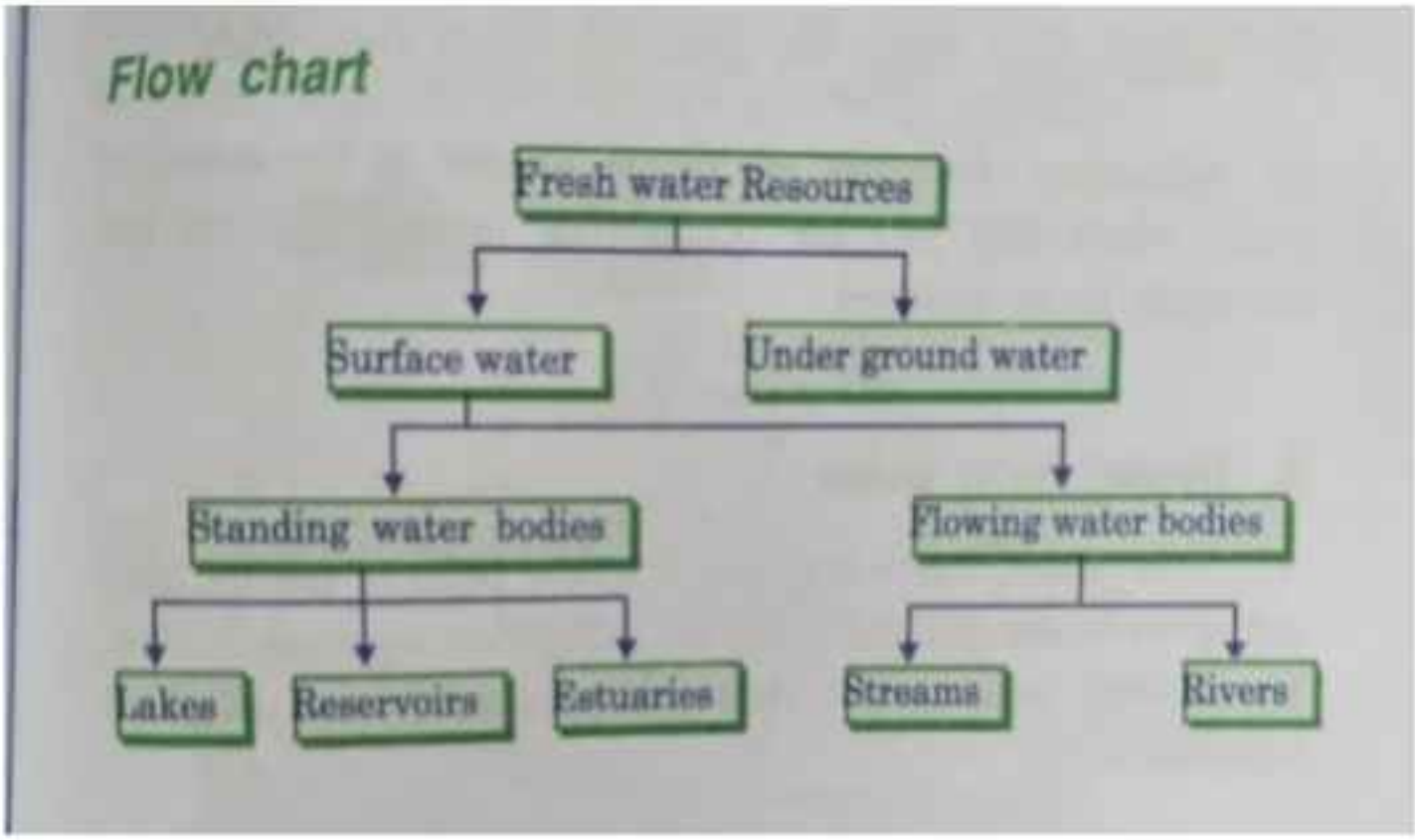
Fig. 5.1 The Water Cycle

Distribution of water resources

- About 97.4% by volume of water is found in oceans & is too salty and cannot be used for drinking, irrigation, industrial purposes.
- Of the remaining 2.6% of fresh water, most of which is locked up in ice or in deep ground water.
- Thus only about 0.014% of the earth's total volume of water is easily available to us as usable ground water.

Types of fresh water resources

- Fresh water resources may be broadly classified into 2 types.
  - Surface water
  - Underground water



Surface water

- The water, which is coming out directly through precipitation & does not percolate down into the ground or does not return to the atmosphere by evaporation, is known as surface water.
- The water stored on the surface of earth is called surface water.

Standing water bodies

Lakes - Contains lesser amount of dissolved minerals, but the quantity of organic matter is very high.
Reservoirs – larger than lakes.
Estuaries – they are deltas formed at the mouth of rivers, where they join the ocean.

Flowing water bodies

- The water which originates from the point of precipitation & flows in streams & rivers are called flowing water bodies.
- They carry sedimentary materials & dissolved minerals.

Under Ground Water

- The water which is found available deep in the ground due to percolation of surface water is called underground water.
- It is the major source of water.
- It is pure & used for all purpose in the world.

Types of underground water systems

Aquifer

- A layer of highly permeable rock containing water is called an aquifer.

Examples :

a) Layers of sand & gravel are good aquifers (have good permeability).
b) Clay & crystalline rocks are not good aquifers (have poor permeability).

- Aquifers are of 2 types,

Unconfined aquifers

- Formed when water collects over a less permeable rock or compact clay.
- They are recharged by water percolating down from the above surface through permeable material.

Confined aquifers

- Formed when water collects over a impermeable rock.
- It is sandwiched between 2 layers of impermeable rock.
- They are recharged only in those areas where the aquifer intersects the land surface.

Uses of water

- The water is used mainly for 2 types of uses

Consumptive use

- Here water is completely utilized and it is not reused.

Example : in domestic application

Non-consumptive use

- Here water is not completely utilized and it is reused.

Example : Hydropower plant

Other important uses of water

- Domestic purposes like drinking, cooking, bathing, washing, etc.,
- Commercial purposes like hotels, theatres, educational institutions, offices, etc.,
- Irrigational purposes like agriculture. About 60-70% of the fresh water is used for irrigation.

- 20-30% of the total fresh water is used for so many industrial operations like refineries, iron & steel, paper & pulp industries.
- Water is very essential for the sustenance of all the living organisms.
- Water also play a key role in sculpting the earth's surface, moderating climate & diluting pollutants.
- Water is universal and cheap coolant.

OVER UTILIZATION OF WATER:

Decrease of Ground water:	***Reason: (a)*** Increased usage of ground water. (b) Inadequate rainfall (c) Construction activities reduces the area for percolation of rainwater
Ground subsidence:	When the groundwater withdrawal is more than recharge rate, the sediments in the aquifer get compacted, which results in sinking of overlaying land surface. This process is known as ground. ***Problems:*** ***a)*** Structural damage in buildings b) Fracture in pipes c) Reversing flow of canals & tidal flooding
Lowering of Water table:	Over utilization of ground water in arid and semi-arid regions for agriculture disturbs the state of equilibrium of the reservoir (disturb the hydrological cycle) in the region. This causes the following problems. • Lowering of water table • Decreased pressure of water changes the speed & direction of water flow.
Intrusion of salt water:	• Over-exploitation of ground water lead to rapid intrusion of salt water from the sea • Water cannot be used for drinking & agricultures.
Earthquake & landslides:	Over utilization of ground water leads to earthquake, landslides & famine.
Drying up of wells:	• As a result of over utilization of ground water, the level of ground water getting depleted at much faster rates than they can be regemerated. • This leads to drying up of dug wells & bore wells.
Pollution of water:	• Water containing nitrogen as nitrate fertilizer, percolates rapidly into ground & get polluted. • Water becomes unsuitable for potable when nitrate concentration exceeds 45 mgs/lit.

DAMS – BENEFITS AND PROBLEMS

Dams are built across the river in order to store water for,

- Irrigation
- Hydroelectric power generation &
- Flood control

Benefits of constructing dams

1) Used to control the flood
2) Used to store the rain water
3) For diverting part or all of the water from river into a channel
4) Drinking & agricultural uses
5) Generate electricity
6) Used for recreational purposes
7) Navigation & Fishery can be developed in the dam areas.
8) Morally to recharge the ground water.

Problems of constructing dams

Upstream problems

1) Displacement of tribal people
2) Loss of non-forest land
3) Loss of forests, flora & fauna
4) Landslips, sedimentation & siltation occurs
5) Stagnation & water logging around reservoirs retards plant growth
6) Breeding of vectors & spread of vector-borne diseases.
7) Reservoir induced seismicity (RIS) causes earthquakes.
8) Navigation & aquaculture activities can be developed in the dam area.

Downstream problems

1) Water logging & salinity due to over irrigation
2) Reduced water flow & silt deposition in rivers
3) Salt water intrusion at river mouth
4) Since the sediments carrying nutrients get deposited in the reservoir, the fertility of the land along the river gets reduced.
5) Sometimes due to structural defects the dam may collapse suddenly & destroy many living organisms.

MINERAL RESOURCES

- **Minerals are naturally occurring substances having definite chemical composition & physical properties.**
- **Ores are minerals or combination of minerals from which useful substances, such as metals, can be profitably extracted & used for manufacture.**

Formation of mineral deposits

Mineral deposits are formed due to,

- Biological decomposition of dead animals & organic matters.
- The concentration of minerals during cooling of molten rock (lava from volcano).
- Evaporation of sea water.
- Oxidation-reduction reaction inside the earth.

Classification of mineral resources

U.S. Geological Survey divides mineral resources into 3 categories,

1) Identified resources – location, existence, quantity & quality of these mineral resources are known by the direct geological evidence & measurements.

2) Undiscovered resources – these mineral resources are assumed to exist on the basis of geological knowledge & theory but their specific locations, quality & quantity are unknown.

3) Reserves – these mineral resources are identified resources, from which a usable minerals can be extracted profitably.

Uses and Exploitation

The important uses of minerals are as follows,

1) **Development of industrial plants & machinery** – **Ex:** iron, aluminium, copper, etc.,
2) **Construction, housing, settlements – Ex:** iron, aluminium, nickel, etc.,
3) **Generation of energy** – **Ex:** coal, lignite, uranium, etc.,
4) **Designing of defense equipments, weapons, ornaments.**
5) **Agricultural purposes, as fertilizers, seed dressings & fungicides**
   Ex: zineb : containing zinc, **maneb :** containing manganese
6) **Jewelry – Ex:** gold, silver, platinum & diamond.
7) **Making of alloys for various purposes** – phosphorites.
8) **Communication purposes** – **Ex:** telephone wires, cables, electronic devices.
9) **Medicinal purposes, particularly in ayurvedic system** – sulphur pyrites.

ENVIRONMENTAL EFFECTS OF EXTRACTING MINERAL RESOURCES:

De-vegetation & defacing of landscape	• Topsoil & vegetation are removed from mining areas. • De-vegetation leads to severe ecological losses.
Groundwater contamination	• Mining pollutes the ground water. • Sulphur present in many ores, is converted into sulphuric acid by microbial action. • Hence water becomes acidic. • Some heavy metals also leach into ground water.
Surface water Pollution	• The drainage of acid mine often contaminates the nearby streams & lakes. They acidic water is harmful to many aquatic life. • Radioactive substances like Uranium also contaminate the surface water and kill the aquatic animals.

Air pollution	* Smelting & roasting done to purify the metal causes air pollution & affects the nearby vegetation. *The SPM (suspended particulate matter) like Arsenic, cadmium, lead etc. contaminate the atmosphere & affects public health.
Subsidence of Lands	It is mainly associated with underground mining, subsidence of mining results in cracks in houses, tilting of buildings, bending of rail tracks etc.

Effects of over exploitation of mineral resources

1) Rapid depletion of mineral deposits.
2) Wastage & dissemination of mineral deposits.
3) Causes environmental pollution.
4) Needs heavy energy requirement.

Management of mineral resources

1) Re-use & Re-cycling of the metals
2) Eco-friendly mining technology
3) Search for new deposit.
4) Modernization of the mining industries
5) Efficient use & protection of mineral resources.
6) The grade ores can be better utilized by using microbial – leaching techniques.

CASE STUDIES

Mining & quarrying in Udaipur

- ✓ About 200 open cast mining & quarrying centres are in Udaipur
- ✓ Of these 100 mining & quarrying centres are illegal & involved in stone mining
- ✓ Nearly 150 tonnes of explosives are used per month in blasting of mines & quarry, which pollute the air, soil & water.
- ✓ This blasting activity adversely affects irrigation & wildlife.

Mining in Sariska Tiger Reserve in Aravalli range

- ✓ The Aravalli range is spread in the North-west India covering Gujarat, Rajasthan, Haryana & Delhi.
- ✓ The hill region is very rich in biodiversity as well as mineral resources.
- ✓ The Sariska Tiger Reserve, in Aravalli range, is very rich in wildlife & has enormous mineral reserves like quartzite, marble & granite.
- ✓ Mining operations around these reserves has made many areas permanently infertile & barren.
- ✓ The Supreme Court has directed the centre & state government of Rajasthan to ensure that all mining activities within the series should be stopped.
- ✓ But still some illegal mining is in progress.

Quarrying thorium & uranium in Kanyakumari district

- ✓ Indian Rare Earths Corporation is quarrying sands, which is enriched with uranium & thorium, near the sea shore in Manali, KK district.
- ✓ It leads to loss of many coconut plantation & sea shore beauty.

FOOD RESOURCES

- Food is an essential requirement for the human survival.
- The main components of food are carbohydrates, fats, proteins, minerals & vitamins.
- Historically humans have dependent on 3 systems for their food supply,

1) **Croplands** – It mostly produces grains. It provide about 76% of world's food – **Ex:** rice, wheat, maize, barley, sugarcane, etc.,
2) **Rangelands** – Produces food from the grazing livestock. It provide 17% of world's food **Ex:** meat, milk, fruits, etc.,
3) **Oceans** – Supply 7% of world's food. **Ex:** fish, prawn, crab, etc.,

Major Food Resources

- Even though the earth is provided with more than 1000's of edible plants & animals, only 15 plants & 8 terrestrial animal species supply 90% of our global intake of calories.
- Rice, wheat & maize are the major grains which provide more than 50% of the calories people consume.

WORLD FOOD PROBLEMS:

The various factors caused for world food problems are given below

- Population growth
- Lack of cultivable land
- Soil erosion, water logging, salinity and water pollution also affect the agricultural productivity.
- In developing countries, urbanization deteriorates the agricultural lands.
- Few food grains like Rice, Wheat, Corn, Maize and few vegetables like Potato, Carrot, Tomato, etc. are the major food for all the people over the world. Hence the food problem arises.
- Human activities degrade the earth's net productivity which leads to food problems.

Nutritional Problems in developing nations

Under Nutrition (or) Under Nourished

- People who cannot receive enough calories (food) to meet their basic energy needs then they are called under nourished.
- Under nourishment leads to mental retardation and infectious diseases like measles and diarrhea.

Malnutrition (or) Malnourished

- People who receive enough calories but not specific essential nutrients like Proteins, Minerals, Vitamins, Iron and Iodine then they are called Malnutrition (or) Malnourished.
- Deficiency of nutrition leads to several diseases.
- Thus chronically under nourished and malnourished people are affected by various disease and too weak to work (or) think clearly.

Over nutrition (or) Over nourished (arises in developed Countries)

- People who consume food in excess of their nutritional requirement are over nourished.
- They are affected by problems of obesity. Diets high in fat, sugar and salt may lead to blood pressure, heart problems and diabetes.

CHANGES CAUSED BY AGRICULTURE AND OVERGRAZING

- In desert and grass land regions where rainfall is insufficient to support crop production. So the land is used for grazing.
- The huge population of livestock needs more grazing lands.

OVERGRAZING

The process of eating vegetation without giving any chance for its regeneration is called overgrazing.

Effects (or) Impacts of overgrazing

- Land degradation
- Soil erosion
- Loss of useful species

AGRICULTURE

Agriculture is an art, science and industry of managing the growth of plants and animals for human use.

Types

(i) Traditional agriculture
(ii) Modern agriculture (or) industrialized agriculture

Traditional agriculture

- It involves a small plot, simple tools, surface water, organic fertilizers and a mixture of crops.
- It is very nearer to natural condition which leads to low production.

Effects of Traditional agriculture

- Deforestation
- Soil erosion
- Depletion nutrients

Modern agriculture

It makes use of hybrid seeds of single crop variety, high – tech equipment's, lot of fertilizers, pesticides and water to produce large amount of single crops.

EFFECTS / IMPACTS OF MODERN AGRICULTURE:

1. Problems in using Fertilizers:

Micronutrient imbalance:

- Chemical fertilizers used in modern agriculture fields contain nitrogen, phosphorus and potassium(NPK)
- Excess of fertilizers used in fields causes micronutrient imbalance.

Blue Baby syndrome:

- Nitrogenous fertilizers used in fields, contaminate the ground water.
- This increase nitrate content in water.
- When the nitrate concentration exceeds 25 mg/lit, they cause serious health problem called "**Blue Baby syndrome**"
- This disease affects infants & leads to death.

Eutrophication:

- A large proportion of N & P fertilizers used in fields is washed off by runoff water and reaches the water bodies, causes over nourishment of the lakes. This process is known as Eutrophication.
- Eutrophication leads lakes to get attacked by algal blooms.
- Since life time of algal blooms are less they die quickly and pollute water, which intum affect the aquatic life.

2. Problems in using pesticides:

- In order to improve the crop yield, lot of pesticides are used in agriculture.

Ist generation Pesticides:

- Sulphur, arsenic, lead or mercury are used to kill the pests.

IInd generation pesticides:

- DDT (Dichlorodiphenyltrichloromethane) is used to kill the pests.

Although these pesticides protect our crops from huge losses due to pests, they produce number of side effects. They are as follows

Death of non-target organisms

- Insecticides not only kill the target species, they also kill the non-target species, which are useful to us.

Producing new pests:

- Some pest species survive even after the pesticide spray; they are immune & are called super pests.

Bio-magnification:

- Many pesticides are non-biodegradable & keep on concentrating in food chain.
- This process is called bio-magnification which is harmful to the human beings.

Risk of cancer:

- It directly acts as carcinogens and it indirectly suppress the immune system.

Quality of an ideal pest:

- On ideal pesticides must kill only the target species
- It must be a biodegradable
- Should not produce new pests and any toxic pesticide vapour.
- Excessive pesticides should not be used.
- Chlorinated & organophosphate pesticides are hazardous & they should not be used.

3. Water logging:

- Water logging is the land where water stand for most of the year

Causes of Water logging:

- Excessive water supply to the croplands.
- Heavy rain
- Poor drainage.
- Poor irrigation management

Effects (or) Problems of water logging:

- Pore-voids in the soil get filled with water and the soil air gets depleted.
- So, the roots of the plants don't get adequate air for respiration.
- So, mechanical strength of the soil decreases and crop yield falls.

Remedy:

- Preventing excessive irrigation.
- Preventing water-logging by Sub-surface drainage technology
- Management of drainage lines for efficient water flow.
- Increase the deep rooting vegetation for greater utilization of water from the soil.

4. Salinity:

Definition:

- Water evaporation leaves behind a thin layer of salts in the topsoil. This process of accumulation of salts is called salinity of soil.
- Saline soils are due to Sodium chloride, calcium chloride, magnesium chloride, sodium sulphate, sodium bicarbonates & sodium carbonates.
- The pH of the water exceeds 8.

Problems (or) Effects of salinity

- Due to salinity the soil becomes alkaline and crop yield decreases.
- Pollution of ground water due to increase in total dissolved solids.

Remedy:

- The salt deposit is removed by flushing them by good quality water.
- Salt water is flushed out by using sub-surface drainage system.
- Reduce the use of synthetic fertilizers.
- Effective recharging of soil for longer periods which is used to reduce salt content of the soil.

CASE STUDIES

Water logging and Salinity in Haryana and Rajasthan

- Introduction of **canal irrigation** in Haryana State resulted in rise in water – table followed by water logging and salinity in many agricultural lands causing huge economic losses as a result of decrease in crop productivity.
- Similarly Rajasthan has also suffered badly due to the biggest irrigation project, **"Indira Gandhi Canal Project"**, which converts a big area into water soaked waste land.

Pesticides in Delhi

- It has been reported in Delhi, that the high accumulation of **pesticides and DDT in the body of mothers** causes premature deliveries or low birth weight infants or death of many children.

Pesticide in Pepsi and Coca-Cola

- Food centre for **Science and Environment (CSE), India**, has reported that Pepsi and Coca-Cola companies are selling soft drinks with pesticide content **30 – 40 times higher** than **European Union (EU) guidelines permit**. This damage the nervous system.

ENERGY RESOURCES

Energy

Energy may be defined as, "any property, which can be converted into work

(Or)

Energy is defined as, "the capacity to do work".

