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**DEPARTMENT OF BIOTECHNOLOGY**  
**2.3.2 C- E-Contents developed by Faculty**

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**CELL BIOLOGY**

**CELL STRUCTURE AND FUNCTION OF THE ORGANELLES**

**Origin of life**

The origin of life was remaining the subject of imagination and speculation for a long time in the world. Most of the people believed “almighty” and had created each form of life. The only astonishing percept is that if life could have arisen once out of either non living element.

**Molecular origin**

Miller (1953) recreated a well known experiment the conditions prevailing on the early earth surface in which electrical discharges was passed through a mixture of gases similar to the early atmosphere. After a week analysis of the mixture revealed a number of amino acids, the building block of protein.

**Cell**

Just as the brick is the unit material of building and atom in chemical structure, so is the cell composting the body of all organisms? It is the structure and functional unit because most vital functions like nutrition, excretion, growth, respiration etc..., takes place in cells.

**Origin of cell**

Robert Hooke (English man) looking a thin slice of place bank under microscope. He found, it made up of many components. It looks like honey-comp and he called it a cell. It 1833,Robert brown observed some round bodies in the centre of the cell of orchid leaves and named it cell nucleus.

Schleiden (1838) and schwann (1839) after extensive study of plant and animal tissue, they are postulated the following cell theory.

1. All “living” bodies are essentially composed of cells.
2. Cells always arise from pre-existing cells.

## **Prokaryotic cell**

Based on the structure a function, living organization has been classified into prokaryotes and eukaryotes. Prokaryotes are the individual whose cell lacks a defined nucleus. All prokaryotes are single celled organization. The cells are typically spherical or rod shape with 1-20 microns. The cell has a rigid wall made of layers of peptidoglycan, oligosaccharides and a complex of protein. The genetic material, DNA is condensed into the central region of the cell called a prokaryon or nucleoid. Prokaryotes does not cellular organelle and it contain 70s ribosome.

## **Eukaryotic cell**

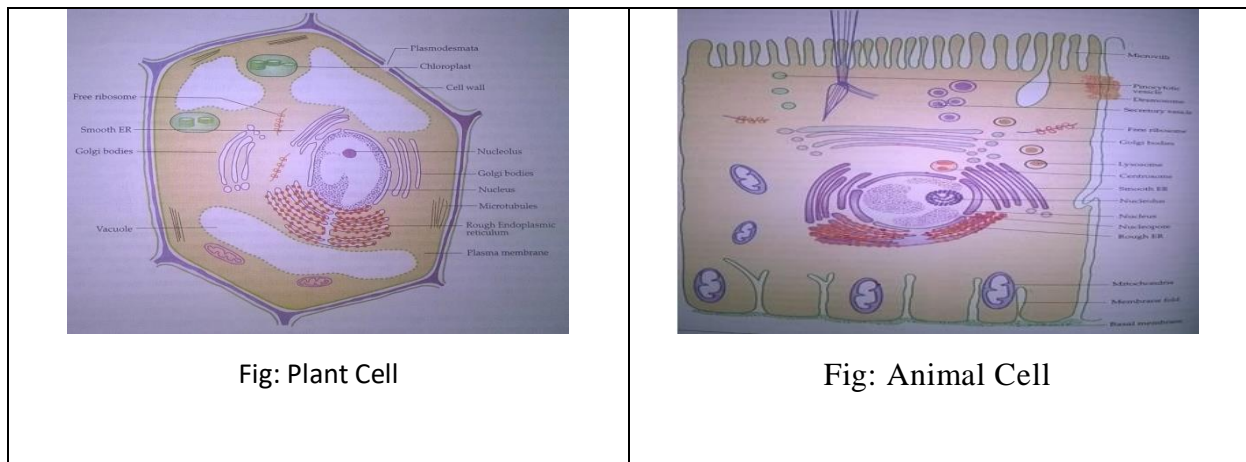
Chromosomes within the membrane bounded well organized nucleus. It contains all cellular organelle with 80s ribosome.

## **Cell structure**

The cell has a well defined structure in all organization except virus. A typical cell contains three major parts .they are

- i. The cytoplasm
- ii. The nucleus
- iii. The surrounding membrane

In animal or cell wall in plant.



## Cell membrane

Cells are surrounded by water impermeable membrane composed of phospholipids .the membrane is given rigidity by interspersions of cholesterol. However they are permeable to metabolic exchanges. All cells have specialized proteins embedded in their membrane, which regulate the entry and exit of fluid and from the cells.

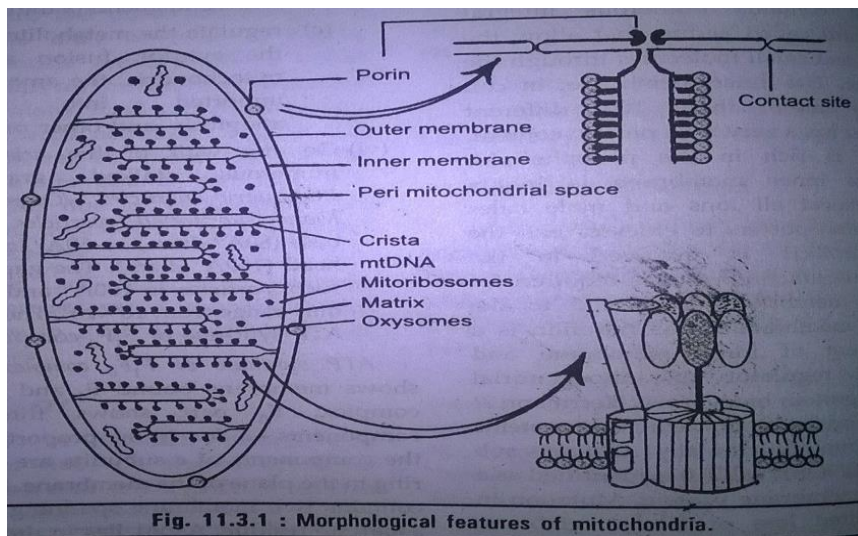
## Cytoplasm

Cytoplasm is surrounded the nucleus and inside the cell membrane. It is a semifluid colloidal substance .it looks homogenous fluid with a large number of organelles with active cell function. The cell organelle streaming occurs in eukaryotes absent in prokaryotes.

## Mitochondria

Mitochondria are power house of the cell .they are small spherical/rod shape body distributed in cytoplasm.it is provide cellular energy through respiration and oxidation. It is center of enzymatic activity and convert energy stored in macromolecule into ATP.

Under electron microscope, mitochondria look double membrane structure. The outer membrane is smooth but the inner membrane is thrown into number of folds called cristae, which contain many enzymes that involved oxidation of food and release energy.



### **Endoplasmic reticulum (E.R)**

The cytoplasm is embedded in a network of double membrane structures called E.R. it is tubular structure. Besides the membrane encloses elements like vesicles, and cisterns of variable sizes and thickness. E.R present in differential cell, it may be smooth or rough. Smooth and rough E.R conditions may be interchanged as per the needs of cells. the rough E.R provide structural base for protein, lipid and phosphor lipids (both E.R).E.R provide channel for transport of substances. E.R regulates passage to mRNA from nucleus to rough E.R. E.R contain several enzymes.

### **Ribosomes (rb)**

Ribosomes are small ( $200 \text{ \AA}^0$ ) dense granules attached outer surface of E.R. Ribosome's are composed 2 major sub-units 70s (prokaryotes) and 80s (eukaryotes). Ribosomes are the site of protein synthesis, it assemble nucleolus and migrate to cytoplasm.

### **Golgi bodies**

Golgi bodies are present in animal cell. It is net like double membrane, commomly found in cell engaged in secretion. Some places it contains with E.R .it's function is not precisely known but probably, concerned with absorption storage and condensation of compounds.

### **Lysozome**

A pinch of form from golgi complex, small vesicle is lysosome.it contains powerful digestive enzymes.

## Centrosome

A pair of round bodies close to the nucleus is centriole. The cytoplasm around centriole is clear and transparent is called centrosphere. Centriole with centrosphere is called centrosome. It duplicates during cell division and show continuous inheritance between cell generations. It found only in animal cell.

## Vacuoles

Vacuoles are watery fluid of cell called cell sap. It push periphery of the cell for easy exchange of substances. The size and number are vary depends on organisms.