Growing Energy Needs

- Energy is essential to all human societies.
- Developmental activities in agriculture, industry, mining, transportation and lighting are all need energy.
- With the demands of growing population, the world is facing further energy deficit.
- Our life style is also changing from a simple way of life to a luxurious life style.
- At present 95% of the commercial energy is available only from the fossil fuels like coal, oil, and natural gas. They are not going to last for many more years.
- So, the growing population and developmental activities requires more amount of energy.

TYPES OF ENERGY RESOURCES

There are two types

1. Renewable Energy Resources
2. Non – Renewable Energy Resources

RENEWABLE ENERGY RESOURCES:

Definition:

- They are natural resources which can be regenerated continuously.
- They can be used again and again in an endless manner.

Examples: Solar energy, Wind energy, Ocean energy, Tidal energy, wood etc.

SOLAR ENERGY:

- The Energy that we get directly from the sun is called solar energy

Methods of Harvesting Solar Energy

(i) Solar cells (or) photovoltaic cells (or) PV cells

- Solar cells consist of a p-type semiconductor and n-type semi-conductor
- They are in close contact with each other.
- When the solar rays fall on the top layer of p-type semi-conductor, the electrons from the valence band get promoted to the conduction band and cross the p-n junction into n-type semi-conductor.
- Thus potential difference produced between two layers causes flow of electrons (i.e. an electric current)

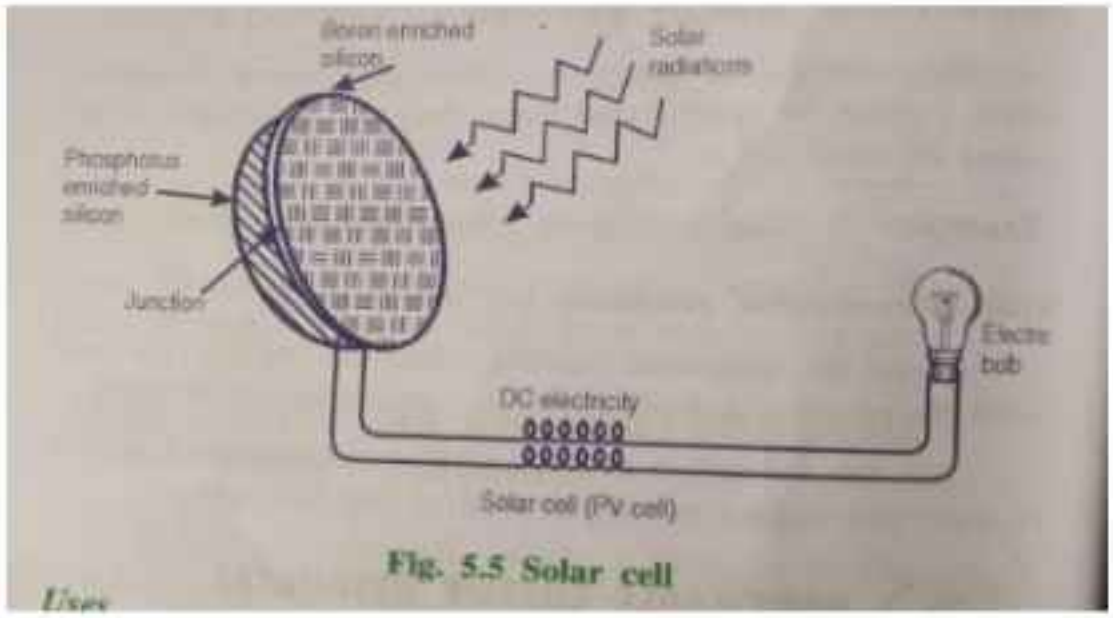


Fig. 5.5 Solar cell

Uses

- Used in calculators, electronic watches. Street lights, water pumps to run radios and TVs.

(ii) Solar Battery

- Large number of solar cells is connected in series to form a solar battery.
- Solar battery produce more electricity which is enough to run water pump, to run street-light, etc.,
- They are used in remote areas where conventional electricity supply is a problem.

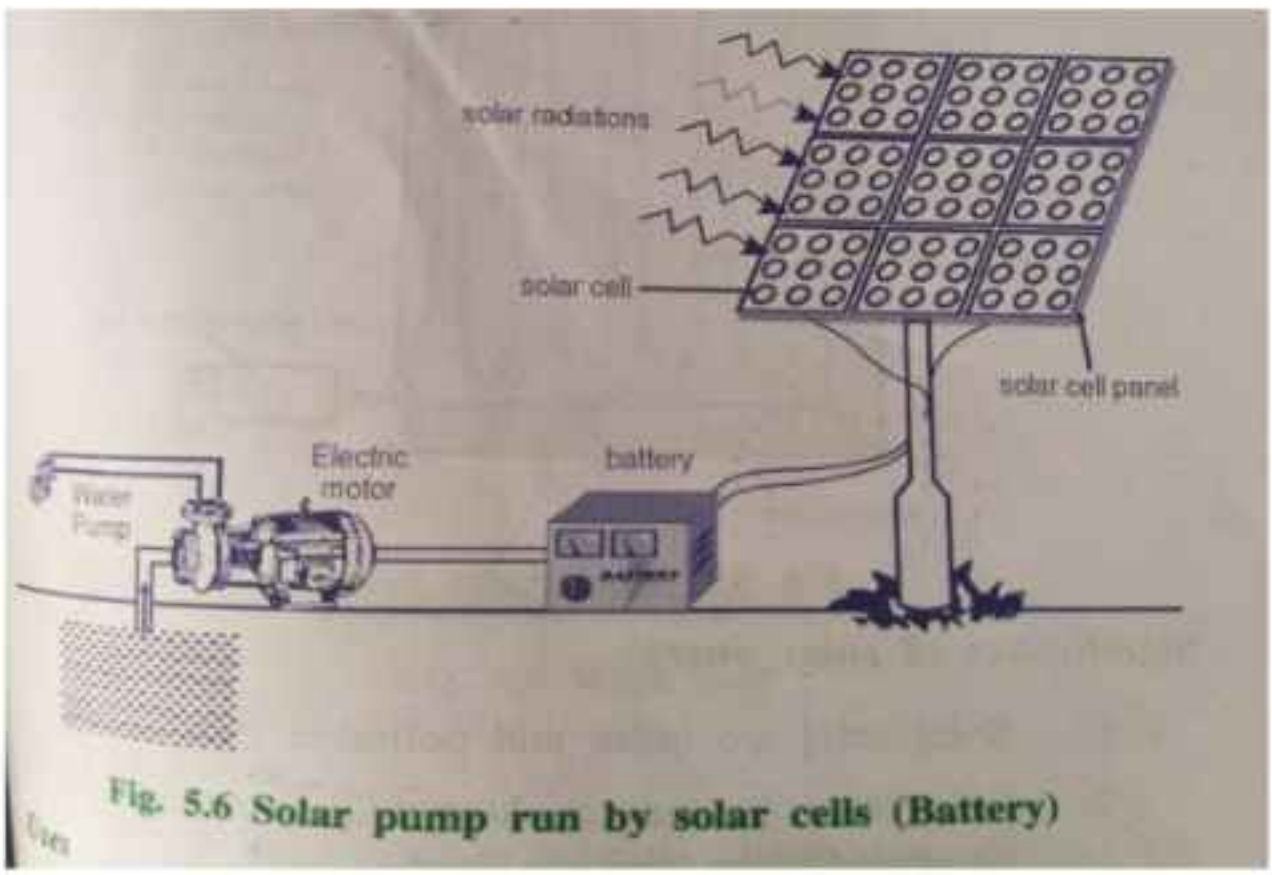


Fig. 5.6 Solar pump run by solar cells (Battery)

(iii) Solar heat collectors

- Solar heat collectors consist of natural materials like stones, bricks, (or) materials like glass.
- They can absorb heat during the day time and release it slowly at night.

Uses

- Used in cold places, where houses are kept in hot condition using solar heat collectors.

(iv) Solar water heater

It consists of

- An insulated box inside of which is painted with black paint.
- Provided with a glass lid to receive and store solar heat.
- Inside the box it has black painted copper coil, which heats the cold water.
- Then flows out into a storage tank.
- From the storage tank water is then supplied through pipes.

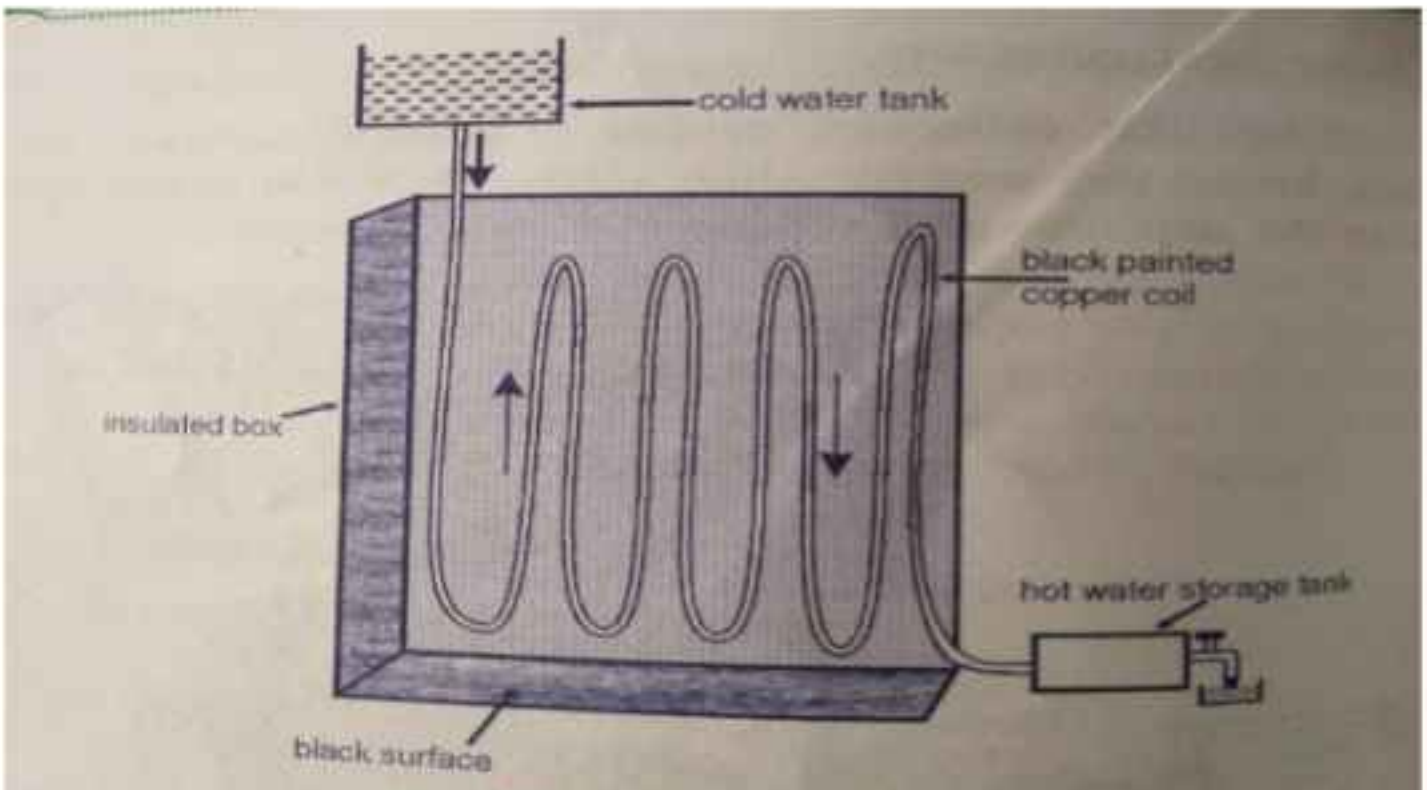


Fig. 5.7 Solar water heater

Significance of Solar energy:

They are noise & pollution free
Solar water heaters, cookers require no fuels
Solar cells can be used in remote & isolated forest & hilly regions.

WIND ENERGY

- Moving air is called wind.
- Energy recovered from the force of the wind is called wind energy.
- The energy possessed by wind is because of its high speed.
- The wind energy is harnessed by making use of wind mills.

Methods of Harvesting wind energy

(a) Wind Mills

- The strike of wind on the blades of the wind mill rotates it continuously.
- The rotational motion of the blade drives machines like water pump, flour mills, electric generators etc.

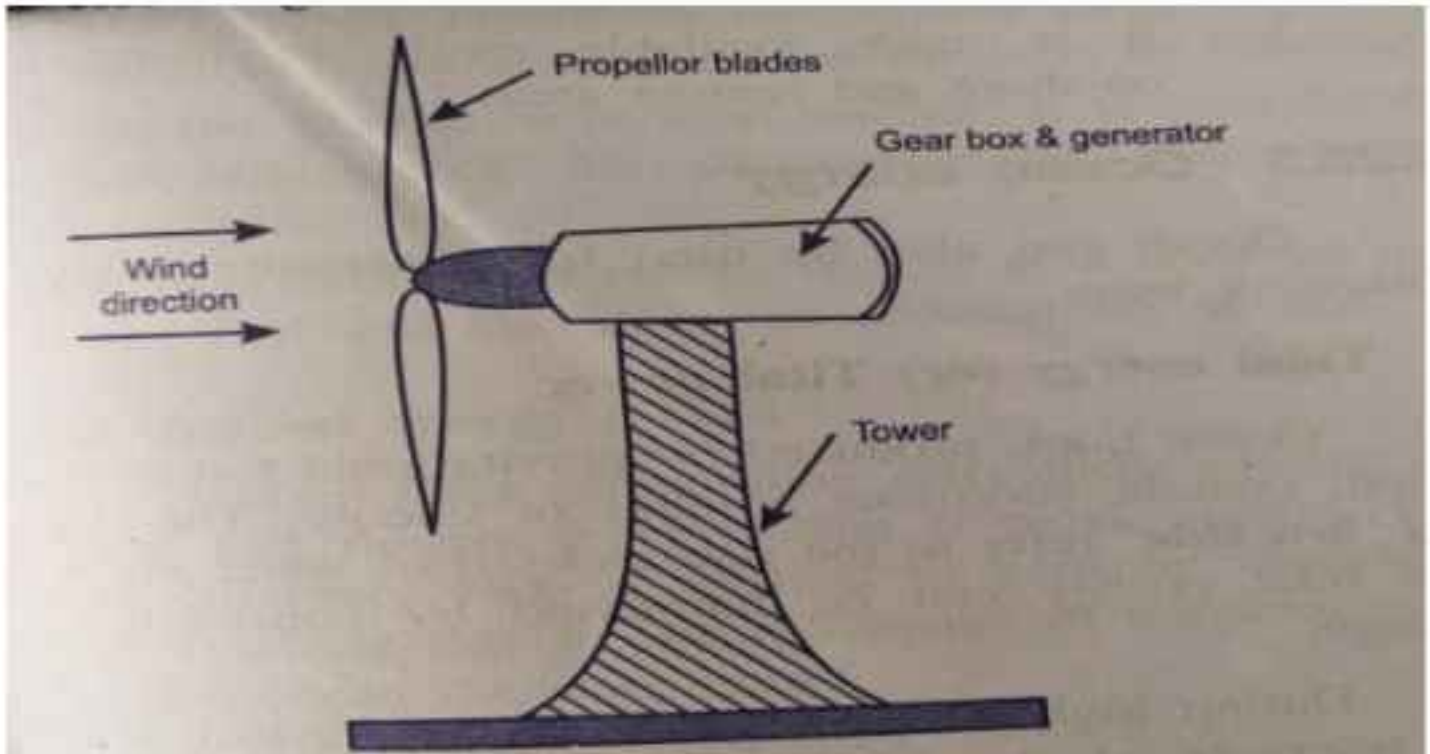


Fig. 5.8 Wind mill

(b) Wind farms

- Wind farm consists of large number of wind mills .
- The wind farms produce a large amount of electricity.

Conditions

The minimum speed required for satisfactory working of a wind generator is 15 km/hr.

Advantages

It does not cause any air pollution and it is very cheap.

OCEAN ENERGY

- It also used for generating energy in the following ways.

(i) Tidal energy (or) Tidal power

Ocean tides, produced by gravitational forces of sun and moon, contain enormous amount of energy.

- The "high tide" and "low tide" refer to the rise and fall of water in the oceans.
- The tidal energy can be harnessed by constructing a tidal barrage.
- During high tide, the sea-water which flow into the reservoir of the barrage, rotates the turbine, which inturn produces electricity by rotating the generators.
- During low tide, when the sea level is low, the sea water stored in the barrage reservoir is allowed to flow into the sea and again rotates the turbine.

Fig. 5.9(a)

Fig. 5.9(b)

Fig. 5.9 (a) Water flows into the reservoir from sea.
Fig. 5.9 (b) Water flows out from the reservoir to the sea.

Significance of tidal energy:

- Do not require large areas.
- Pollution free energy source.
- No fuel is used
- Does not produce any wastes.

(ii) Ocean thermal energy (OTE)

- The temperature difference between the surface level & deeper level of the oceans are used to generate electricity.

- The energy available due to the difference in temperature of water is called ocean thermal energy.

Condition

The temperature difference should be of 20^0C or more between surface water and deeperwater.

Process

- The warm surface water of ocean is used to boil a low boiling liquid like ammonia.
- The high vapour pressure thus produced turns the turbine of the generator and generates electricity.

Significance: OTE is Continuous, renewable, pollution free, used to produce H_2.

(iii) Geo-thermal Energy

- The energy harnessed from high temperature & pressure present inside the earth is called geothermal energy.

1. Natural geysers

- In some places, the hot water (or) steam comes from the ground through cracks naturally

2. Artificial geysers

- In some places, we can drill a hole up to the hot region & make the hot water to rush out through the pipe with very high pressure.
- Thus, the hot water (or) steam coming out from the natural (or) artificial geysers is allowed to rotate the turbine of a generator to produce electricity.

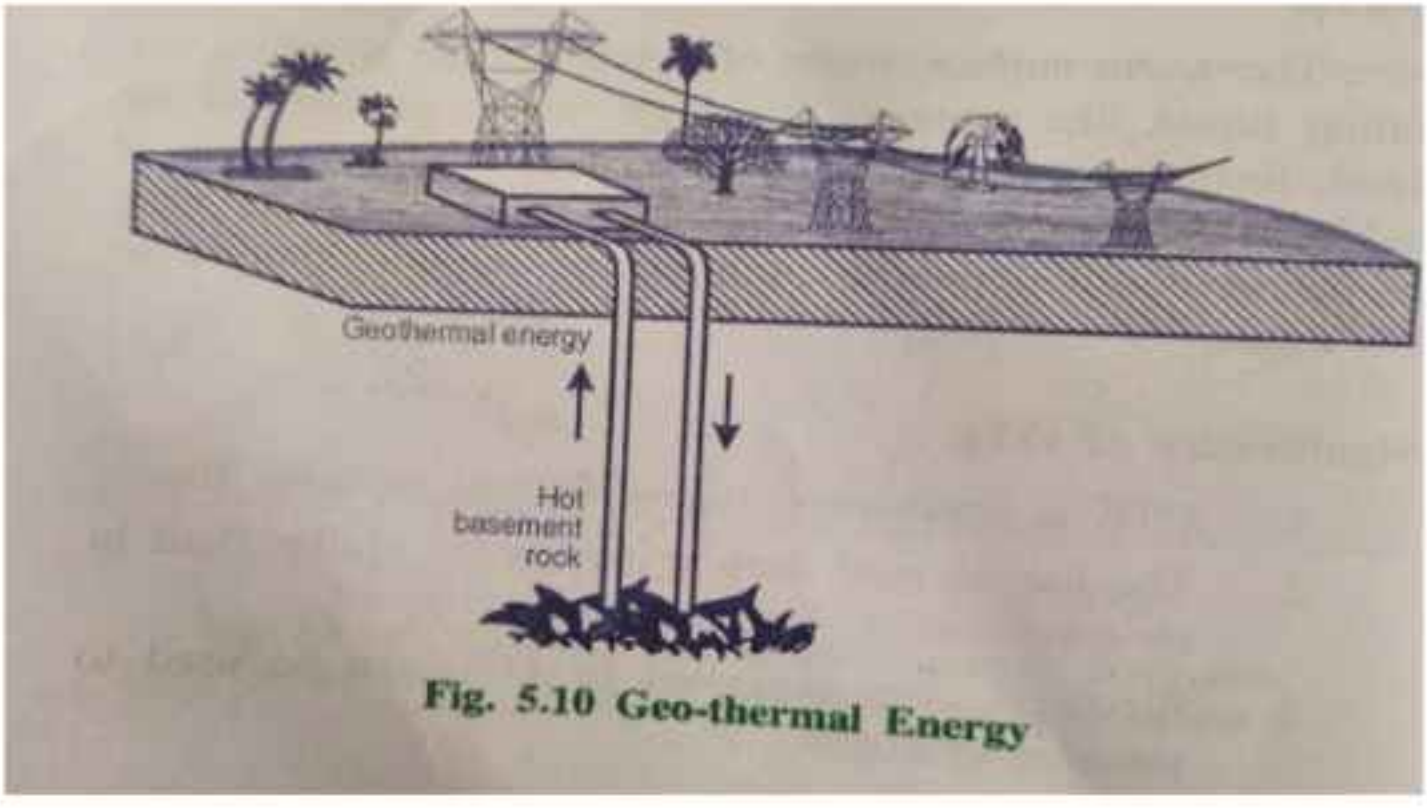


Fig. 5.10 Geo-thermal Energy

Significance:

- Power generation is higher than solar & wind energies.
- Can be brought on line quickly.
- Used for direct uses such as hot water bath, resorts, aquaculture, greenhouses.

BIOMASS ENERGY

- Biomass is the organic matter, produced by plants or animals, used as source of energy.
- Most of the biomass is burned directly for heating, cooling and industrial purposes.

Ex: Wood, crop residues, seeds, cattle dung, sewage, agricultural wastes.

(a) Biogas

- Mixture of methane, carbondioxide, hydrogen sulphide, etc.
- It contains about 65% of methane gas as a major constituent
- Biogas is obtained by the **anaerobic fermentation** of animal dung or plant wastes in the presence of water.

(b) Bio fuels : *Biofuels are the fuels, obtained by the* ***fermentation*** *of biomass.*

Examples:

(i) Ethanol : Easily produced from the **sugarcane**. Its calorific value is less than petrol, and produces much less heat than petrol.

(ii)Methanol : obtained from **ethanol or sugar**-containing plants. Its calorific value is also too low than gasoline and diesel.

(iii)Gasohol = Gasohol is a mixture of **ethanol** + **gasoline**.

(c) Hydrogen Fuel

- Hydrogen can be produced by **thermal dissociation** or **photolysis** or **electrolysis** of water.
- It possesses high calorific value.
- It is non-polluting, because the combustion product is water.

$$2H_2 + O_2 \text{----->} 2H_2O + 150KJ$$

Disadvantages of hydrogen fuel

1. Hydrogen is highly inflammable and explosive in nature
2. Safe handling is required
3. It is difficult to store and transport.

NON-RENEABLE ENERGY RESOURCES

- It has accumulated in nature over a long time and cannot be renewed when exhausted.
- Ex: Coal, Petroleum, LPG, Natural gas etc.

(i) Coal

- Coal is a solid fossil fuel formed in several stages.
- It is subjected to intense heat and pressure over millions of years.

Various stages of coal

Wood ----→Peat ------ →Lignite -----→Bituminous coal ------→ Anthracite

Disadvantages

1. When coal is burnt it produces CO_2 causes global warming
2. Coal contains impurities like S and N, it produces toxic gases during burning.

(ii) Petroleum

- Petroleum or crude oil is a thick liquid consists of more than hundreds of combustible hydrocarbons and small amount S, O, N as impurities.

Occurrence

- Petroleum was formed by the decomposition of dead animals and plants, that were buried under lake and ocean at high temperature and pressure for millions of years

Fractional distillation

- Hydrocarbons are separated by fractioning the crude oil.

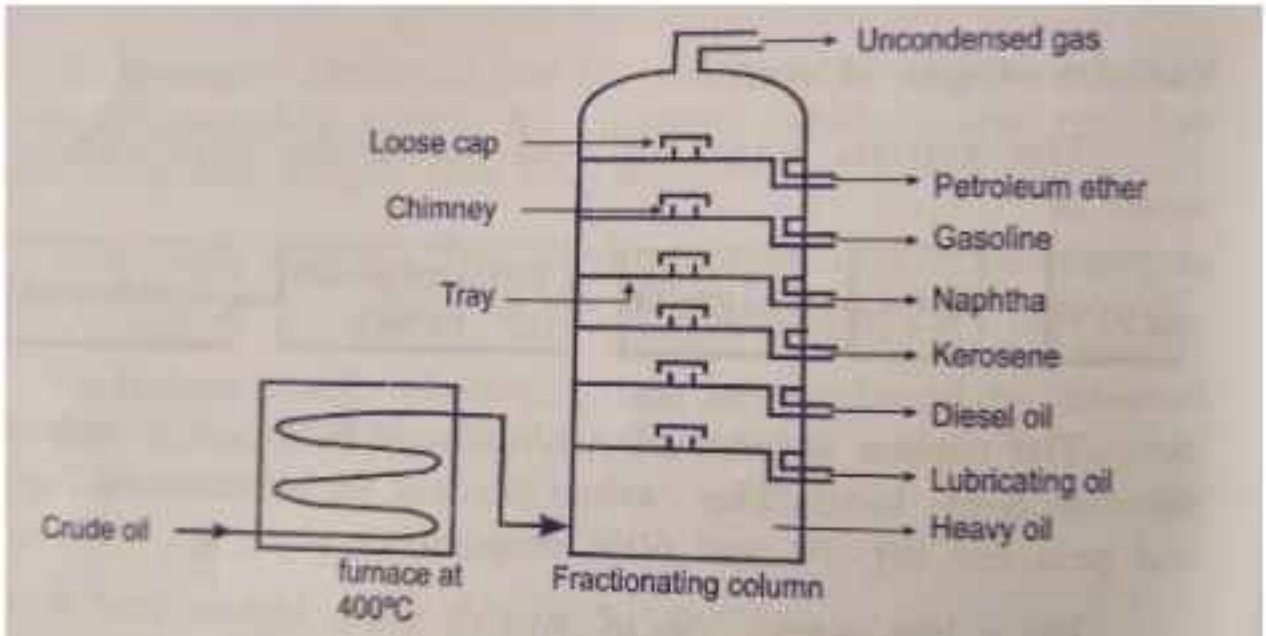


Fig. 5.12 Fractionating column

(iii) LPG (Liquefied Petroleum Gas)

- The petroleum gas, **converted into liquid** under high pressure is LPG
- LPG is colorless and odorless gas.
- During bottling some **mercaptans** is added, to detect leakage of LPG from the cylinder.

(iv) Natural Gas

- Mixture of **50-90% methane** and small amount of other **hydrocarbons.**
- Its calorific value ranges from 12,000-14,000 k-cal/m^3.

(i) Dry gas = the natural gas + lower hydrocarbons like methane and ethane, is called dry gas.

(ii) Wet gas = natural gas + higher hydrocarbons like propane, butane along with methane is called wet gas.

NUCLEAR ENERGY

- Dr. H. Bhabha is the father of nuclear reaction.
- India has 10 nuclear reactors, which produce 2% of India's electricity.

(a) Nuclear Fission

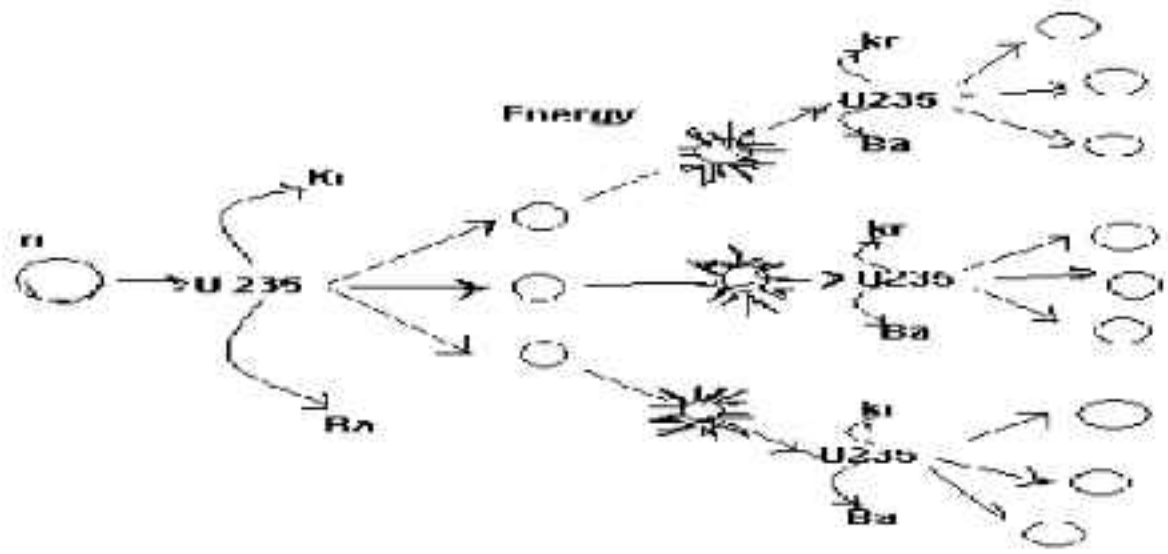
- Heavier nucleus is split into lighter nuclei, on bombardment by fast moving neutrons, and a large amount of energy is released.

Ex: Fission of U^{235}

- When U^{235} nucleus is hit by a thermal neutron, it undergoes the following reaction with the release of **3** neutrons.
- $_{92}U^{235} + {}_0n^1 \text{ ----- } \rightarrow {}_{56}Ba^{140} + {}_{36}Kr^{93} + 3\,{}_0n^1 + \text{Energy}$
- Each of the above 3 neutrons strikes another U^{235} nucleus causing (3x3) 9 subsequent reactions.
- These 9 reactions further give rise to (3x9) 27 reactions.
- This process of propagation of the reaction by multiplication in threes at each fission is called **chain reaction.**

Fission reaction of U^{235} is given below.

$_{92}U^{235} + {}_0n^1 \text{ ----- } \rightarrow {}_{56}Ba^{140} + {}_{36}Kr^{93} + 3\,{}_0n^1 + \text{Energy}$



Nuclear fission-chain reaction

(b) Nuclear fusion:

Lighter nucleuses are combined together at extremely high temperatures to form heavier nucleus and a large amount of energy is released.

Ex: **Fusion of** $_1H^2$

Two $_1H^2$ (Deuterium) atoms may fuse to form helium at 1 billion ^0C with the release of large amount of energy.

$$_1H^2 + {}_1H^2 \rightarrow {}_2He^4 + \text{energy}$$

$$_1H^2 + {}_1H^3 \rightarrow {}_2He^4 + {}_0n^1 + \text{energy}$$

Nuclear power of India

- Tarapur (Maharashtra),
- Ranapratap Sagar (Rajasthan)
- Kalpakkam (Tamil Nadu)
- Narora (U.P).

USES OF ALTERNATE (RENEWABLE) ENERGY RESOURCES (OR)

NEED OF ALTERNATE (RENEWABLE) ENERGY RESOURCES

1. It protect the environment from pollution.
   - Radioactive pollutants released from nuclear power plant are highly dangerous. The radioactive waste also requires large land or aquatic area which can cause harmful effects to human beings and aquatic life respectively.
   - In thermal power plant, burning of coal, wood, oil etc., produces smoke which causes respiratory and digestive problems which leads to lungs, stomach and eye diseases. After burning, disposal of fly ash requires large ash ponds.
   - All the problems are solved by using alternative energy resources like Wind energy, Tidal energy, Geothermal energy, Hydroelectric power station, etc.

2. Hydroelectric power project does not upset the ecology.
3. Alternative energy resources reduce the production cost. It is also continuously available and the energy can be drawn at any time.
4. It causes very less environmental impact.
5. Fossil fuels are non-renewable energy resources which are replaced by solar energy.
6. Useless waste materials like food waste, wood, crop residues cattle dung, sewage waste, etc., are converted into useful biogas. This process reduces the pollution and also gives pollution less useful product.
7. Thus, non-conventional energy resources are essentially required.

CASE STUDIES

Wind energy in India

- India has generating 1200 Mw electricity using wind energy.
- The largest wind farm of our country is near Kanyakumari in Tamil Nadu, which generates 380 Mw electricity.

Hydrogen-fuel cell car

- General motor company of china discovered the experimental cars, which run on electric motors fueled by hydrogen and oxygen.
- This car produces no emission, only water droplets and water vapour come out of the exhaust pipe.

ENERGY CONSERVATION PROCESSES

- It is the process of changing energy from one form to another.
- **Energy source ----------→ Energy conversion ----------→ useful Energy**
- Examples for different energy conversion

Energy Sources	Types of Energy	Energy after conversion
Hydro (water)	Potential Energy	Kinetic energy → Electrical Energy
Wind, Hydro	Kinetic Energy	Electrical Energy
Geothermal, Ocean – Thermal	Thermal Energy	Mechanical Energy → Electrical Energy
Solar	Radiant Energy	Thermal Energy → Electrical Energy.

ANAEROBIC DIGESTION

- It is a series of biological processes in which micro-organisms break down biodegradable materials in the absence of oxygen.
- The end of the product is bio-gas.
- Anaerobic digestion is used to convert livestock manure, municipal waste water, solids food waste, high strength industrial waste water and residuals, fats oils and greases into bio-gas.

Steps involved in anaerobic digestion

Step: I Hydrolysis

- Breakdown the insoluble organic polymers to soluble materials such as carbohydrates and make them available for bacteria.

Step: II Acidogenesis

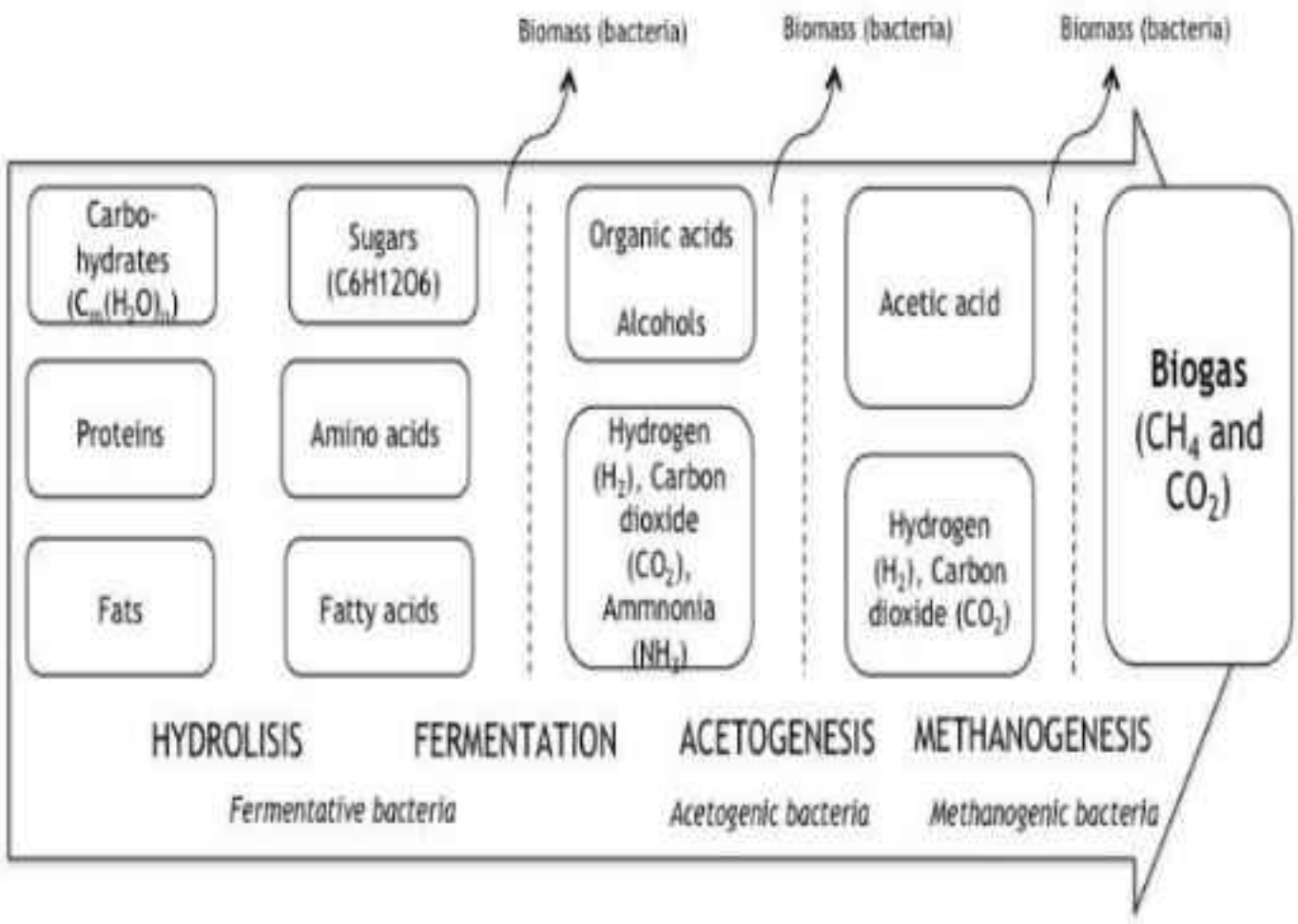
- Acidogenic bacteria convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia and organic acids.

Step: III Acetogenesis

- The organic acids are converted into acetic acid along with additional ammonia, hydrogen and carbon dioxide by the acetogenic bacteria.

Step: IV Methanogenesis

- Finally, the above products are converted into methane and carbon dioxide by methanogenesis.



BIO-GAS

Bio-gas is a mixture of various gases formed by the anaerobic degradation of biological matter (cow dung) in the absence of free oxygen.

Composition of Bio-gas

Compound	%
Methane	50 – 70
Carbon dioxide	25 – 50
Nitrogen	0 – 10
Hydrogen	0 – 1
Hydrogen Sulphide	0 – 3
Oxygen	0

Production of Bio-gas

- Bio-gas is produced in a bio-gas plant.

Construction

- Bio-gas plant consists of a well like underground tank (called digester) covered with dome shaped roof with gas out let pipe.
- The dome of the digester acts a gas holder.
- On the left hand side of the digester there is a sloping inlet chamber through which cattle dung + water slurry is introduced.
- On the right hand side, there is a outlet chamber, through which spent dung slurry gets collected.

Working

- Slurry (animal dung + water) is fed into the digester through the inlet chamber.
- It is left for about two months for fermentation.
- Anaerobic micro-organisms are responsible for this action.
- As a result of anaerobic fermentation, bio-gas is collected in the dome.
- When sufficient amount of bio-gas is collected in the dome, it exerts a large pressure on the slurry and this in turn forces the spent slurry to the over flow tank through the outlet chamber.
- Once the bio-gas plant starts functioning, more and more slurry may be fed into the digester to get continuous supply of bio-gas.

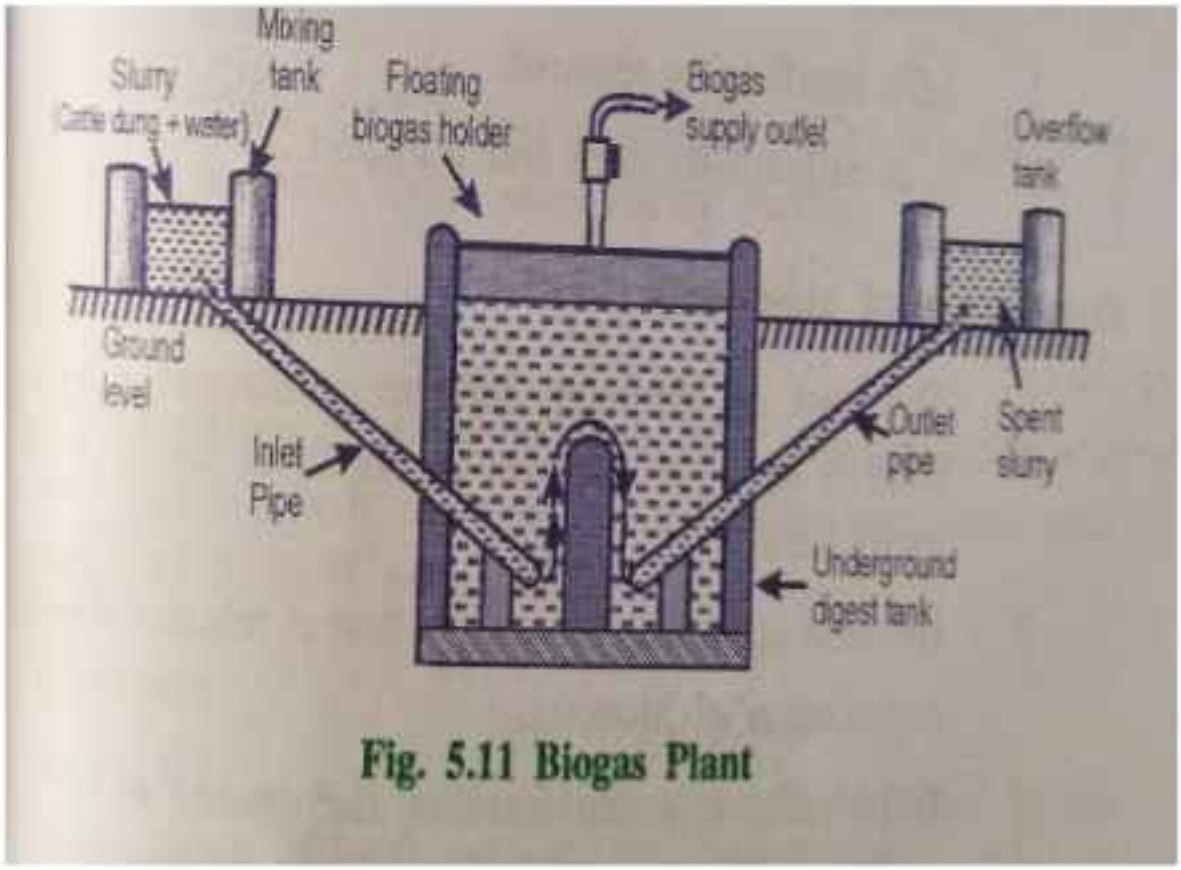


Fig. 5.11 Biogas Plant

Uses

- Bio-gas is used for cooking food and heating water.
- Used to run engine.
- Used as an illuminant in villages
- Used for running tube-well and water pump-set engines.
- It also used in gas turbines and fuel cells for producing electricity.