## Cell wall

A rigid outside cell membrane of plant cells are called cell wall. It contains large pores and allows both solute and solvent pass through it.it gives a definite shape, mechanical support and strength to tissues. It is made of cellulose. It has 3 parts, they are

- i. **Middle lamella:** walls or neighbour cells are joined by middle lamella. It's composed by pectin. It is first originate following cell division.
- ii. **Primary cell wall:** It lies in-between middle lamella and secondary cell wall. it constitutes cellulose, pectin, protein, lipid, hemi cellulose etc;
- iii. **Secondary cell wall:** The inner most layer of the cell wall. Intermediate between primary wall and cytosol called plasma membrane or plasma lemma.

## Plastids

In plants, double membrane spherical, discoidal or ellipsoid shape found in leaves. They are three types

- i. **Leucoplast:** colorless bodies found in tissue, not exposed to light, they serve as storage organs. **Eg:** Potatto.
- ii. **Chloroplast:** It contains green pigments, chlorophyll and serve as photosynthetic factory

- iii. **Chromoplast:** It contains other than chlorophyll eg: carotenes, xanthophyll. Mostly found in petals of flowers & fruits, it helps pollination.

All 3 develop from small membrane organelle called proplastids.

## **Pherosome**

It present only in plant cell. They are vesicles of 0.5-1 dia . it helps to store lipid and acid phosphate.

## **Nucleus**

Nucleus is prominent, dense protoplasmic body found in the center of the cells. It controls all cellular activities and inheritance. The shape of the nucleus may be oval to flattened lobe, spherical. It has three parts: nuclear membrane, nucleolus and chromosomes. Nuclear sap present in between nucleus and chromosomes are nucleoplasam. The nuclear membrane has inner and outer envelope with enclosed narrow channel or cistern, nucleoplasam continuous with cytoplasm. The pores allow import and export of protein and RNA from nucleus to cytoplasm.

Staining of nucleus reveals dark network called chromatin which during cell division becomes thread like bodies are chromosomes. Interphase chromosomal material is chromatin. It divided into two types

1. Heterochromatin
2. Euchromatin

## **Membrane protein**

Membrane protein is a protein molecule that is attached or associate with the membrane of a cell. It consist phospholipid bilayer and a variety of proteins that accomplish vital biological functions.

- Structural proteins are attached to micro filament in the cytoskeleton which ensures stability of the cell.
- Cell adhesion molecules allow cell to identify each other and interface.
- Membrane enzymes are involved variety of substance production.
- Membrane receptor protein serves as connection between the cell's internal and

external environments.

- Transport proteins are maintaining the concentration of ions in cell.

Membrane protein divided into three types

## 1) **Integral membrane protein**

Integral membrane proteins are permanently attached to membrane and bound to lipid layer. It is displayed by detergent like SDS, TRITON, X-100 etc, based on relationship with bilayer, it is classified into

- a) **Integral polytopic protein:** It is also called trans membrane protein and contains either beta-barrels or alpha helical.
- b) **Integral monotopic protein;** One side of this protein is attached with lipid membrane and does not span across the membrane.

## 2) **Peripheral membrane protein;**

It is an extrinsic protein; they do not interact with hydrophobic lipid bilayer. It is temporarily attached either to lipid bilayer / integral proteins.

## 3) **Lipid anchored protein;**

Lipid anchored protein is bound to lipid bilayer through lipidated amino acid residues.

## **Membrane protein complex**

Membrane proteins commonly function as complexes. They are vital to cellular functions. They are exchanged in and out of existing protein complexes. Based on synthesis membrane proteins are constitutive membrane protein (mRNA attached to translocator) and non-constitutive membrane protein. (Toxin)

## **Membrane protein structure**

Membrane proteins have alpha helical bundles and beta-barrel porins. One portion attached to the lipid bilayer consists of hydrophobic amino acids and other portions do not touch the lipid bilayer; they consist of hydrophilic amino acids. They are stabilized by weak interactions and influenced by additional interactions with the solubilizing environment. Membrane proteins are characterized by x-ray crystallography and NMR techniques. All



membrane protein structural biology should be subjected to careful scrutiny.

## **The cytoskeleton:**

Cells contains elaborate arrays of protein fibers serve such functions.

- Establishing cell shape
- Providing mechanical strength
- Locomotion
- Intercellular transport
- Chromosome separation in mitosis&miosis.

Cytoskeleton is made up of three kinds of protein filaments.