LAND RESOURCES

Land as a resource

- Land is the most important and valuable resources for mankind and it provide food, fibres, wood medicine and other biological materials needed for food.
- Soil present in the land provides the various minerals for plants growth which supports the life supporting systems.
- The land resources are classified as renewable resources, because it is continuously regenerated by natural process at a very slow rate. But, if the rate of erosion is faster than the rate of renewal, then the land resource becomes a non-renewable resource.

Uses of land

- Keeping effective biodiversity
- Food production
- Mineral deposits and ground water
- Wet lands

- Irrigation
- Industrial production
- Biogeochemical cycle, waste distribution and disposal
- Infrastructure development like houses, buildings, dam etc.

LAND (SOIL) DEGRADATION

- It is defined as any change in the land that reduces its quality and productivity.
- It is also defined as deterioration of soil or loss of fertility of soil.

Cause of land degradation

(i) Population

- Increase in population increases the pressure on the limited land resources for the production of food, fuel wood etc. So, the soil gets degraded due to over-exploitation.

(ii) Urbanization
(iii) To increase the crop productivity excessive fertilizers and pesticides are used which leads to pollution of land.
(iv) Increase in food production leads to nutrient depletion in the top soil.
(v) disposal of industrial waste, Water-logging, soil erosion, salinization also cause land degradation.

Effect of land (soil) degradation

- Decrease in the quality of soil texture and soil structure.
- Loss of soil fertility and net productivity.
- Loss of economy and biodiversity.
- Increase in salinity and water logging.
- Desertification

SOIL EROSION

- It is defined as the removal of top fertile soil from one place to another.

Types of soil erosion

Normal erosion: gradual removal of top soil by the natural processes. Rate of erosion is slow.
Accelerated erosion: it is mainly due to man-made activities. The rate of erosion is faster than the rate formation of soil.

Causes of Soil erosion

- Deforestation without reforestation.
- Overgrazing of cattle.
- Surface mining without land reclamation.

- Poor irrigation techniques.
- Landslides also cause soil erosion
- Construction of developmental projects also removes the vegetal cover which leads to soil erosion.
- Water affects soil erosion in the form of rain, run-off, rapid flow etc.
- Wind is also carrying away the fine particles of soil and creates the soil erosion.

Effects of Soil erosion

- Loss of top soil
- Soil loss its ability to hold water and sediments.
- Transported sediments pollute the water and affects the aquatic life.
- Decrease the crop productivity.

Control measure

- Minimizing the effects of rainfall impact on the soil surface.
- Minimizing the volume or velocity of run-off water.
- Reforestation.

DESERTIFICATION

- It is the progressive destruction or degradation of existing vegetation cover from the land surface to form desert.

Causes of desertification

- Deforestation
- Mining and Quarrying
- Overgrazing
- Climate change (failure of monsoon, drought, flood etc.)
- Pollution
- Desertification is identified by de-vegetation, loss of vegetal covers, depletion of ground water, salinization and severe soil erosion.

Effects of desertification

- Increase in surface runoff and stream discharge.
- Reduction of water infiltration and ground water recharge.
- Reduction of soil fertility.
- Around 600 million people are threatened by desertification.

MAN-INDUCED LANDSLIDES

- Landslides are the process of downward movement of a part of land portion on another land portion.
- It occurs mainly in the hill regions.

- If the landslides occur due to man-made activities such as mining, construction of dams, roads, railway track etc., then the landslides are called man-induced landslides.

Causes of landslides

- Over-exploitation of groundwater
- Improper mining operation and its abandonment.
- Construction of dams on faulty plans
- Improper border road slopes
- Deforestation
- Improper construction of small hydropower plants in hilly regions.
- Tunneling of transport and water ways.
- Large scale disposal of hazardous waste.
- Removal of vegetation

Effects of landslides

- Loss of habitat and biodiversity
- Large scale destruction of vegetation
- Increase the turbidity of nearby water sources and reducing the land productivity.
- Destruction of communication links.
- Loss of infrastructure and economy.

ROLE OF INDIVIDUAL IN CONSERVATION OF NATURAL RESOURCES:

1.*Conservation of energy*

- Turn off lights, fans and other appliances when not in use.
- Dry the clothes in sun instead of drier
- Use solar cooker for cooking food on sunny days and will cut down LPG expenses.
- Grow trees and climbers near the houses and get a cool breeze and shade. This will cut off electricity charges on coolers and A/C
- Ride bicycle or just walk instead of using your car or scooter.
- Always use pressure cooker.

2.*Conservation of water:*

- Use minimum water for all domestic purpose
- Check for water leaks in pipes & toilets & repair them properly
- Reuse the soapy water after washing clothes for washing courtyards, drive ways etc.
- Use drip irrigation to improve irrigation efficiency & reduce evaporation
- The waste water from kitchen, bath tub can be used for watering the plants
- Build rainwater harvesting system in your home

3.*Conservation of soil:*

- Grow plants, trees & grass which bind the soil & prevent its erosion
- Don't irrigate the plants using strong flow of water, as it will wash off the top soil
- Soil erosion can be prevented by the use of sprinkling irrigation
- Use green manure in the garden, which will protect the soil
- Use mixed cropping, so that specific soil nutrients will not get depleted
- While constructing the house don't uproot the trees

4.*Conservation of food resources:*

- Eat minimum amount of food, avoid over eating.
- Don't waste the food, instead give it to someone before getting spoiled
- Cook only required amount of food
- Don't cook food unnecessarily
- Don't store large amounts of food grains & protect them from insects.

5. *Conservation of forest:*

- Use non-timber products
- Plant more trees & protect them
- Grassing, fishing must be controlled
- Minimize the use of papers & fuel wood
- Avoid developmental work like dam, road and construction in forest areas.

EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLES

- Equity means fairness or principles of justice.
- Equitable use of resources is a concept which deals with the rational use of resources between man's resource requirement and availability.

Sustainable development

- Sustainable development is the development of health environment without damaging the natural resources and it must be available for the future generation.

Unsustainable development

- Unsustainable development is the degradation of the environment due to over utilization and over exploitation of the natural resources.

Causes for unsustainability

- Major reason for unsustainability is the difference between developed nations and developing nation.

(i) In developing nations, due to over population and low income, they consumes too low natural resources
(ii) In developed countries, due to low population and more income they consume more natural resources.

- Hence, it is necessary to redistribute the productive assets with in nation and country.

Tools for sustainable development

- In order to achieve sustainable life styles,

(a) It is essential to equally distribute the natural resources and income to everyone in order to meet the basic needs.
(b) The developed countries should minimize their natural resources consumption and provide the excess resources to poor countries.
(c) Providing incentives and assistance for development of poor nation

- So that the differences between poor and rich countries will be reduced and which will also lead to sustainable development.

CONFLICTS OVER WATER:

- Due to increase in population and decrease in water resources, conflicts over water start.

1. Conflicts through use:

- Unequal distribution of water led to inter-state or international disputes.

Examples:

a. **International conflicts:**

- India & Pakistan fight to water from the Indus.
- Iran & Iraq fight for water from Shatt-al-Arab water
- India & Bangladesh fight for Bhramaputra river
- Mixico & USA fight over Colorado river.

b. **National Conflicts:**

- Sharing of Cavery water problem between Karnataka & Tamilnadu.
- Sharing of Krishna water problem between Karnataka & Andhra Pradesh.
- Sharing of Siruveni water problem between Tamilnadu & kerala.

2. Construction of Dams/Power stations:

- For hydroelectric power generation, dams built across the rivers, initiates conflict between the states.

3. Conflict through pollution:

- Rivers & Lakes are used for electricity, shipping & for industrial purpose.
- Disposal of waste water & industrial waste decrease the quality of water & causes pollution.
- Thus the problem of cleaning the water takes on an international conflict.

CASE STUDY

CONFLICTS ON INDIAN RIVER:

- In India most of the rivers are polluted, mainly because of direct inflow of untreated sewage.

Examples:

Damodar river → It is the most polluted river, carrying 43 industries discharges/

Yamuna river → 19,000 cubic meters of Water containing DDT derivatives are dumped in the river.

Ganga river → 1000 cubic meters of polluted water from 68 industries are discharged in the river.

Periyar river → The River is dying due to mining of 4,37,000 tonnes of sand everyday & become salty due to intrusion of sea water

Suriyaqalayan river → 34 tanneries located around this river contaminate drinking water, & make soil unfit for agriculture.

Thamraparni river → Continous brick making on its bank has converted the river into mud pools.

CAVERY WATER DISPUTE:

- It is an important conflict between Tamil Nadu and Karnataka.
- Tamil Nadu, occupying in downstream region of the river, wants water-use regulated in the upstream. But the upstream state Karnataka refuses to do so.
- The Cauvery water dispute Tribunal set up on 2nd June 1990, directed Karnataka to ensure 205 TMCF of water to Mettur dam every Year.

WATER CONFLICTS IN THE MIDDLE EAST :

In Ethiopia, Sudan & Egypt

- Three river basins, that is, the Jordan, the Tigris-Euphrates and the Nile, are the shared water resources by the Middle East countries.
- Ethiopia controls 80% of the Nile's flow and plans to increase it.

- Sudan is also trying to divert more water
- Egypt, is badly affected on except, which is more or less a desert, a thin strip of irrigated cropland along the river Nile.
- The population of Egypt is likely to double in the next 15 – 20 years, thereby water crisis increases.

DROUGHT

- Drought is nothing but scarcity of water, which occurs due to inadequate rainfall, late arrival of rains and excessive withdrawal of ground water.
- Thus the lack of water for the normal needs of agriculture, livestock, industry or human population may be termed as a drought.
- Drought is understood from dry weather, which persists long enough to produce a serious hydrological imbalance, leading to damage of plants, animals and human life.

Types of drought

Drought are classified into four types

1. Meteorological drought
2. Hydrological drought
3. Agricultural drought
4. Socio-economic drought.

Meteorological drought

- It occurs when the total amount of rainfall is less than 75% of the normal rainfall. This drought will be severe if the rainfall is less than 50% of the normal rainfall.

Hydrological drought

- It occurs when the total amount of rainfall is less than the average rainfall. It is generally associated with reduction of statistical average of water reserves available in source such as aquifers, lake and reservoirs.

Agricultural drought

- This occurs due to the shortage as well as the timing of overall rainfall, which inturn reduce the ground water and reservoir levels, soil moisture. Agricultural drought affects the cropped plants

Socio-economic drought

- It occurs due to reduction in the availability of food and social security of the people in the affected areas. Socio-economic drought leads to famine.

Causes of drought

- When annual rainfall is below normal and less than evaporation, drought is created.
- High population is also another cause for drought. Population growth leads to poor land use and makes the situation worse.
- Intensive cropping pattern and over exploitation of scarce water resources through dug well or bore well to get high productivity has converted drought prone areas into desert.
- Deforestation leads to desertification and drought too.

Effects of drought

- Drought causes hunger, malnutrition and scarcity of drinking water and also changes the quality of water.
- Reduce the crop productivity and adversely affects human and livestock population.
- It leads to desertification
- It leads to degradation of natural resources.
- It leads migration of people and urbanization.

Drought management

- Indigenous knowledge in control of drought and desertification is very useful for dealing with the problems.
- Rain water harvesting method is used to conserve more water and to control drought.
- To improve the ground water level in drought area.
- Use modern irrigation technique to conserve the water.
- Afforestation activities also improve the potential of water in drought area.
- Use mixed crop which minimize the risks of crop failures in dry area.

IMPORTANT UNIVERSITY QUESTIONS

1. Describe the **causes, effects and prevention measures of deforestation.**
2. Discuss the uses and effects of **over-utilization of surface and ground water** sources.
3. Discuss the **effects of dam on forest and tribal people.**
4. Discuss the **benefit and problems of dam** construction. **(merits and demerits of dam)**
5. What are the **changes caused by agriculture and overgrazing?**
   (OR) Explain the adverse environmental impacts of **modern agriculture.**
   (OR) Write notes on use and effect of **fertilizers and pesticides.**
6. Discuss the environmental effects of extracting and using of **mineral resources.**
7. Write short notes on (i) **world food problems** (ii) **water logging and salinity.**
8. Discuss the production of **biogas.** Mention **its uses.**
9. What are **renewable resources**? Explain the methods of **harnessing** the wind and solar **energy.**
10. Briefly discuss the **needs for alternative energy resources.**
11. What is **land degradation?** Discuss the causes and effects of land degradation.

12. What is **soil erosion?** Discuss the causes and effects of soil erosion.
13. What is **desertification?** Discuss the causes and effects of desertification.
14. Write short notes on **man-induced landslide**.
15. Explain in detail the **role of an individual in conservation of natural resources**.
16. Discuss the **impact of mining** on environment and human health.
17. Write short notes on **(i) drought (ii) water conflict.**

UNIT IV **SOCIAL ISSUES AND ENVIRONMENT**

INTRODUCTION

- About 16% of world population lives in India but only 2.4% of land area is available.
- More population, more natural resources are consumed. Hence there is a heavy pressure on the natural resources including land.
- An average Indian consumes a much lower amount of resources than a person in the developing world.
- Green revolution of 1960's could meet India's growing demand for food, but there are recognized soil health problems like deficiency of *micronutrients, organic matter, soil salinity & damage of soil structure.*
- There is a need to develop & modernize the technologies without losing our sound traditional values & practices.

FROM UNSUSTAINABLE DEVELOPMENT TO SUSTAINABLE DEVELOPMENT

- Sustainable development is defined as, ***"meeting the needs of the present without compromising the ability of future generations to meet their own needs".***

True sustainable development aims at optimum use of natural resources with

- high degree of reusability
- Minimum wastage
- Least generation of toxic byproducts &
- Maximum productivity

Dimensions of sustainable development

Sustainable development is multi-dimensional concept aiming at benefits derived from the *interactions between society, economy & environment.*

123 Dimensions of sustainable development

Aspects of sustainable development

Inter-generational equity

It states that we should hand over safe, healthy & resourceful environment to our future generation.

Intra-generational equity

It state that the technological development of rich countries should support the economic growth of poor countries and helps to improve their wealth.

Approaches for sustainable development

- *Developing appropriate technology*

  It is the one, which is locally adaptable, eco-friendly, resource efficient and culturally suitable. It uses less resource and produces minimum waste.

- *Reduce, reuse, recycle [3R] approach*

  It insists optimum use of natural resources, using it again and again instead of throwing it on the waste land or water and recycling material into further products it reduces pressure on our natural resources and reduces waste generation and pollution.

- *Providing environmental education and awareness*

  By providing environmental education and awareness, the thinking and attitude of people towards our earth and the environment can be changed.

- *Consumption of renewable resources*

  In order to attain the sustainability, it is very essential to consume the renewable resources.

- *Conservation of non-renewable resources* – conserved by recycling and reusing

- *Population control.* – To control population by adapting modern techniques.

URBAN PROBLEMS RELATED TO ENERGY

Urbanization is the movement of human population from rural areas to urban areas for the want of better education, communication, health, employment, etc.

Causes of urbanization

Since cities are the main centers of *economic growth, trade, transportation, education, medical facilities & employment, rural people moves to cities.*

Urban sprawl

- About 50% of the world population lives in urban area & people from rural area is moving to cities for employment.
- Thus the urban growth is so fast & it is difficult to accommodate all their facilities within a limited area.
- As a result there is spreading of the cities into sub-urban or rural areas.
- This phenomenon is known as ***urban sprawl***.

Energy demanding activities

- ✓ In developing countries, urban growth is very fast & pollution is uncontrollable.
- ✓ When compared to rural people, urban people consume a lot of energy & materials & generate a lot of waste.
- ✓ This is because urban people have a higher standard of life & their lifestyle demands more energy inputs.

Examples for energy demanding activities

- Residential & commercial lightings.
- Transportation including motor cycle, car & public transport
- Modern lifestyle using a large number of electrical gadgets in everyday life.
- Industries using a large proportion of energy.
- Control and prevention of pollution needs more energy.

Thus due to high population growth and high energy demanding activities, the urban problems related to energy are much more magnified as compared to the rural population.

Solution for urban energy problem

1. Urban people may use public transport instead of using motor cycles & cars.
2) Energy consumption must be minimized in all aspects.
3) Use of energy efficient technology.
4) Use of solar energy & wind energy.
5) Imposing strict laws, penalties & energy audit.

WATER CONSERVATION

- The process of saving water for future utilization is known as water conservation.

Need for water conservation

- Though the resources of water are more, the quality and reliability are not high due to changes in environmental factors.
- Better lifestyles need more water.
- As the population increases, the requirement of water is also Increase.

- Deforestation decreases annual rainfall.
- Over exploitation of ground water leads to drought.
- Agricultural and industrial activities require more water.

Strategies of water conservation

The following strategies (measures) can be adopted for conservation of water.

Reducing evaporation losses

- Evaporation of water in humid region can be reduced by placing horizontal barriers of asphalt below the soil surface, which increases the water availability & crop yield.

Reducing irrigation losses

- Sprinkling irrigation & drip irrigation conserves water by 30-40%.
- Growing hybrid crop varieties, which require less water.
- Irrigation in early morning or later evening reduces evaporation losses.

Re-use of water

- Treated waste water can be used for ferti-irrigation.
- Grey water from washings, bathrooms, etc., may be used for washing cars, watering gardens, etc.

Preventing wastage of water

- Closing the taps when not in use.
- Repairing any leakage from pipes.
- Using small capacity of taps.

Decreasing run-off losses

- Run-off on most of the soils can be reduced by allowing most of the water to infiltrate into the soil. This can be done by using contour cultivation or terrace farming.

Avoid discharge of sewage

The discharge of sewage into natural water resources should be prevented as much as possible.

METHODS OF WATER CONSERVATION

There are so many methods available for water conservation, of which the following are important methods

1) Rainwater harvesting
2) Watershed management

RAIN WATER HARVESTING:

It is technique of capturing & storing of rainwater for furtherutilization

Need (or) objectives of rain water harvesting

- To meet the increasing demands of water.
- To raise the water table by recharging the ground water.
- To reduce ground water contamination from the intrusion of saline water.
- To reduce the surface run off loss & soil erosion
- To increase in hydro static pressure to stop land subsidence.
- To minimize water crisis & water conflicts

Concept of rainwater harvesting

- Rainwater harvesting involves collecting water that falls on the roof of house during rain storms & passing it through PVC or aluminium pipe to a nearby covered storage unit.

Method (or) type of Rain water Harvesting

- The most common method of rainwater harvesting is roof top rainwater harvesting.

Roof top rainwater harvesting

- In this method rainwater is collected from the roof of the building & is stored in the ground for future use.
- It is the low cost & effective technique.
- The rainwater from the top of the roofs, road surfaces, play grounds, open lands is diverted into the surface tank or recharge pits through a delivery system.
- This can be used to recharge underground aquifers by diverting the water from stored water to dug-well or bore wells.
- Here the pit base is filled with stones and sand, which serves as a sand filler.