### **1. Actin filaments:**

Monomers of the protein actin polymerize to form long, thin fibers with 8 nm diameter. This is called micro filaments.

### **2. Intermediate filaments:**

The cytoplasmic fibers are 10 nm in diameter. It constitutes keratin (hair), lamins, neuro filaments, vimentins etc.,

### **3. Microtubules:**

They are straight hollow 25 nm diameter and consists 13 proto filaments. It is 1000 times long as wide. It assembles alpha tubulin and beta tubulin. It originates at centrosome. The attachment end is minus the other end is plus end. (polymerization site).

## **Microtubule motors:**

Microtubule motors are kinesins (more towards plus) and dyneins (more towards minus end).

Cytoskeletal filament, their usefulness actually depends upon a large number of accessory proteins that link the filaments to other cell components. In addition some motor protein helps to move the organelles to different locations within the cell. They use

energy from ATP to slide along the microtubules (MT's).

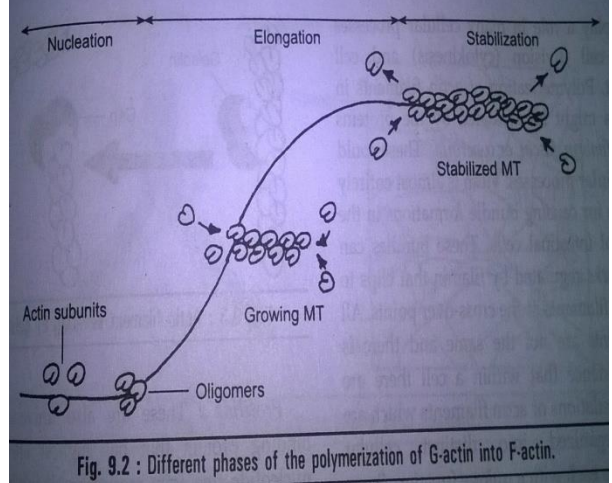
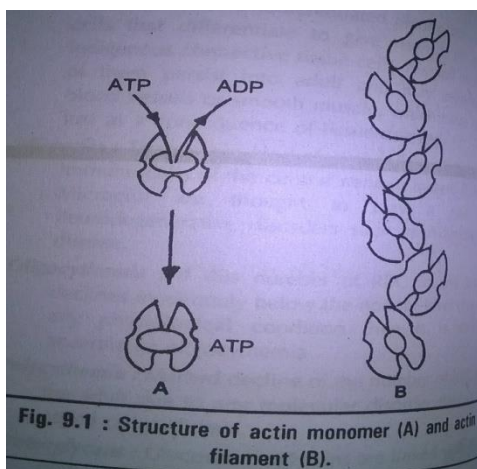
**Actin/ Microfilament:**

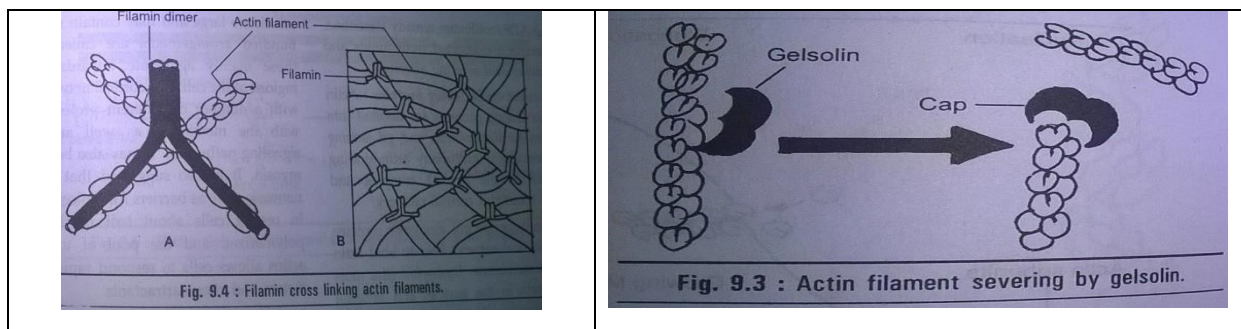
Actin is a globular protein that polymerises helically forming actin filaments (7-8 dia). These are thin cytoskeletal protein. It has 15% total cellular protein.

**Structure:**

The actin monomer is approximately pear shaped showing four domains but folded into two asymmetric domain with large cleft called ATPase fold that almost bisect the molecule towards bottom of cleft there are binding sites for  $Mg^{++}$  and ATP or ADP. Both N and C terminal are near the bottom of small domain. Post transaltional modification of actin includes acetylation of N-terminus and methylation of histidine 68 ofr phosphorylation on tyrosine-211.

The exact atomic model of microfilament is yet to be defined by electron microscope studies reveal the filament appears as double stranded helices and due to monomers (G-actin) the ends of the filament (F-actin) are referred to as pointed ('-end) and barbed (+end). Monomers rotted  $166^0$  with respect to neighboring monomer. It means every  $13^{th}$  subunits the filament rotates. Overall rate of monomer differ both ends. The barbed end prefers tenfold monomer addition over pointed end. This phenomenon is "Treadmill effect".





### Microfilament assembly:

Polymerization starts with weak binding of two actin monomers but addition of 3<sup>rd</sup> stabilizes the complex forming a trimer. It adds additional molecules and form nucleation site. This is slow polymerization process, it followed elongation phase. ATP actin then binds the plus end and the ATP is subsequently hydrolysed which reduces the binding strength between neighboring units and destabilize the filament is “steady state phase”.

Nucleating protein, “Cofilin” binds to ADP actin unit and promotes their dissociation from the minus end and prevent their reassembly. The protein “profilin” reverse these effects by stimulate exchange of bound ADP for ATP. Profilin and ATP hydrolysis both are required for nucleation mediated by the “formin”. Another important filament protein is “ATP<sup>2/3</sup>” protein. It serves as site for nucleation; stimulate the formation of G-actin trimers.

Actin filaments assemble two types of structure like bundles and networks. It appear double strand helix polymerization actin mediated by villin, fimbrin, fascin etc.,

### Myosin:

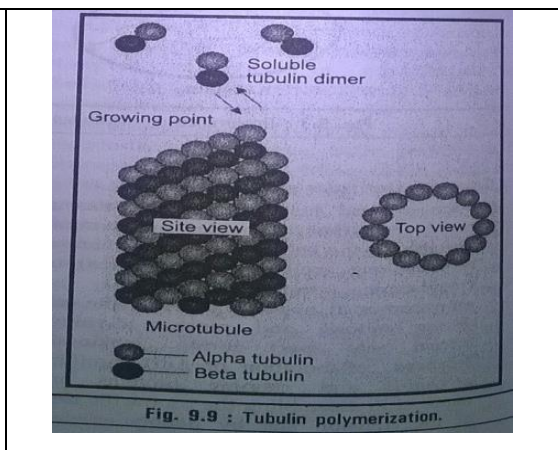
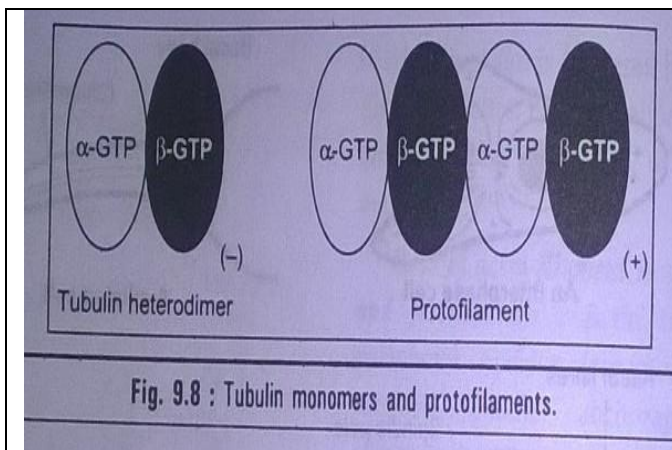
Motor protein consists two distinct domains a motor head portion with ATPase function and a tail part that can be either form fibers. Myosin is protein responsible for generation muscle contraction. Previously myosin obtains in muscle cells only, now myosin in all cells. Myosin divided into ten subtypes.