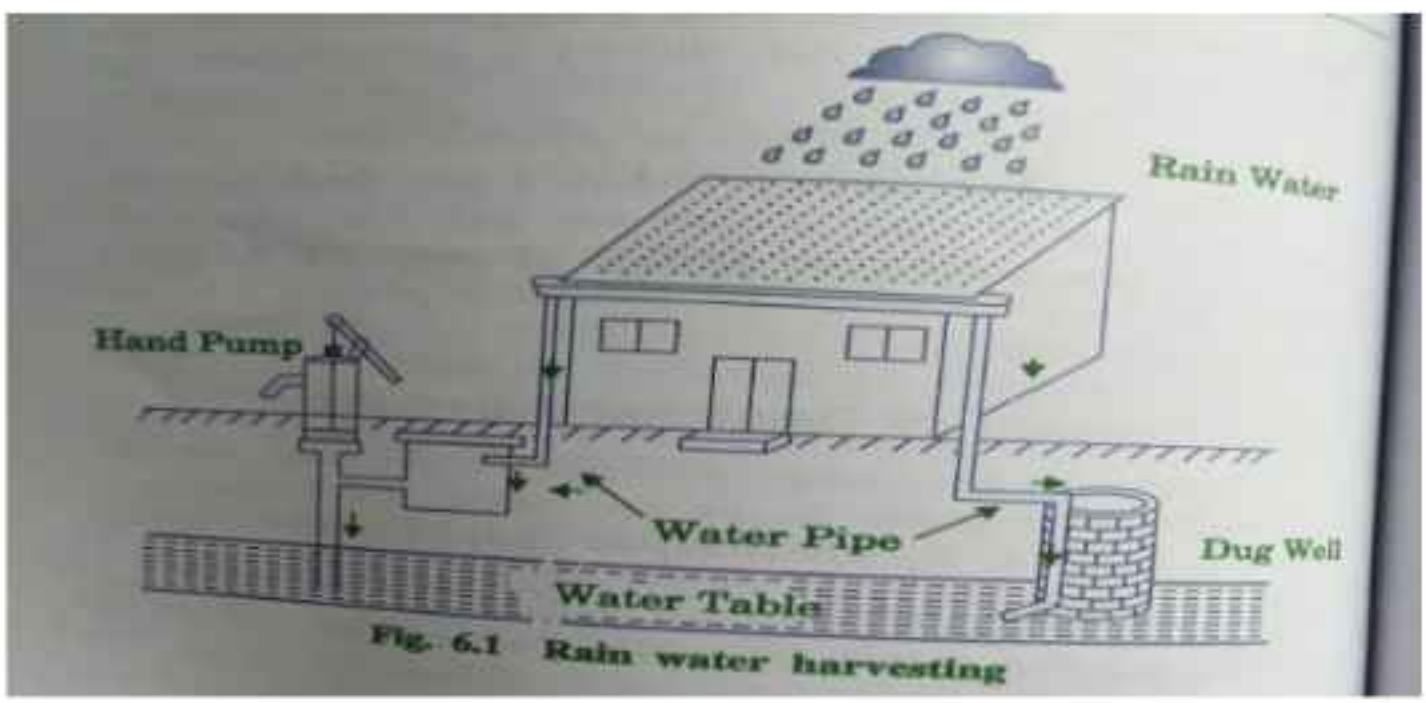


Fig. 6.1 Rain water harvesting

Advantages of Rain water Harvesting :

- Reduces the use of current for pumping water
- Reduce the effect of drought
- Increase the water level in well
- Rise in ground water level
- Minimise soil erosion & flood hazards
- Upgrading the social & environmental status
- Future generation is assured of water.

WATER SHED MANAGEMENT

Watershed (or) Drainage basin

- Watershed is defined as ***the land area from which water drains under the influence of gravity into a stream, lake, reservoir or other body of surface water.***

Watershed management

- ***The management of rainfall and resultant runoff is called watershed management.***
- It also involves conservation, regeneration & proper use of water.

Factors affecting watershed

- The watersheds are found to be degraded due to uncontrolled, unplanned & unscientific land use activities.
- Overgrazing, deforestation, mining, construction activities also affect & degrade various watersheds.
- Droughty climates also affect the watershed.

Need (or) Objectives of watershed management

1) To minimize the risks of floods, droughts & landslides.
2) For developmental activities like domestic water supply, irrigation, hydropower generation, etc.,
3) To generate huge employment opportunities in the backward rain-fed areas to ensure livelihood security.
4) To promote social forestry & horticultural activity on all suitable areas of land.
5) To protect the soil from erosion by runoff.
6) To raise the groundwater level.

Concept of watershed management

Watershed is not a technology but a concept which integrates construction management & budgeting of rainwater through simple but discrete hydrological units.

Watershed management techniques

In watershed management, various civil structures were constructed to improve groundwater storage.

1) **Trenches (Pits)** : Trenches were dug at equal intervals to improve groundwater storage.
2) **Earthern dam (or) Stone embankment** : To check the run-off water, earthen dam must be constructed in the catchment area.
3) **Farm pond** : It can be built to improve water storage capacity of the catchment area.
4) **Underground barriers (Dykes)** : It should be built along the nullahs to raise the water table.

Maintenance of watershed (or) components of integrated watershed management

1) **Water harvesting** – Proper storage of water in watershed is done with provisions that the water can be used in dry seasons in low rainfall areas.
2) **Afforestation & Agroforestry** – help to prevent soil erosion and retention of moisture in watershed areas.
3) **Reducing soil erosion** – Terracing, bunding, contour cropping, strip cropping etc., are used to minimize soil erosion and runoff on the slopes of watersheds.
4) **Scientific mining & quarrying** – minimizing the destructive effects of mining in watershed areas.
5) **Public participation** – People's co-operation is essential for watershed management.
6) **Minimizing livestock population** – Livestock population present in the surrounding villages of the watershed should be reduced.

RESETTLEMENT AND REHABILITATION OF PEOPLE

- **Resettlement is simple relocation or displacement of human population. This process does not focus on their future welfare.**
- **Rehabilitation is defined as the process of replacing the lost economic assets, safeguard employment, provide safe land for building, repair damaged infrastructures, etc.,**
- **Rehabilitation involves making the system to work again by allowing the system to function normally.**
- Resettlement & rehabilitation is one of the most serious problems caused by the developmental activities.
- Though the developmental project raises the quality & standard of living of the people, there is over exploitation of natural resources & degradation of the environment.
- Besides this, the native people are directly affected.

Causes of displacement of people

Due to Developmental activities:

- It includes construction of dams, mining, roads, airports, etc. This activities causes large scale displacement of local people from their home and loss of their traditional profession or occupation.
- **Dams in India :** In our country, a number of big and medium dams have been constructed under different valley projects. The most important social consequences was the displacement of millions of tribal people from their land to urban areas as redugees.

Example:

- **Hirakund dam:** it has displaced more than 20,000 people residing in about 250 villages.
- **Tehri Dam:** it has displaced more than 10,000 residents of Tehri town.

Due to Disaster:

- **Natural disaster:** It includes earthquake, floods, droughts, landslides, volcanic eruptions etc.
- **Manmade disaster:** It includes Industrial accidents, nuclear accidents, dam bursts etc.

Due to conservation initiatives

- These include national park, sanctuary, forest reserves, biosphere reserve etc.

Rehabilitation issues

- In India, most of the displacements have resulted due to land requirements by the government using Land Acquisition Act, 1897.
- Tribal are usually the most affected among the displaced, who are already very poor. Displacement further increases their poverty by losing home, land, jobs, food security etc.
- Break up of families is an important social issue.
- Even if the tribal get cash compensation, they are not familiar with the market policies & trends.
- Loss of identity & loss of the intimate link between the people & the environment is one of the big losses.
- Marriages, social and cultural functions, their folk-songs, dances and activities vanish with their displacement.

Rehabilitation policy

1) The extent of damage & suffering that the proposed project would cause should be studied & ascertained before starting the project.
2) The rehabilitation & resettlement work should be a part of the project & all those affected should be rehabilitated before the commencement of the project.
3) The people should be rehabilitated on "minimum dislocation basis", by choosing adjacent areas.
4) The extent of rehabilitation should meet the ends of social justice & balanced development.

CASE STUDIES

SARDOR SAROVAR DAM

- River Narmada flows through Madhya Pradesh, Maharashtra and Gujarat and merges in Arabian sea. The Sardor Sarovar Dam is situated in the Narmada Valley.

Issue

- As a result of construction of dam, about 573 villages consisting 10 lakh people would be homeless and 45,000 hectares of forest and 2,00,000 hectares of cultivated lands would be submerged in Maharashtra.
- The affected tribal people must be given adequate compensation in the form of land, jobs, cash compensation, etc. and care should be taken to improve their quality of their life.

TEHRI DAM PROJECT

- It constructed across the rivers Bhagirathi and Bhilanganga, close to the Gashwal town of Tehri. The dam would submerge nearly 100 villages, including Tehri, a historical village, 85,600 families will have relocated.

PONG DAM

- It is constructed on Beas River in Himachal Pradesh and Punjab. The water is utilized to irrigate Rajasthan. Therefore, Rajasthan agreed to provide land to the outsides in the area of Indira Gandhi Canal.
- Out of 30,000 families uprooted due to Pong Dam, only 16,000 were considered eligible for allotment, as there were only bonafide cultivators.

ROLE OF NON-GOVERNMENTAL ORGANIZATION (NGO)

- Non-government organization is a people's organization which is working for the protection of the environment.
- Voluntary organizations help the government in local environmental issues & interact at grass root level.

Important roles of NGO's

- To protect environment resources and their economical use.
- To organize courses like lectures, seminars.
- To create informational materials like newsletters, brochures, booklets, articles and videos.
- To analyses and monitor the resources independently.
- To protect the rights of the citizens to a healthy environment and the consumer's rights to clean environment.
- To keep vigil in the surrounding area, well, river, lake, land and air against pollution and reporting to state board/central board.
- To conduct sampling and analysis of well or river water to establish its quality.
- To publish the notified restricted areas where industries, industrial operations should not be carried out.

Some important NGO's in India

- The NGO, "***mahila mandals***", create awareness among the women in remote villages by educating & helping them to become healthy & economically self-dependent.
- Kerala Sastra Sahitya Parishad, Centre for Science & Environment (CSE). The report as per CSE on permissible limits of pesticides in the cola drinks sensitized the public all over the country.
- Bombay Natural History Society (BNHS), Madras Naturalists Society (MNS), Chennai, World Wide Fund for Nature (WWF), India are some of the NGOs taking many steps for the environmental protection & health.
- Centre for Environmental Education (CEE), Ahmadabad.
- Environmental Society of India, Chandigarh.
- Centre for Himalayan Environment and Development, Chamoli.
- Orissa Environmental Society (OES), Bhuvaneswar.
- Society for Conservation of Forest and Wild life, Pune.

ENVIRONMENTAL ETHICS

- Environmental ethics refers to the issues, principles and guidelines relating to human interactions with their environment.
- It also means that *efforts must be taken to protect an environment & to maintain its stability from the hazardous chemical pollutants.*

Functions of environment

- It is life supporting medium for all organisms.
- It provides food, air, water, & other natural resources to the human beings.
- It moderates the climatic conditions.
- It disintegrates all the waste discharged by the modern society.
- A healthy economy depends on healthy environment.

Environmental problems

- Deforestation activities.
- Population growth & urbanization.
- Pollution due to effluent and smoke discharge from the industries.
- Water scarcity.
- Land degradation and degradation of soil fertility.

Solutions to environmental problems

1) Reduce the waste of matter & energy resources.
2) Recycle & reuse as many of our waste products & resources as possible.
3) Over-exploitation of natural resources must be reduced.
4) Soil degradation must be minimized.
5) Biodiversity of the earth must be protected.
6) Reduce population & increase the economic growth of our country.

Ethical guidelines

1) You should love & honor the earth since it has blessed you with life & governs your survival.
2) You should keep each day sacred to earth & celebrate the turning of its seasons.
3) You should not hold yourself above other living things & have no right to drive them into extinction.
4) You should be grateful to the plants & animals which nourish you by giving you food.
5) You should not waste your resources on destructive weapons.
6) You should not steal from future generations their right to live in a clean & safe planet by polluting it.
7) You should consume the material goods in moderate amounts so that all may share the earth's precious treasure of resources.

GREEN CHEMISTRY

- It is the chemistry which involves designing and production of chemicals without polluting the environment.
- Green Chemistry is the pollution free chemistry.

GOAL (OR) 12 PRINCIPLES OF GREEN CHEMISTRY

1. **Prevention of wastes**

- It is better to prevent waste than to treat or clean up waste.

2. **Atom Economy**

- Synthetic methods should be designed to maximize the use of all raw materials.

3. **Less hazardous chemical synthesis**

- Synthetic methods should be designed little or no toxicity to human health and the environment.

4. **Designing safer chemicals**

- Chemical products should be designed with minimum toxicity.

5. **Safer solvents and auxiliaries**

- The auxiliary substances (Ex. Solvents, separation agents etc.) should be harmless.

6. **Design for energy efficiency**

- Energy requirements of chemical processes should be minimized. If possible synthetic methods should be conducted at ambient temperature and pressure.

7. **Use of renewable feedstock**

- A raw material or feedstock should be renewable rather than non-renewable.

8. **Reduce derivatives**

- Unnecessary derivation (modification of physical/chemical processes) should be minimized or avoided.

9. **Catalysis**

- Catalytic reagents are superior to stoichiometric reagents. It should be recyclable and reusable.

10. **Design for degradation**

- Chemical products should be degradable products and do not persist in the environment for long time.

11. **Real – time analysis for pollution prevention**

- Analytical methodologies need to be further developed to allow for real-time, in process monitoring and control prior to the formation of hazardous substances.

12. **Inherently safer chemistry for accident prevention**

- Substances used in a chemical process should not be potential for chemical accidents, explosions and fires.

CLIMATE

- Climate is the average weather of an area. It is the general weather conditions, seasonal variations of a region. The average of such conditions over a long period is called climate.

Causes of climate change

- Presence of greenhouse gases in the atmosphere increases the global temperature.
- Depletion of ozone layer also increases the global temperature.
- Uneven distribution of rainfall.
- Rotation of earth on its axis.
- Seasonal changes.

Effects of climate change

- It disturbs the agriculture that would lead to migration of animals including humans.
- It upset the hydrological cycle, results in floods and droughts in different regions of the world.
- Global pattern of winds and ocean currents also gets disturbed by climate.

GREEN HOUSE EFFECT

- The progressive warming up of earth's surface due to blanketing effect of man made CO_2 in the atmosphere is called greenhouse effect.
- The major Greenhouse gases are

  1. CO_2
  2. CH_4
  3. N_2O
  4. **Clorofloure Carbons (CFCs).**

  Among this CO_2 is the most important greenhouse gas.

- The earth temperature is constant by balancing the incoming and outgoing radiations. Every day, the earth is warmed by the sun. Heat is then slowly radiated back into the atmosphere. Thus, energy balance is setup.
- But due to manmade activities the concentration of greenhouse gases are increasing at a fast rate. This causes the earth's surface temperature to rise slowly. Deforestation, use of fossil fuels, use of CFC are responsible for such a situation. In the past few decades, earth's temperature has increased by 2-3 degrees. This effect is known as **global warming.**

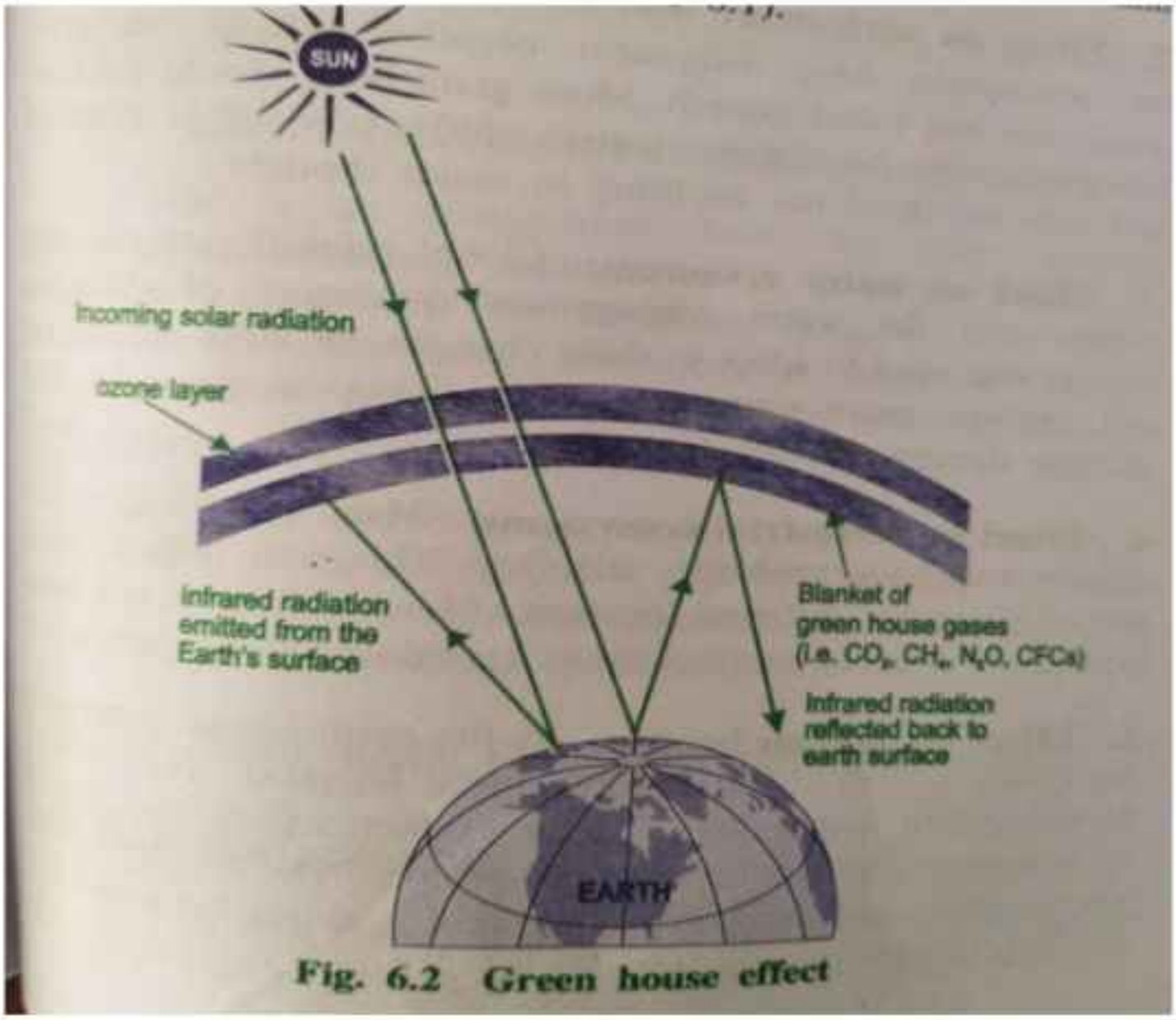


Fig. 6.2 Green house effect

Causes of greenhouse effect

i) **Deforestation:** Due to deforestation, photosynthesis takes place to limited extend, which increases CO_2 content in the atmosphere leading to global warming.

ii) **Burning of fossil fuels:** Large amount of greenhouse gases (CO_2, NOx, SOx etc.) are released into the atmosphere due to the burning of fossil fuels, oil, coal and gas.

iii) **Electrical Appliances:** Chlorofluorocarbons (CFCs) are widely used in refrigerators as coolants, aerosol cans, foaming agents, fire extinguisher chemicals, and cleaners used in the electronic industry. These gases slowly make way into earth's atmosphere resulting in global warming.

iv) **Population explosion:** Population growth increases CO_2 level (by respiration). With the increase in population, the needs and wants of people increase leading to urbanization and industrialization resulting in higher greenhouse emission.

v) **Transportation:** This also increases the greenhouse gases.

Consequences or effects of Global warming

i) **Global temperature increase:** It is estimated that the earth temperature will rise between 1.5 to 5.5°C by 2050 if input of greenhouse gases continues to rise at the present rate.

ii) **Rise in Sea Level:** With the increase in global temperature there will be rise in sea water levels mainly due to melting of polar ice caps and glaciers.

iii) **Effects on Human Health:** Global warming is completely changing the rainfall pattern thereby spreading of water borne diseases like malaria, filariasis etc.

iv) **Effects on Agriculture:** The High CO_2 level in the atmosphere results, the climatic pattern shifts and the rainfall is reduced. So the soils are dried and this result in drought and less crop production.

v) **Effects on water resources:** Rise in temperature leads to drought and flood which results in drinking water demand.

vi) **Effects on Terrestrial ecosystems** : Animals and plants will have problems in adapting so they will be in risk of extinction.

vii) **Ocean Acidification:** Increased atmospheric CO_2 increases the amount of CO_2 dissolved in the oceans. CO_2 dissolved in the ocean reacts with water to form carbonic acid, resulting in acidification.

Control of Global Warming

To slow down global warming the following steps will be important:
(i) Cut down the current rate of use of CFCs and fossil fuels.
(ii) Use energy more efficiently.
(iii) Utilizing renewable resources like wind, solar, hydro power etc.
(iv) Use natural gas instead of coal
(v) Adopt sustainable agriculture.
(vi) Stabilize population growth.
(vii) Control deforestation and plant more trees.
(viii) Remove CO_2 by photosynthetic algae.