**Table:** Complexes of myosin

S.No	Complex of myosin	Examples
1	Myosin - I	Drosophila, Mouse, rat, yeast
2	Myosin - II	Plasmodium, Arabidopsis
3	Myosin - III	Drosophila
4	Myosin - V	<i>C.elegans</i> , mouse
5	Myosin - VI	Drosophila, rat
6	Myosin - VII	Man, <i>C.elegans</i> ,
7	Myosin - IX	Hman , mouse
8	Myosin - XI & XII	Maize
9	Myosin - X	Toxoplasma

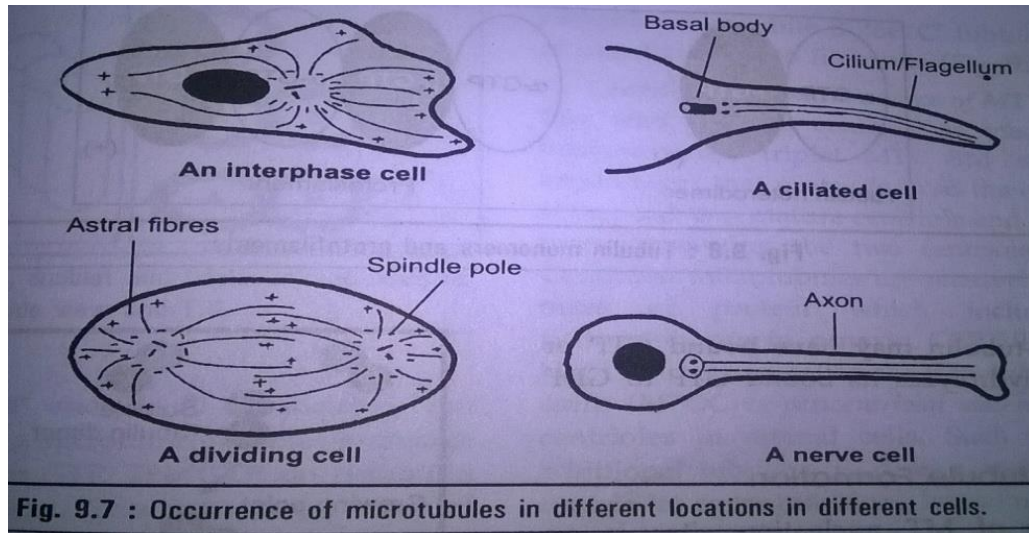
**Microtubules:**

A microtubules (MT) is a hollow cylinder 24 nm in dia. Microtubules have axis, tubulin, heterodimers are joined end to end to form proto filaments, with alter  $\alpha$  and  $\beta$  subunits.



The membrane associated proteins (MAP's) includes kinesins and dinesin

which walk along the moving microtubules in opposite directions. Kinesin is double headed motor protein that moves along microtubules. The energy for their movement is provided by the hydrolysis of ATP.



Different vesicles are seen attached to membrane associated proteins (MAP's) and the microtubule conveyer belt kinesin move the vesicle towards the plus end and dynein walks towards the minus end.

Two models have been proposed kinesin movement hand over hand and inchworm models.

- Microtubules role in formation of flagella and cilia helps to movement.
- Associate proteins
- Regulation of epithelial apical junction formation
- Organalle interaction.

### Reference:

Aminul Islam. 2014. Text book of cell biology. Arunabha sen publisher, Kolkata. Pp: 207-230, 239, 367.

**CELL DIVISION AND CONNECTION**

**Cell cycle**

It is the series of events taking place in a cell during cell division. Cell cycle consists of four distinct phases: G<sub>1</sub>, S, G<sub>2</sub> and M.

**G<sub>0</sub> phase**

The G<sub>0</sub> phase or the '*resting phase*' is a period in the cell cycle in which cells exist in a **quiescent** state. G<sub>0</sub> phase is viewed as either an extended G<sub>1</sub> phase, where the cell is neither dividing nor preparing to divide. Cellular senescence is different from quiescence because it is a state that occurs in response to DNA damage or degradation that would make a cell's progeny nonviable. Senescence is often a biochemical alternative to the self destruction of such a damaged cell by **apoptosis**.

**Interphase**

This is so called 'resting stage' but is in fact a period of great activity. Three important processes which are preparatory to cell division take place during interphase.

- 1) **Replication of DNA** takes place, and also synthesis of basic nuclear proteins, the **histones**.
- 2) The **centrioles divide**, forming a pair of new centrioles, which are at right angles to each other.
- 3) **Synthesis of energy-rich compounds** which provide energy for cell division and synthesis of proteins which are later found in the spindle, takes place at the end of interphase.

Interphase can be divided into three periods:

**G<sub>1</sub> phase**

It takes place at the end of one cell division. RNA and proteins are synthesized during

this period, but there is no synthesis of DNA.

## **S phase**

During this phase, DNA is formed from purine and pyrimidine nucleotides. The DNA content of the nucleus is doubled.

## **G<sub>2</sub> phase**

During this phase, synthesis of RNA and protein continues, but DNA synthesis stops.

## **M phase**

It consists of nuclear division i.e. karyokinesis.

## **MITOSIS**

The process of cell division whereby the chromosomes are duplicated and distributed equally to the daughter cells is called mitosis. The mitotic cycle is divided into many phases: prophase, prometaphase, metaphase, anaphase and telophase. The period between two mitotic cycle is called Interphase.

### **Interphase**

During this phase, duplication of chromosomes takes place. The chromosome (called the *monad*) becomes double, and is then called the *dyad*.

### **Prophase**

During this phase, the cell becomes spheroid and there is increase in viscosity and refractivity. The chromosomes shorten and thicken and become stainable. By the end of prophase, the double nature of chromosomes is visible. Each chromosome consists of two **chromatids** united by a **centromere** and is called a dyad.

### **Prometaphase**

The beginning of this phase is marked by the disappearance of the nuclear membrane. When the nuclear membrane dissolves, a fluid area is observed in the centre of the cell. The chromosomes move freely through this area as they proceed towards the equator.

## **Metaphase**

At metaphase the chromosomes have reached the central or equatorial portion of the spindle. They are lined up in one place to form the equatorial plate or *metaphasic plate*. The centrioles lie on the equator of the spindle.

RNA synthesis ceases during metaphase and anaphase.

## **Anaphase**

The centromeres of chromosome divide simultaneously as anaphase commences, and the two chromatids of each pair separate. They are now called *daughter chromosomes*. The two sets of chromosomes migrate towards the poles. The forces behind chromosome movement are not yet known. Various theories have been suggested for the migration of chromosome, e.g. (1) pulling by contraction of spindle fibres. (2) pushing by expansion of the fibres. (3) combination of contraction and expansion (4) viscosity changes in the cell.

## **Telophase**

It begins when the two sets of daughter chromosomes reach opposite poles of the cell. The gel of the spindle reverts to sol state and the spindle disappears. A new nuclear membrane is formed at constrictions called the *nuclear organisers*, in one pair of chromosomes. Each daughter cell gets the same complement of nucleoli at the same sites as did the parent cell. The chromosomes gradually uncoil and become less compact.

## **Cytokinesis**

In animal cells a cleavage furrow appears at the beginning of telophase. This furrow or constriction becomes progressively deeper as the spindle breaks down. Eventually the ingrowing constrictions join and separate two daughter cells. This division is called



cytokinesis.

## Significance of mitosis

- ❖ Equal distribution of chromosomes.
- ❖ Restoration of surface-volume ratio.
- ❖ Restoration of *nucleoplasmic index*.
- ❖ Repair of body.

## Important terms

**Centric** - when the centriole is present and participates in cell division, mitosis is said to be centric.

**Acentric** – when the centriole is absent in a species, mitosis is said to be acentric.

**Astral** – cell division in which aster is formed is called astral mitosis.

**Eumitosis**- when there is no differentiation between cytoplasm and nucleoplasm during *prometaphase*, the mitosis is called extranuclear or eumitosis.

**Premitosis**- when mitosis takes place within nuclear membrane, it is called premitosis.

**Spindle** – it is largely a protein gel and undergoes a cycle of dissolution and re-formation. There are two type of spindle: anastral and astral.

**Microtubules**- long cylinders, about 250Å in diameter. They are restricted to eukaryotes and are not found in prokaryotes. They are found in the mitotic spindle and are said to be *labile*.

## MEIOSIS

This process reduces the chromosome number to half and counteracts the effect of fertilisation. Meiosis consists of two cell divisions which take place one after the other, during which the number of chromosomes is halved. The two divisions are: **first meiotic division** and **second meiotic division**.

### Types of meiosis

- There are three types of meiosis:
  - Zygotic or initial meiosis
  - Gametic or terminal meiosis
  - Sporic or indeterminate meiosis

### The first meiotic division

#### Interphase

It precedes meiosis and is important because DNA replication takes place.