ACID RAIN

- Normal rain water is always slightly acidic because of the fact that CO_2 present in the atmosphere gets dissolved in it.
- **Due to presence of CO_2, SO_2 & NO_2 gases as pollutant in the atmosphere, the pH of the rain water is further lowered. This type of precipitation of water is called acid rain or acid deposition.**

Formation or causes of Acid rain:

- Acid rain means the presence of excessive acids in rain water.
- Thermal power plants, industries and vehicles release nitrous oxide & sulphur dioxide into atmosphere due to burning of coal and oil. When these gases react with water vapour in the atmosphere, they form acids and descend on to earth's "acid rain" through rain water.

$$SOx + H_2O \rightarrow H_2SO_4$$

$$NOx + H_2O \rightarrow HNO_3$$

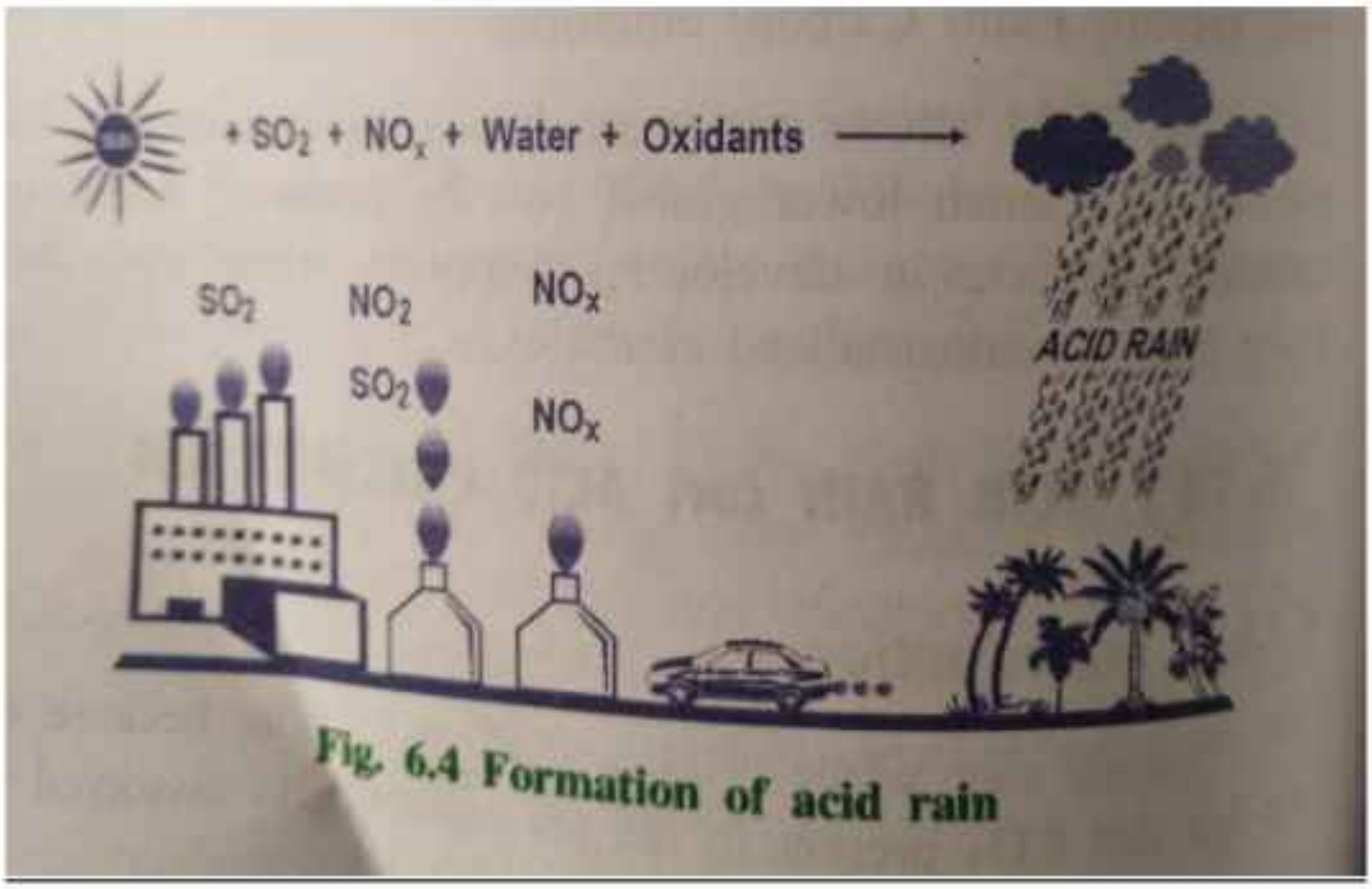


Fig. 6.4 Formation of acid rain

Effects of acid rain

1. On Human beings

- It destroys human life. Human nervous system, respiratory system and digestive system are affected by acid rain.
- It also causes premature death from heart and lung disorders like asthma & bronchitis.

2. On Buildings

- Taj Mahal in Agra suffer due to SO_2 and H_2SO_4 acid fumes released from Mathura refinery. Crystals of $CuSO_4$ and $MgSO_4$ are formed as a result of corrosion caused by acid rain.

- British Parliament building suffered due to H_2SO_4 rains.
- Acid rain contributes to the corrosion of metals and the deterioration of paint and stone. These effects seriously reduce the value of building, bridges and cultural objects.
- Dry deposition of acidic compounds can also dirty buildings and other structures. These increases the maintenance cost.

3. On terrestrial and Lake Ecosystem

- In terrestrial vegetation, acid rain reduces the rate of photosynthesis and growth.
- Acid rain severely retards the growth of crops such as beans, reddish, potato, spinach and carrots etc.
- Black Flies, mosquitoes, deer files and aquatic worms occur abundantly where fishes are eliminated due to acid deposition.
- The microbial action is reduced in acidic water which leads to decrease in decomposition rate of dead wastages. Thus the essential nutrients such as nitrogen, & phosphorous stay up in dead wastages.
- Biomass production is reduced and fish population decreases.

Control measures

- Improvement in technologies and switching to clean combustion technologies are highly essential in order to monitor the air pollution.
- Emission of SO_2 & NO_2 from industries and power plants should be reduced by using pollution control equipment's.
- Replacement of coal by natural gas.
- Liming of lakes and soils should be done.
- Coal with lower sulphur content can be used.

OZONE LAYER DEPLETION

- Ozone is a gas (O_3) found throughout the atmosphere, but most highly concentrated in the stratosphere between 10 and 50 km above sea level, where it is known as the 'ozone layer'.
- It protects us from the Ultraviolet radiation of the sun.
- Recent evidence shown that ozone layer is becoming thinner & holes have developed.
- **The process of creation of hole in ozone layer due to chlorofloro carbon and nitrous oxide in the stratosphere is called ozone layer depletion.**
- Without ozone layer life on the earth surface would not be possible.

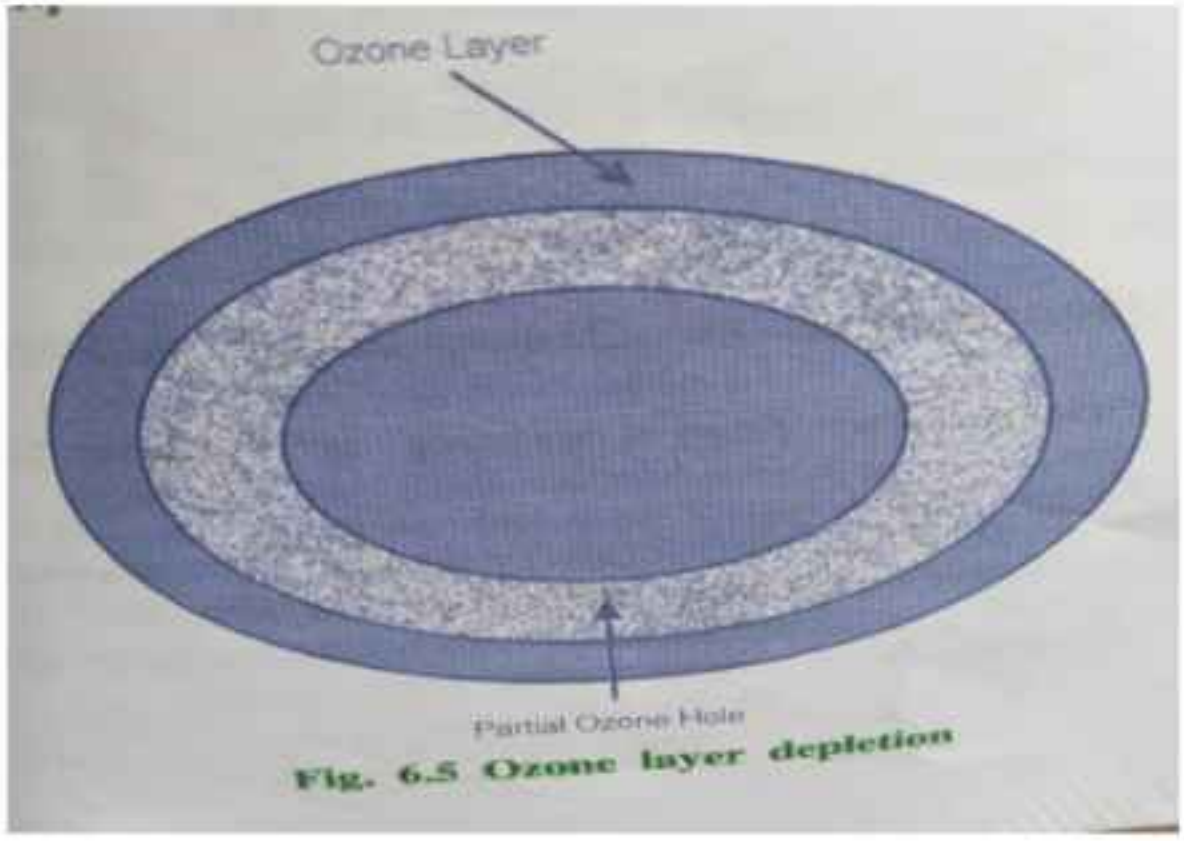


Fig. 6.5 Ozone layer depletion

Ozone depleting substances

The ozone depleting substances essentially consists of chlorine or bromine atoms which are extremely reactive while they are in the free state. The following gases are accumulated in the atmosphere and are found to be instruments in ozone depletion.

1. **Chloro Fluro Carbon (CFC)**

- **Sources:** Refrigerants (freon) in refrigerators, propellent in aerosol spray cans, blowing agent, foam plastic blowing agent.

2. **Hydro Chloro Fluoro Carbon (HCFC)**

- **Sources:** Used in Refrigerants, blowing agents etc.

3. **Bromo Fluoro Carbon (BFC)**

- **Sources:** Used in fire extinguisher.

4. **Other chemicals**

   a) Certain halogen compounds are potential ozone destroyers upto ten times more powerful than the CFC's.
   b) Sometimes the atmospheric sulphur dioxide is converted into sulphuric acid which greatly increases the rate of ozone depletion.

Formation of Ozone:

- Ozone is formed by photochemical reaction.
- In the presence of light, O_2 molecule dissociates to form oxygen atoms.

$$O_2 + h\nu \rightarrow O^\bullet + O^\bullet$$

- This oxygen atom reacts with molecular oxygen to form ozone.

$$O^\bullet + O_2 \rightarrow O_3$$

Mechanism of Ozone layer depletion:

- The effect of Freon on ozone layer is occurred through two steps.
- Chloro Fluro Carbon (CFC) produces chlorine which breaks the ozone into oxygen.
- **Step I : Photo dissociation of CFC**

$$CF_2Cl_2 + h\nu \rightarrow Cl + CF_2Cl$$

- **Step II : Ozone depletion**

$$Cl + O_3 \rightarrow ClO + O_2$$

$$ClO + O^\bullet \rightarrow Cl + O_2$$

- Each chlorine atom is capable of attacking several ozone molecules. So that a long chain process is involved.

- A loss of 1% of ozone results in a 2% increase of UV – rays reaching the earth surface.
- Air Crafts and jet engines produce NO in the atmosphere which also reduces the ozone.

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO + O_2 \rightarrow NO_2 + O^\bullet$$

Effects

- **On human health**

Ozone layer depletion results, penetration of more amount of UV – rays which produce Skin cancer, Non melanine skin cancer, slow blindness, Allergies, reduces human resistivity, infectious diseases etc.

- **On aquatic systems**

UV rays directly affect the aquatic forms such as phytoplankton, fish and larval crabs.
The phytoplankton consumes large amount of CO_2. Decrease in population of phytoplankton could have more amount of CO_2 in the atmosphere which contributes to the global warming.

- **On materials**

Degradation of paints, plastics, & other polymeric material result in economic loss.

- **On climate**

Increasing the average temperature of the earth surface & cause global warming.

Measurement of Ozone

The amount of ozone is measured by Dobson spectrometer & expressed in Dobson units (DU).

1 DU is equivalent to a 0.01 mm thickness of pure ozone at 1 atm pressure.

Control Measures

- Replacing CFCs by other materials which are less damaging.
- Use of gases such as methyl bromide which is a crop fumigant also to be controlled
- Manufacturing & using of ozone depleting chemicals should be stopped.

NUCLEAR ACCIDENTS & HOLOCAUST

- Energy released during a nuclear reaction is called nuclear energy.
- The most serious hazard to human & environmental health from the nuclear accident is the release of large amounts of nuclear energy & radioactive products into the atmosphere.

Type of nuclear accidents

Nuclear test

- Nuclear explosions carried out in underground leads to emission of radioactive rays in the atmosphere.

Nuclear power plant accidents

- Radiations get released during this accident.
- The nuclear power plant located in the seismic vulnerable area may cause nuclear accidents.

Improper disposal of radioactive waste

- It is another source of accident.
- Drums stored underground can rust & leak radioactive materials into water, land & air.

Accident during transport

- Trucks carrying radioactive waste or fuels are involved in frequent accidents.

Core melt down

- It is the major accident at a nuclear power plant.

Effect of nuclear radiation

1) Radiation may break chemical bonds such as DNA in cells which cause prolonged effects to human being. It may be even carried to future generations.
2) Exposure at low dose of radiation (100-250 rads), people do not die, but begin to suffer from fatigue, vomiting & loss of hair.
3) Exposure at higher dose of radiation (400-500 rads), affect bone marrow, blood cells, natural resistance & blood fails to clot.
4) Exposure at very high dose of radiation (10,000 rads) completely destroys the organisms.

Nuclear Holocaust

- It means destruction of biodiversity by nuclear equipment's & nuclear bombs.
- In a holocaust, a large number of living beings are totally destroyed as in case of nuclear war.

Effect of nuclear holocaust

(a) Nuclear winter

- Nuclear bombardment will cause combustion of wood, plastics, petroleum, forest, etc.,
- Large quantity of black soot will be carried to the stratosphere.
- Black soot will absorb all UV-radiations & will not allow the radiation to reach the earth.
- This result in cooling effect & water evaporation will also reduce.
- This process opposite to global warming is called nuclear winter.

Effect of nuclear winter

- Lowers the global temperature, even in summer the temperature will be at around freezing temperature.
- Crop productivity will be reduced causing famines & human sufferings.

(b) It ignites all combustible material, destroy all the living beings, material crushing, destruction of homes.

Examples of Nuclear Holocausts

Nuclear war

Japan, Hiroshima & Nagasaki are the examples of nuclear holocaust, which had happened at 2nd world war.

At Chernobyl

- When the operators lost the control of a water-cooled, graphite moderated reactor during a low power tests at Chernobyl in Ukraine, the nuclear reactor exploded.
- Chernobyl victims include,

a) 31 deaths at the time.
b) An estimated 2000 extra cases of cancer in Europe over the next 50 years.
c) A much greater loss of life & damage to health can still be attributed to the coal industry.

Control measures

1) Suitable precautions are to be taken & training must be given to people for handling these materials to avoid accident.
2) Constant monitoring of the radiation level has to be carried out.
3) Nuclear power plants are constantly monitored and controlled by the authorities.
4) Regular checks & control measures are done by Atomic Energy Regulatory Board under the Department of Atomic Energy.

Case studies

Chernobyl Nuclear Disaster:(Nuclear Pollution)

- On April 26th 1986, melt down of the Chernobyl nuclear reactor in Ukraine, Russia, has leaked out the radioactive rays & radioactive materials. This was happened due to poor reactor design & human error.

Effects:

- About 2000 persons died, more suffered due to degeneration of cells, severe bleeding, anemia, and skin cancer.
- Plants and animals was also affected more.

Nuclear holocaust in Japan:

- In 1945 two nuclear atom bombs were dropped on Hiroshima & Nagasaki cities in Japan. This explosion emitted neutrons, gamma radiations and strontium ($_{90}Sr^{*}$)

Effects:

- This '$_{90}Sr$' has the property of replacing calcium in the bones & so many people were affected by bone deformities
- This holocaust killed about 1,00,000 people and totally destroy the city.

WASTELAND RECLAMATION

- The land which is not in use is called waste land.
- The waste land is *unproductive, unfit for cultivation, grazing & other economic uses.*
- About 20% of the geographical area of India is waste land.

Type of waste lands

- ***Uncultivable waste lands***

- These lands cannot be brought under cultivation.
- Examples- *Baren rocky areas, hilly slopes, sandy deserts, etc.,*

- ***Cultivable waste lands***

- These are cultivable but not cultivated for more than 5 years.
- Cultivable waste lands are important for agricultural purposes.
- Examples- *degraded forest lands, saline lands, water logged &marsh lands, etc.,*

Causes for waste land formation

- Due to soil Erosion, Deforestation, Water logging, Salinity.
- Excessive use of pesticides.
- Developmental activities like construction of dams and power projects have caused considerable damage to land due to water logging.
- Over-exploitation of natural resources.
- Disposal of sewage and industrial wastes.
- Growing demands for fuel, fodder, wood and food causes degradation and loss of soil productivity.
- Mining destroy forests & cultivable land.

Objectives of waste land reclamation

- To improve the physical structure and quality of the soil.
- To prevent soil erosion.
- To avoid over – exploitation of natural resources.
- To conserve the biological resources.
- To improve the availability of good quality of water.
- To supply fuel, fodder, timber for local use.
- To provide source of income to the rural poor.

Methods of waste land reclamation (or) Integrated waste land development programme

Drainage

- Excess water is removed by artificial drainage.
- This process is used for water-logged soil reclamation.

Leaching

- It is the process of removal of salt from the salt affected soil by applying excess amount of water.
- Leaching is done by dividing the field in small plots.
- In continuous leaching 0.5 to 1.0 cm water is required to remove 90% of soluble salts.

Irrigation practices

- High frequency irrigation with controlled amount of water helps to maintain better water availability in the land.

Green manures & bio fertilizers

- Application of green manure is found to improve the saline soils.

Application of Gypsum

- Soil solidity can be reduced with gypsum.
- Calcium of gypsum replaces sodium from the exchangeable sites.
- This process converts clay back into calcium clay.

Afforestation programmes

- The National Commission on Agriculture (NCA) has launched several afforestation schemes.
- The National Development Board has decided to bring 5 million hacres of waste land annually for firewood & fodder plantation.

Social Forestry Programmes

- These programmes involve strip plantation on road, canal sides, degraded forest land, etc.

CONSUMERISM AND WASTE PRODUCTS

- ***Consumerism refers to the consumption of resources by the people.***
- It is an organized movement of citizens & government.
- The special concentration is given to improve the rights & power of the buyers in relation to the sellers.
- Consumerism is related to both increase in population size as well as increase in our demand due to change in life-style.
- In the modern society our needs have increased & so consumerism of resources has also increased.

Traditionally favorable rights of sellers

- The right to introduce any product.
- The right to change any price.
- The right to spend any amount to promote their product.
- The right to use incentives to promote their products.

Traditional buyer rights

- The right to buy or not to buy.
- The right to expect a product to be safe.
- The right to expect the product to perform as claimed.

Objectives of consumerism

- It improves the rights & powers of the buyers.
- It involves making the manufacturer liable for the entire life cycle of a product.
- It forces the manufacturer to reuse & recycle the product after usage.
- The items which are very difficult to decompose like computers, televisions etc., can be returned to manufacturer for reclaiming useful parts & disposing the rest.
- The reusable packing materials like bottles can be taken back to the manufacturer. It makes the products cheaper & avoids littering & pollutions.
- Active consumerism improves human health & happiness & also it saves resources.

Sources of wastes

- The sources of the waste materials are *agriculture, mining, industrial & municipal wastes.*

Examples for waste products

- Glass, papers, garbage, plastics, soft drink canes, metals, food wastes, automobile wastes, construction & factory wastes.

E-waste (Electronic & electrical wastes)

- Computers, printers, mobile phones, Xerox machines, calculators, etc.

Effects of wastes

- The wastes released from chemical industries & from explosives are dangerous to human life.
- The dumped wastes degrade soil & make unfit for irrigation.
- E-waste contains more than 1000 chemicals, which are toxic & cause environmental pollution.
- Plastics are difficult to recycle or incinerate safely because they are non-biodegradable & their combustion produces several toxic gases.

Factors affecting consumerism & generation of wastes

People over-population

- It occurs when there are more people than the available supply of food & water.
- Over population causes degradation of resources, poverty & premature death.
- This situation occurs in less developed countries (LDCs).
- Thus in LDCs per capita consumption of resources & waste generation are less.

Consumption over-population

- It occurs when there are less people than the available resources.
- Due to luxurious life-style per capita consumption of resources is very high.
- If the consumption is more, the generation of waste is also more & greater is the degradation of environment.

ENVIRONMENTAL LEGISLATION AND LAWS

Environmental management requires a strong legal framework in order to protect our valuable environment from the sources which are causing severe environmental pollution.
The major environmental problems around us are,

a) Air and water pollution by industries.
b) Deforestation.
c) Land degradation.
d) Urbanization
e) Waste management etc.

Important Protection Acts

The government of India and State Government have implemented a number of protection act,

1. Environment (Protection) Act, 1986.
2. Air (Prevention and Control of Pollution) Act, 1981 amended in 1987.
3. Water (Prevention and Control of Pollution) Act 1974 and amendment act, 1987.
4. Wildlife (Protection) Act, 1972.
5. Forest (Conservation) Act, 1980.

ENVIRONMENT (PROTECTION) ACT 1986:

- It is a general legislation law to rectify the gaps & laps in other environmental laws.
- This act empowers the Central Govt. to fix the standard of quality of air, water, soil & noise and to formulate procedures and safeguards for handling of hazard substances.

Objectives:

- To protect & improvement of the environment
- To prevent hazards to all living creatures & property
- To maintain peaceful relationship between humans & their environment

Important Features of Environment Act:

- The Act further empowers the government to lay down procedures & safeguards for the prevention of accidents which cause pollution & give remedial measures if an accident occurs.
- The government has the authority to close or prohibit or regulate any industry or its operation, if the violation of this Act occurs.
- The penal sections of the Act contain more stringent penalties such as imprisonment for a term extending to 5 years or fine upto Rupees 1 lakh or both.
- If the violation continues, an additional fine of Rupees 5000 per day may be imposed.
- The Act fixes the liability of the offence punishable under Act on the person who is directly in charge.
- The Act empowers the officer of Central government to inspect the site or the plant or the machinery for preventing pollution & to collect samples of air, water, soil or other material from any factory or its premises for testing.
- The Environment (Protection) Act is the most comprehensive legislation with powers for the central government to directly act, avoiding many regulatory authorities or agencies.

AIR ACT 1981:

- This act deals with the problems relating to air pollution.
- It allows the establishment of Central & State Control Boards provided with absolute powers to monitor air quality & pollution control.

Objectives of the air act

- To prevent, control & abatement of air pollution.
- To maintain the quality of air.
- To establish a board for the prevention & control of air pollution.

Important features of air act

- The Central Board may lay down the standards for the quality of air.
- The Central Board settle disputes between State Boards provide technical assistance & guidance to State board.
- The State Board verifies the emissions of air pollutants from industrial (or) automobile units
- The State Board Collect information about air pollution and also to function as inspectorates of air pollution.
- The State Boards will examine the manufacturing processes & the control of equipment to verify, whether they meet the standards prescribed.
- The State Board can advise the State Government to declare certain heavily polluted areas as pollution control areas & can advise to avoid the burning of waste products which cause air pollution in such areas.
- The directions of the Central Board are mandatory on State Boards.
- The operation of an industrial unit is prohibited in a heavily polluted area without the consent of the Central Board.

- Violation of law is punishable with imprisonment for a term which may extend to 3 months or fine up to Rs. 10,000 or both.
- This Act applies to all pollution industries. The Air Act further empower the State Boards to order closure of any industrial unit or stoppage or regulation of supply of water, electricity or other services, if it is highly polluting.

WATER ACT 1974:

- This act provides for maintaining & restoring the sources of water.
- It also provides for preventing & controlling water pollution.

Objectives of the water act

- Prevention & control of water pollution
- Maintaining or restoring the wholesomeness of water
- Establishing central & state boards for the prevention & control of water pollution.

Important features of water act

- This act aims at, to protect the water from all kinds of pollution & to preserve the quality of water in all aquifers.
- Establishment of Central Board & State Boards for prevention of water pollution.
- The States are empowered to restrain any person from discharging a pollutant or sewage or effluent into any water body without the consent of the Board.
- Violation of this act leads to prison sentence ranging from 3months to 6 years.
- Requires permission to set up an industry which discharges effluent.

State Pollution Control Board

- The approval of the State Pollution Control Board is needed to,
- Establishing any industry or any treatment & disposal system or any extension or addition there to, discharge effluent into a stream or well or river or on land.
- Use of any new or altered outlet for the discharge of sewage.
- In case of violation of this act, the State Board can Send a notice to the concerned organization.
- Issue orders to closure or stoppage of supply of electricity, water or any other services to the polluting unit.
- Non-compliance of the order leads to imprisonment for a term of one & a half years to 6 years & fine of Rs.5000 for everyday if the default continues.

WILDLIFE PROTECTION ACT 1972:

- This Act is aimed to protect & preserve wildlife.
- Wildlife refers to all animals & plants that are not domesticated.

- India has rich wildlife heritage which includes 350 species of mammals, 1200 species of birds & about 20,000 known species of insects.
- Some of them are listed as 'endangered species' in the Wildlife (Protection) Act.
- The wildlife is declining due to human actions.
- Wildlife populations are regularly monitored & management strategies formulated to protect them.

Objectives of the wildlife Act

- Maintain essential ecological processes and life supporting systems.
- To preserve biodiversity.
- To ensure a continuous use of species.

Important features

- The Act covers the rights & non-rights of forest dwellers.
- It provides restricted grazing in sanctuaries but prohibits in national parks.
- It also prohibits the collection of non-timber forest.
- The rights of forest dwellers recognized by the Forest Policy of 1988 are taken away by the Amended Wild life Act of 1991.
- This act provides for setting up of National Parks, Wildlife Sanctuaries etc.
- This act imposes a ban on the trade and commerce in scheduled animals.
- A person violating any provision of this act shall be guilty of an offence against this act and shall be punished with imprisonment for three years or a fine of Rs. 2300 or both.

FOREST CONSERVATION ACT 1980:

- This act provides conservation of forests & related aspects.
- This act also covers all type of forests including reserved forests, protected forests & any forested land.
- This act is enacted in 1980 & aims at to arrest deforestation.

Objectives of forest act

- To protect & conserve the forest.
- To ensure judicious use of forest products.

Important features of forest act

- The reserved forests shall not be diverted or DE reserved without the prior permission of the central government.
- The forest land may not be used for non-forest purposes.
- Any illegal non-forest activity within a forest area can be immediately stopped under act.

Important features of Amendment Act of 1988

- Forest departments are forbidden to assign any forest land 'by way of lease or otherwise to any private person' or non-government body for re-afforestation.
- Clearance of any forest land of naturally grown trees for the purpose of re-afforestation is forbidden.
- The diversion of forest land for non-forest uses is cognizable offence & anyone who violates the law is punishable.

Environmental Audits

- Environmental audits are intended to quantify environmental performance and environmental position. It also aims to define what needs to be done to improve on indicators of such performance and position.

Types of audits

There are three types of environmental audits.

1. **Liability audit:** It assesses compliance with legal obligations.
2. **A management audit:** It verifies that an environmental management strategy meets its stated objectives.
3. **A functional audit (activity or issues audit):** It investigates a specific area such as energy or water use.

ENFORCEMENT MACHINERY INVOLVED IN ENVIRONMENTAL LEGISLATION

- There are number of environmental laws in the form of Acts for safeguarding our environmental quality.
- But we cannot implement it strictly as there are many drawbacks & problems in implementing environmental legislations.

Problems in enforcing the legislation

- We have not achieved the target of bringing 33% of our land cover under forest.
- We lose our wildlife continuously.
- The rivers are now opened to sewer.
- The air in town is badly polluted.
- There are many drawbacks in our environmental laws and in their implementation.

Drawbacks of the Wildlife Protection Act, 1972

- Since this Act has been enacted just as fallout of Stockholm Conference held in 1972, it has not included any locally evolved conservation measures.
- The ownership certificates for some animal articles (like leopard & tiger skins) often serve as a tool for illegal trading.
- Since Jammu & Kashmir has its own Wildlife Act, hunting & trading of many endangered species, prohibited in other states, are allowed in J&K.
- The offenders of the Act are not subjected to very harsh fines. It is just a fine of Rs.25,000 or imprisonment for up to 3 years.

Drawbacks of the Forest (conservation) Act, 1980

- This Act just transfers the powers from state to centre to decide the conversion of reserve forest lands to non-forest areas.
- The power has been centralized at the top & the local communities have been completely neglected.
- The tribals were totally dependent on forest resources. When they were stopped from taking those resources, they involve in criminal activities like smuggling, killing, etc.,
- The tribal communities have rich knowledge about forest resources, their importance & conservation. But their role & contribution is not acknowledged.

Drawbacks of Pollution related Act

- The power & authority has been given only to central government with little of power to state government. It hinders effective implementation of the Act in the states.
- The penalties are very small when compared to the damage caused by the big industries due to pollution.
- Litigation, related to environment is expensive, since it involves technical knowledge.
- For small unit it is very expensive to install Effluent Treatment Plant.
- The position of chairman of the Board is occupied by political appointee. Hence it is difficult to implement the act without political interference.

CENTRAL AND STATE POLLUTION CONTROL BOARDS

- A central & state pollution control board takes many step to control pollution.

Functions of Central Board

- It advises the central government regarding the prevention of pollution.
- It plans for the prevention & control of pollution.
- It establishes labs for the analysis of air & water samples.

- It provides technical assistance & guidance to state boards & sponsor research regarding water, air pollution.
- It identifies areas or industries causing air pollution.
- It encourages industries to recycle & reuse the wastes.
- It also advises the industries to treat waste water & gases with modern technology.

Functions of the State Board

- It advises the state government on any matter concerning the prevention & control of pollution.
- It has the right to inspect at all times any pollution control equipment, industrial plant & gives orders to take the necessary steps to control pollution.
- It encourages research & investigations regarding pollution.
- It organizes educational programme in collaboration with central board.
- The analyst of the board is expected to analyze the sample, sent to him & submit a report to the board & respective industry.

PUBLIC AWARENESS

- Our environment is presently degrading due to many activities like pollution, deforestation, overgrazing, rapid industrialization and urbanization.
- In order to conserve our environment, each and every one must be aware about our environment problems and objectives of various environment policies at national and local levels.

Objectives of public awareness

- Create awareness among people of rural and city about ecological imbalances, local environment, technological development and various development plants.
- To organize meetings, group discussion on development, tree plantation programmes exhibitions etc.
- To eliminate poverty by providing employment that overcome the basic environmental issues.
- To focus on current environment problems and situations.
- To learn to live simple and eco-friendlily manner.

Methods to create environmental awareness

Environmental awareness must be created through formal and informal education to all sections of the society. The various methods that is useful for raising environmental awareness are discussed here.

1. **Environmental awareness in schools and colleges**

- Environmental education must be imparted to the students in schools and colleges.

2. **Through mass – media**

- Media like radio, TV and cable network can educate the people on environmental issues through cartoons, documentaries, plantation campaign, street plays etc.

3. **Cinema**

- Film about environmental education should be prepared and screened in the theatre compulsorily. These films may be released with tax free to attract the public.

4. **Newspapers**

- All the newspaper as well as magazines must publish the environment related problems.

5. **Audio - Visual media**

- To disseminate the concept of environment, special audio-visual and slide shows should be arranged in all public places.

6. **Voluntary organizations**

- The services of the voluntary bodies like, Rotary club, NCC, NSS, should be effectively utilized for spreading the environmental awareness.

7. **Traditional techniques**

- The traditional techniques like folk plays, dramas, may be utilized to spread environmental messages to the public. These techniques attract the rural people very much.

8. **Arranging competitions**

- Story writing, essay writing and painting competition on environmental issues should be organized for students, as well as for the public. Attractive prizes should be awarded for the best effort.

9. **Leaders appeal**

- Political leaders, cine actors and popular social reformers can make an appeal to the public about the urgency of environmental protection.

10. Non – government organizations (NGOs)

- Voluntary organization can help by advising the government about some local environmental issues. Also they can be effective in organizing public movements for protection of environment through creation of awareness.

IMPORTANT QUESTIONS

1. **RAIN WATER HARVESTING.**
2. **WATERSHED MANAGEMENT.**
3. **SUSTAINABLE DEVELOPMENT AND IT APPROACH.**
4. **RESETTLEMENT AND REHABILITATION OF PEOPLE, ITS PROBLEMS AND CONCERNS.**
5. **WASTELAND RECLAMATION.**
6. **NUCLEAR ACCIDENTS AND HOLOCAUST WITH CASE STUDIES.**
7. **CONSUMERISM.**
8. **ENVIRONMENT AND WATER ACT.**
9. **FOREST AND WILDLIFE PROTECTION ACT.**
10. **AIR ACT.**
11. **ISSUES INVOLVED IN THE ENFORCEMENT OF ENVIRONMENTAL LEGISLATION.**
12. **ENVIRONMENTAL ETHICS.**
13. **URBAN PROBLEMS RELATED TO ENERGY.**
14. **GREENHOUSE EFFECT (GLOBAL WARMING).**
15. **ACID RAIN.**
16. **OZONE LAYER DEPLETION.**

UNIT- V HUMAN POPULATION AND THE ENVIRONMENT

Definitions

Population

- A group of individuals belonging to the same species which live in a given area at given time.

Population density

- Number of individuals of the population per unit area (or) per unit-volume.

Parameters affecting population size

1. **Birthrate (OR) Nationality**

- Number of live births per 1,000 people in a population in a given year.

2. **Death Rate (OR) Mortality**

- Number of deaths per 1000 people in a population in a given year

3. **Immigration**

- It denotes the arrival of individuals from neighboring population.

4. **Emigration**

- It denotes the disposal of individuals from the original population to new areas.

POPULATION GROWTH

- It is the difference between the rate of birth and death of a country or region or city.
- In 1800 the global population was about 1 billion people. In 1930 it reached 2 billion. In 1975 it reached 4 billion within 45 years. Now the population is 6 billion. It reaches 10 billion by 2050 as per the World Bank calculation.

Causes of rapid population growth

1. Due to decrease in death rate and increase in birth rate.
2. Availability of antibiotics, immunization, increased food production, clean water and air, decreases the famine-related deaths and infant mortality.
3. Children's are required to help parents in their occupation.
4. Child Marriages
5. People's superstitions- People believe that it is because of God's grace.

Characteristics of Population growth

Exponential growth

- Population growth occurs exponentially like 10, 10^2, 10^3, 10^4 etc., which shows the dramatic increase in global population in the past 160 years.

Doubling Time

- It is the time required for the population to double its size at a constant annual rate. It is calculated as follows:-
- Td = 70 / r When r = annual growth rate
- If a nation has 2 % annual growth, its population will double in 35 years.

Infant Mentality rate

- It is the percentage of infant died out of those born in one year. Even though this rate is decreased in the last 50 years the pattern differs widely in developing and developed countries.

Total fertility rates (TFR):

- Average number of children delivered by a woman in her life time. The TFR varies from 2 in developed countries to 4.7 in developing countries.

Male-Female ratio

- This ratio should be fairly balance in the society. But the Male – female ratio has been upset in many countries including China and India. In china the ratio of girls and boys is 100 : 140.

Demographic transition:

- Population growth is related to economic development. The birth rate and death rate fall due to improved living conditions. This results in low population growth. This pheromones in called demographic transition.

Problems of population growth (environmental issues)

- Increasing demands for food and natural resources
- Inadequate housing and health services
- Loss of agricultural lands.
- Unemployment and Environmental pollution.

VARIATION OF POPULATION AMONG NATION:

- At present the world's population has crossed 6 billion. Less developed countries (Africa, Asia, and South America) have 80% population while developed countries have only 20%.
- In most developed countries like USA, Canada, Australia population increases by less than 1%. But is less developed countries the population increases by more than 1% / year.
- Kenya is the fastest population growing countries in the world, where 20 million people are residing.
- China & India's population was above 1000 million in 2000 years. Its share is 1/3 of the world population.
- Europe and North America accounts for 14% of world population.

Variation of population based on Age structure

- Age structure of population can be classified into 3 classes.

a. Pre- productive population (0 – 14 years)
b. Reproductive population (15 - 44 years)
c. Post reproductive population (Above 45 years)

Variation of population is now explained based on the above three classes.

a. Pyramid shaped Variation of population (increase)

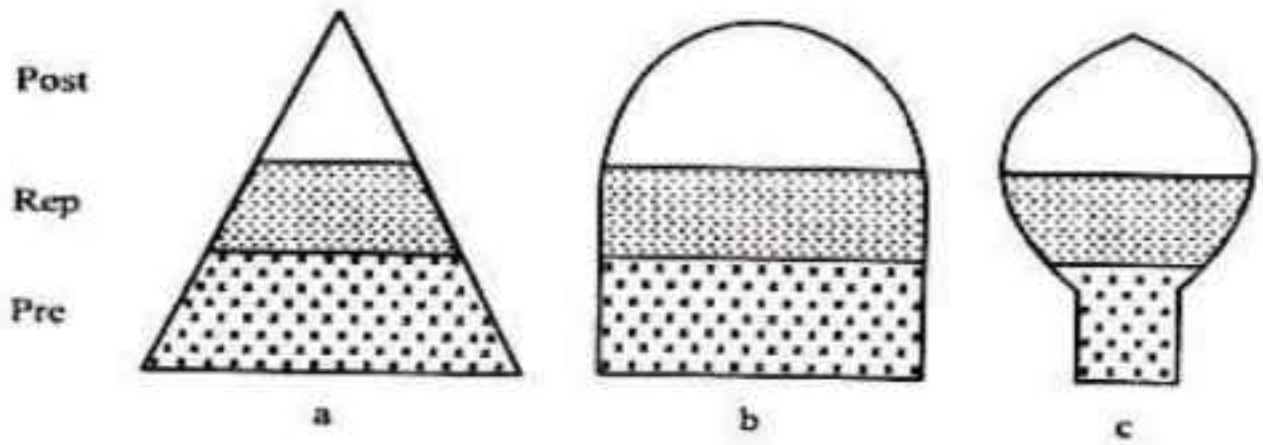
- **Ex:** India, Bangladesh, Ethiopia, Nigeria etc.
- The Pre-productive population (0-14 years) is more than the reproductive population (15-44 years) and post reproductive population (above 45 years).
- Here large number of young people enters into reproductive age group, hence ***Population growth is increases.***

b. Bell shaped variation of population (stable)

- **Ex:** France, USA, UK, Canada etc.
- Pre- productive population and reproductive population is more (OR) less equal.
- Hence ***population growth in stable.***

c. Urn shaped variation of populations (decrease

- **Ex:** Germany, Italy, Sweden, Japan etc.
- Pre-productive age group population is smaller than the reproductive age group population. In the next 10 years, the number of people in reproductive age group is less than the before, resulting in a ***decrease of population growth.***



FIGUR 13.1 : AGE PYRAMIDS

POPULATION EXPLOSION:

- The enormous increase in population, due to low death rate and high birth rate is called as population explosion.

Doubling time: The number of years needed for a population to double in size. The doubling time varies from country to country.

Name of the country	Doubling time
India, Turkey	28 years
Nigeria	27 years
Pakistan	21 years
USA	87 years
UK	231 years
France	117 years

Population growth is higher in developing countries and lower in developed countries.

Cause of population explosion:

- Invention of modern medical facilities reduces the death rate and increases the birth rate, which leads to population explosion.
- Increase of life expectancy is another important reason for population explosion.
- **Ex:** In 1956, the average life expectancy of the human beings was 40 years. But now it is 61years.
- Illiteracy is one of the reasons for the population explosion.

Effect of population explosion (or) environmental impacts of growing population

- Population explosion leads to environmental degradation.
- Population explosion causes over exploitation of natural resources. Hence there will be a shortage of resources for the future generation.
- Increases in population will increases diseases, economic inequity and command wars.
- Most renewable resources like forests, grass lands are under threat.
- It leads to unemployment and low living standard of people.
- Lack of basic amenities like water supply and sanitation, education, health etc.
- Population explosion is the main cause for pollution of air, land, water and noise.
- Disposal of plastics and wastages is another problem of over population.
- It damages the environment, ecosystem and biodiversity.

Remedy:

- Immediately reduce the fertility rate through birth control programs.

FAMILY WELFARE PROGRAMME

- Family welfare programme was implemented by Govt. of India as a voluntary programme. It is a policy of growth covering human health, family welfare, children and women's right.

Objectives:

- Slow down the population explosion by reducing fertility.
- Pressure on the environment, due to over exploitation of natural resources is reduces.
- To improve the life style.

Population stabilization Ratio

- The ratio is derived by dividing crude birth rate by crude death rate.

Developed countries

- The stabilization ratio of developed countries is 1, which indicating zero population growth.

Developing countries

- The ratio of developing countries is rearing 3 which is expected to lower down by 2025.
- Stabilization in developing countries is possible only through family welfare programmes.

FAMILY PLANNING PROGRAMME

- If provides educational and clinical services that help couple to choose how many children to have and when to have them.
- Family planning programme provides information on birth spacing, birth control and health care for pregnant woman and infants.
- It also reduced the number of legal and illegal abortions per year and decreased the risk of death from pregnancies.

Objectives:

- Reduce infant mortality rate to below 30 per 1000 infants.
- Achieve 100% registration of births, deaths, marriage and pregnancies.
- Encourages late marriages and late child bearing.
- Encourages breast feeding.
- Enables to improve woman's health education and employment.
- Constrain the spread of Aids / HIV.
- Prevent and control of communal diseases.
- Promote vigorously the small family norms.

Fertility control methods (or) methods of family planning

A) Traditional methods

- It includes some tradition like taboos and folk medicine.

B) Modern methods

(i) Permanent method : It is done by a **minor surgery.**

a) **Tubectomy:** It is **female sterilization** done by tying the tubes that carry the ovum to the uterus.

b) **Vasectomy:** It is **male sterilization** done by tying the tubes that carry the sperm.
Both are very simple procedures, done under local anesthesia, which are painless and patients have no post-operative problems.

(ii) Temporary method

a) Condoms: Condoms are **used by males** to prevent sperms.

b) **Copper Ts:** Copper Ts are small objects and can be placed by a doctor in the uterus so that the ovum cannot be implanted, even if fertilized. They do not distub any functions in the women's life.

c) **Oral contraceptive pills and injectable drugs** are available that prevent sperms from fertilizing the ovum.

Problems of Family planning programmes

a) Family planning is a women – centered programme
   - Generally women are forced to undergo sterilization or to adopt the family planning

b) Imbalance in male – female sex ratio.

Family planning programme in India

- In 1952 India started family planning programme.
- In 1970 Indian govt. forced Family planning campaign all over the country.
- In 1978 govt. legally raised the minimum age of marriage for men from 18 to 21 and for women 15 to 18 years.
- In 1981 census report showed there is no drop in population. Hence funding for Family planning programme has been increased.

ENVIRONMENT & HUMAN HEALTH

Healthy person: Physically fit person without suffering any disease is called a healthy person.

Disease: Harmful changes in the body's condition by nutritional, biological, chemical (or) psychological factors are called diseases.

Factors influencing human health

Human health is influenced by

(i) Nutritional factors
(ii) Biological factors
(iii) Chemical factors
(iv) Psychological factors and Pollution

Important hazards and their Health effects (or) Deterioration of environment and Health

Physical Hazards – ***Radioactive and UV radiations*** = affects the body cell, causes skin cancer. ***Global warming*** = cause famine & mortality. ***Noise*** = Painful and irreparable damage to human ear.

Chemical Hazards – ***Combustion of Fossil fuels*** = Asthma & lung diseases. ***Industrial effluence*** = cause cancer & death. ***Pesticides*** = affect food chain. ***Heavy metals*** = contaminate water. ***Chlorofluro carbons*** = damage ozone layer.

Biological Hazards – ***Bacteria, Viruses, Parasites*** = Diarrhoea, malaria, parasitic worms, cholera, anemia and respiratory disease.

Preventive measures

- Always wash your hand before eating.
- Cut short and clean your nails systematic.
- Drinking chemically treated and filtered water.
- Eat food always in hot condition.
- Wash the vegetables and fruits with a clean water before cooking.
- Avoid plastic containers and aluminium vessels.
- Do physical exercise to have proper blood circulation.

NIMBY syndrome

- NIMBY means Not In My Back Yard. The developmental activities like airport, construction of railway tracks, roadways, nuclear power plants etc. are essentially need in the society. But, it causes some public nuisance through pollution. So, these kinds of projects are opposed by the nearby local residents. This is called NIMBY syndrome. These people are called as nimbies.

HUMAN RIGHTS

- Human rights are the fundamental rights, which are possessed by human beings irrespective of their caste, nationality, sex & language.
- The aim of Govt. is to ensure happiness to all the citizen with equal rights.
- IN 1948 Universal Declaration of Human Rights (UNDHR) was established by UN.
- Some of the main declarations of Human rights, which are globally accepted are as follows.

- Human right to freedom *[express views, forming union, building houses, choose any profession]*
- Human right to property *[right to earn property]*
- Human right to freedom of religion *[freedom to choose religion to his wishes]*
- Human right to culture and education *[right to conserve culture, language, establishing educational institution]*

- Human right to constitutional remedies *[can go to court, if fundamental rights are denied]*
- Human right to equality *[all citizens are equal before law without discrimination of religion, sex, caste, place]*
- Human right against exploitation *[children should not be employed as labours]*
- Human right to food and environment *[right to get sufficient food, safe, water, healthy environment]*
- Human right to good health *[right to have very good physical and mental health]*.

Indian Constitution

- Indian constitution provides for civil, social, cultural, educational and political rights.
- **Article 14:** Provide equality before law.
- **Article 15:** Prohibits discrimination on the ground of race, religion, caste, sex (or) place of birth.
- **Article 16:** Provides equal opportunity for all citizens in regarding to employment.
- **Article 19:** Provides for freedom of speech and expression, forming association and union.
- **Article 20:** Protection from conviction except in accordance with the law of the land.
- **Article 22:** Lays down the rights of a person in custody.
- **Article 23:** Deals with the right to work without any discrimination
- **Article 24:** Prohibits exploitation of labour children.
- **Article 25:** Grantees freedom to profess, practice and propagate a religion of one's choice.
- Article **26:** Deals with the right to participate in the cultural life of the community.

VALUE EDUCATION

- Education is nothing but learning, through which knowledge about a particular thing can be acquired. With the help of our knowledge and experience we can identify our value to understand ourselves and our relationship with others and their environment.

Types of Education:

1. **Formal Education:** All learning process are self-related. All people will read, write, will get good jobs and take with any problem with the help of formal education.

2. **Value Education:** It is an instrument used to analyse our behavior and provide proper direction to our youth. It teaches them the distinction between right & wrong, to be compassionate, helpful, loving, generous and tolerant.
Ex: If a person is highly qualified and well settled in life, sometimes he does not know how to behave with his environment. But value education does this.

3. Value based environmental education: The provides knowledge about the principle of ecology, fundamental of environment and biodiversity. It creates sense of duty to care for natural resources and to manage them in sustainable key.

Objectives:

- Improve integral growth of human being.
- To create attitudes and improvement towards sustainable life style.
- To increase awareness about our national history, cultural heritage, constitutional rights, national integration, community development and environment.
- To create and develop awareness about the values and their significance and role.
- To understand about our natural environment in which how land, air and water are interlinked.
- To know about various living and non-living organism and their interaction with the environment.

Methods (Elements) of imparting value education

1. **Teaching:** In this approach, a teacher/parent/elder teaches a child/junior about the meaning of 'values' by stating the real and artificial situations.

2. **Playing a role as an actor:** In this approach, the value education is imparted by playing the role of great people, who are famous/well known for their high values.
   Ex: Playing role of Kamarajar to teach his ideal values is an act of high values.

3. **Problem solving by question – answer techniques:** In this approach, a confusion regarding any topic is removed by raising different questions and then suggesting their high-valued solution.

4. **By studying Biographic of high – value men:** In this approach, the life sketch of great men is studied as a topic in a subject. In this way one learns about the high-values established by them.
   Ex: Learning about the great Subhas Chandra Bose.

5. **Persuasion:** In this approach, the learner is convinced to accept certain high values and behave accordingly.
   Ex: pledging never to accept dowry, never to drink alcohol etc.

6. **Modeling:** It is a method in which a certain individual perceived as ideal values is presented to the learners as a model.

Types of values:

1. Universal values (or) social values:

- These values tell about the importance of the human conditions. These are reflected in life, joy, love, tolerance, truth etc.

2. Cultural values:

- This value varies with respect to time and place. These are concerned with rights & wrong, good & bad true & false and behavior of human beings. It is reflected in language, education, law, economics, philosophy etc.

3. Individual values:

These are personal principles and the result of individual personality and experience. Parents & teachers are the main key to shape and individual values. It is reflected in individual goals, relationship, commitments, etc.

4. Global values:

Human civilization is a part of the planet. Nature and natural phenomena on the earth are interconnected and inter-linked with special bonds of harmony. If this harmony disturbed anywhere leads to catastrophic results due to ecological imbalance.

5. Spiritual values

These promote conservationism and transform our consumeristic approach

HIV/AIDS

- **AIDS** is abbreviated as **Acquired Immuno Deficiency Syndrome** caused by a virus called HIV (**Human Immune deficiency Virus**).
- It Discovered in 1983.

Origin of HIV/AIDS

(i) **Through African Monkey or Chimpanzees to human**
(ii) **Through Vaccine Programmes**

- HIV spread in Africa through HIV contaminated Polio vaccine prepared from monkey's kidney.
- Spread through Hepatitis-B viral vaccine in Los Angles and NewYork.
- Also spread through small pox vaccine programme of Africa

World scenario

- Nearly 90% of the people who are infected with AIDS live in developing countries.
- 13% of world's population live is Africa.
  Almost all states of African countries were affected by HIV.
- India ranks 2nd in the world with 5.1 million HIV affected people.

Scenario in India

- Large number of infected people has been found in Maharashtra & Tamil Nadu followed by Delhi, UP, Karnataka & Goa.
- Till September 2003, 24,667 cases are found in Tamil Nadu.

Factors influencing modes of Transmission of HIV

1. Unprotected sex with infected person.
2. Using needles or syringes from HIV positive person.
3. During pregnancy, breast feeding HIV transmits from mother to infant babies.
4. Blood transfusion during accident and pregnancy.
5. Biologically the male to female transmission is 2 to 4 time more efficient than female to male transmission.
6. Women's cervical tissue is more vulnerable to HIV than men.
7. Transmissions of HIV to new born babies happen easily.

Factors not influencing transmission of HIV

1. Tears, food, air, cough, handshake and normal kissing.
2. Mosquito flies and insect bites.
3. Sharing of utensils, clothes, toilets and bathroom.

Functions of HIV in human body

- White blood cells (WBC) are responsible for the formation of antibodies called T-helper cells' T- helper cells are the key infection fighters in the immune system. Once HIV cells are enter into the body they destroy the T-cells & cause many infection diseases.

Symptoms of AIDS

Minor symptoms

- Persistent cough for more than one month.
- General skin disease.
- Viral infection.
- Fungus infection in mouth and throat.
- Frequent fever, headache and fatigue.

Major symptoms

- Fever for more than one month
- Diarrhea for more than one month.
- Cough & TB for more than one month.
- Fall of hairs.
- 10% of body weight loss within short period.

Control and Preventive measures

- **Education:** *health education enables people to avoid indiscriminate sex and encourages the use of condoms. One should avoid sharing razors, needles and syringes.*
- **Prevention of Blood borne HIV transmission:** *screening of blood for HIV before transmission & following strict sterilization in hospitals.*

- **Primary health care:** *Encourage the AIDS awareness programme, participation of voluntary health agencies etc.*
- **Counseling services:** *Counseling provided either in person or through telephone.*
- **Drug treatment:** *Early medical care, taking nutritious diet, maintaining stress free mind.*

Effects

- Death
- Loss of labor & level of production decreases
- Inability to work due to lack of energy & frequent fever & sweating
- More water is needed for maintaining hygiene in AIDS affected locality.

WOMANS WELFARE

- The main aim of women welfare is to improve the status of the women by providing opportunities in education, employment and economic independence.

Need of Women Welfare

Generally a woman faces the following problems in the society. So we urgently need the women welfare.

- Women suffer gender discrimination and devaluation at home, matrimony, workplace, public & power.
- High number of cases of dowry death, rape, domestic violence and mental torture to women.
- Human rights of women are violated and decision making are alsoneglected.

Objectives:

- To overcome the above problem we need the following objectives
- To provide education
- To impart vocational training
- To generate awareness
- To improve employment opportunities
- To aware problems of population
- To restore dignity, status, equality and respect for women.

Objectives of a National Commission For Women

- To examine constitutional & legal rights for women.
- To review existing legislations
- To sensitize the enforcement & administrative machinery to women's causes.

Various Organizations towards Women Welfare:

The National Network for Women & Mining (NNWM) → fighting for a gender audit of India's mining companies.

United Nations Decade for Women → inclusion of women welfare related issues on international agenda.

International Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) → Protection & Promotion of women's human and socio-economic upliftment.

Non-Government Organizations (NGO's) → Empower, educate village women & making self-dependent

Ministry for Women and Child Development → work for upliftment of women by family planning, health care, education & awareness.

CHILD WELFARE:

- Children occupy nearly 40% of total population. They are considered to be the assets of a society. Of 21 million children born every year in India, 20 million children in our country are estimated to be working as child labours in various hazardous industries like match industry, fire work industry etc.

Reason for child Labours:

Poverty: it is the main reason to force these children to work in unhealthy conditions

Want of Money: parents need money for their family, so they are in a position to send their children for work.

Various Organizations towards Child Welfare:

1. **UN Conventions on Rights of Child or International Law** → *promote & protect children in our society*

Rights of the Child:

- **The right to survival** → *emphasizes on good health, nutrition, standard of living*
- **The right to participation** → *freedom of thought to the child*
- **The right to development** → *ensures education, care, support, social security & recreation*
- **The right to protection** → *freedom from exploitation, inhuman treatment & neglect*

2. **World summit on children** → *it is focused agenda for the well-being of the children is targeted to be achieved in the beginning of the new millennium*

3. **Ministry of Human Resource Development (MHRD)** → *concentrate on child's health, education, nutrition, clean and safe drinking water etc.*

Environmental degradation & child welfare → *children are most affected due to pollution, even the child growing in the mother's womb, gets affected by environmental toxins.*

Center for Science & Environment (CSE) → *keeping environment clean for healthy life of children.*

ROLE OF INFORMATION TECHNOLOGY (IT) IN ENVIRONMENT PROTECTION

- IT plays a vital role in the field of environment education. IT means collection, processing, storage and dissemination of information. The internet facilities, information through satellites, www and geographical information system provides up to date information on various aspects of environment and weather.

Software's for environmental education

Remote sensing

- It refers to any method which can be used to gather information about an object without coming in contact with it. Any force field like Gravity, magnetic, electromagnetic forces could be used for remote sensing. Remote sensing covers various disciplines from laboratory testing to astronomies. Now remote sensing is used to denote identification of earth feathers by detecting the characteristic electromagnetic radiation that is reflected by the earth.

Applications

- **Agriculture:** In India agriculture provides livelihood of 70% of population and contributes to about 35% of net nation product. We require optimal management of land and water resources along with high yielding variety seeds, fertilizer input etc. Remote sensing can provide valuable information for land and water management.
- **Forests:** Remote sensing provides information clearly on the type, density and extent of forest cover, wood volume and biomass, forest fire, encroachment etc.
- **Land cover:** Spatial information on land use is required at different scales depends upon use. Remote sensing data is converted to map, the spatial resolution plays a role on the scale of mapping.
- **Water resources:** Remote sensing data has been used in many application related to surface water body mapping, ground water targeting, wet land, flood monitoring, reservoir sedimentation, water quality monitoring etc. One of the simplest applications is inventorying surface water body.

DATABASE

- It is the collection of inter related data on various objects. In the computer the information of database is arranged in a systematic manner.

Applications:

(a) The ministry of environment and forest

- They are compiling database on various biotic components.
- Database is also available for diseases likes HIV |AIDS, Malaria, Fluorosis etc.

(b) National Management Information System (NMIS)

- They compile database on R & D Projects along with information about research scientists and personnel involved.

c) Environmental Information System

- It functions in 25 centres all over the country.
- They generate network of database in areas like pollution control, remote sensing, biodiversity, and desertification.

GEOGRAPHICAL INFORMATION SYSTEM (GIS)

- It is a technique of superimposing various thematic maps using digital data on a large number of inter-related aspects.

Applications

- Different thematic maps having digital information on various aspects like water resources, soil type, forest land, crop land, grass lands are superimposed on a layered form in computer using software's.
- Interpretation of polluted zones, degraded lands can be made on GIS base.
- GIS can be used to check unplanned growth and related environmental problems.

SATELLITE DATA:

- It helps in providing correct and reliable information about forest-cover
- Provides information of monsoon, ozone layer depletion, Smog etc.
- Helps in discovering reserves of oil, minerals etc.

WORLD WIDE WEB

- More current data is available on www.

Important on-line learning centre.

- www .mhhe.com \ environmental science.
- Multimedia Digital content manager (DCM) in the form of CD-ROM.

Applications

- Online learning
- Digital files or photos, animations on environmental studies.

ROLE OF INFORMATION TECHNOLOGY IN HUMAN HEALTH

The health service technology involves three systems

- Finance and accounting
- Pathology
- Patient Administration – clinical system.

Applications

- Data regarding birth and death rates, immunization, sanitation programme are maintained
- Helps doctor to monitor the health of the people effectively
- The information regarding the outbreak of epidemic diseases can be conveyed easily
- Online Consultation with expert doctors for better treatment.
- Drugs and its replacement can be administered efficiently.

CASE STUDIES ON ROLE OF IT IN ENVIRONMENT PROTECTION

Study on polluted back waters of Kerala

- A part of the back waters present in the Anchutengu-Kodianam Kulam, Kerala has been polluted due to the soaking of coconut-husks for the production of coir fibre. This polluted water has affected the fishery resources to a large extent.
- The environment of the coastal areas covering the polluted and non-polluted zones were studied by Indian Remote Sensing (IRS) Satellite. The IRS data were compared with water quality parameters such as turbidity, dissolved oxygen, production of H_2S and primary productivity mechanism. Proper analysis of these IRS has been carried out and the necessary steps were undertaken for the proper development of aquatic systems.

Ocean colour Monitor (OCM) to study phytoplankton's

- IRS-P4 is the first Indian Satellite used to get the required data's of oceanographic community. The space application centre which is the part of Indian Space Research Organisation (ISRO) has developed many applications of IRS-4.
- The IRS-P4 data has been found to be of great use for the estimation of phytoplankton in oceanic waters as well as the detection and monitoring of phytoplankton blooms. It is also helpful in the identification of fishery zones.

GIS for forest management

- The forest area of Bichua Range along Pench River in Madhya Pradesh was surveyed using GIS and remote sensing. The multi data images obtained by the satellite revealed that the forest is largely covered by Deacon Basalt and altered gneissic rocks. The various forest covers and denuded areas of the forest were also analysed. The deforestation and other ecological imbalances in the forest areas were detected. A work plan is being prepared on these data's for the effective forest management.

CASE STUDIES ON ROLE OF IT IN HUMAN HEALTH PROTECTION

Health service of New South Wales

- The health services of New South Wales are dominated by the state-administered public health service providing integrated hospitals and community services to the population of 3 million people. The health services have a geographically divisionalised structure. A new IT package was introduced in these health centres to streamline the various operations of the hospitals and help in providing better services to the people.
- The IT packages purchased from U.S. Company was found successful in the finance and accounting and pathology systems. But there is a difficulty in implementing patient administrative system or clinical system which involves the registration, admission and transfer of patients as well as medical records, clinical order entry, results operating and the clinic scheduling systems.

Home medical transcription system (Hometrans)'

- An American company M-square has started a scheme named 'Home medical transcription system' (Hometrans) under which a medical online business can be started from home. An individual interested in it; needs to have a computer, a telephone, a help line, and some essential software. The entire system has to be connected to interest. Therefore the following procedure has to be adopted.

- Company will provide a User ID (specific name of user) and a password to the user.
- Then the user can download the dictation files from server of Hometrans.
- The user will translate the download dictation into text.
- The companies will upkeep the account of daily working of the user and pays after counting the lines.
- The user knows about his work and payments at any time. It can be accomplished by connecting into a network. Presently many people are operating medical transcription from their homes.

IMPORTANT QUESTIONS

1. Discuss the **various populations among nation.**
2. Write the methods and strategies of imparting **value education.**
3. Write explanatory notes on **women and child welfare.**
4. Explain the **role of IT in environment and human health.**
5. Write short notes on (i) **family welfare programme.**
6. Write short notes on **Human Rights.**
7. What is **AIDS?** What are sources and mode of transmission of HIV infection? How can it be prevented?
8. Write briefly on implementation of **family planning programme.**
9. What is population explosion? Discuss the **causes and effects of population explosion.**
10. Explain detail about **population growth.**
11. Describe about **environment and human health relation.**