#### Prophase I

It is the most important stage of meiosis and differs considerably from the prophase of mitosis. It is divided into six stages: preleptotene, leptotene, zygotene, pachytee, diplotene and diakinesis.

- a) **Preleptotene:** The chromosomes are very thin and cannot be seen, except sometimes for the sex chromosomes.
- b) **Leptotene:** Also called *leptonema*. During this stage the chromosomes become more distinct and their double nature is seen in many organisms. Leptotene chromosomes may be irregularly arranged, or may be polarized towards the centrioles forming a 'bouquet'. The cytoplasm has many polyribisomes.
- c) **Zygotene:** The chromosomes becomes shorter and thicker. Length-wise pairing of homologous chromosomes begins. As a result of pairing, the chromosomes become approximated throughout their length.

- d) **Pachytene:** It is the longest stage in mammalian spermatogenesis. During this stage, the chromosomes are associated in *bivalents* or *tetrad*. Each bivalent consists of four chromosomes and is united by a *centromere*.
- e) **Diplotene:** It is marked by separation of paired homologues. The separating chromosomes are held together at one or more points where breaks and fusion had occurred. These points are called *chiasmata*.
- f) **Diakinesis:** The chromosomes become more contracted. The bivalents are more evenly distributed in the nucleus and migrate towards the periphery.

## **Prometaphase I**

The nuclear membrane disappears in this stage and chromosomes reach their maximum contraction. Spindle formation begins.

## **Metaphase I**

Spindle is formed and these fibres are attached to the centromeres of two homologous chromosomes.

## **Anaphase I**

The homologous chromosomes move towards the poles of the cell. The chromosomes do not separate simultaneously. The short chromosome separate quickly while the separation of long chromosomes is delayed because they have interstitial chiasmata.

## **Telophase I**

The nuclear membrane is reformed but the nucleoli do not reappear. Unlike in mitosis, the spindle fibres do not disappear completely.

## **The second meiotic division**

It is similar to mitosis but differs from mitosis in that DNA does not duplicate while the centromeres do. Telophase I is followed by a short period of interkinesis (Interphase II).

**Prophase II**

The chromatids of prophase II have widely separated arms. Spindle formation takes place and nuclear membrane disappears.

**Metaphase II**

The chromosomes become oriented on the equatorial plate and have the same relationship to the spindle as in mitosis.

**Anaphase II**

The centromeres divide and the two chromatids of each chromosome separate and move to the poles. After separation the chromatids are called chromosomes.

**Telophase II**

Reconstitution of the nuclei takes place as in mitosis. Each nucleus contains the haploid number of chromosomes.

<b>MITOSIS</b>	<b>MEIOSIS</b>
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<p>The cell divides only once.</p> <p>Mitosis takes place in the somatic cells of the body.</p> <p>It occurs in both sexually as well as asexually reproducing organisms.</p> <p>DNA replication takes place during Interphase I.</p> <p>The duration of prophase is short.</p> <p>There is no synapsis.</p> <p>The arms of prophase chromatids are close to one another.</p> <p>Spindle fibres disappear completely.</p> <p>Nucleoli reappear at telophase.</p> <p>Chromosome number remains constant.</p> <p>Chromosomes divide only once.</p>	<p>There are two cell divisions.</p> <p>Meiosis takes place in germ cells.</p> <p>It occurs in sexually reproducing organisms.</p> <p>DNA replication takes place during Interphase I but not Interphase II.</p> <p>Prophase is comparatively longer.</p> <p>Synapsis of homologous chromosomes takes place.</p> <p>The arms of chromatids are separated widely in prophase II.</p> <p>Spindle fibres do not disappear completely.</p> <p>Nucleoli do not reappear in telophase I.</p> <p>Chromosome number is halved.</p> <p>Chromosomes divide once although the cell divides twice.</p>
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### EXTRACELLULAR MATRIX

Tissue is composed of an interconnected network of macromolecules called extracellular matrix (ECM). It is made up of proteoglycans, water, minerals, and fibrous proteins. The components of the extracellular matrix are produced and organized by the cells that live within it. In most tissues, **fibroblasts** are charged with this responsibility. Several types of **fibrous proteins**, including collagen, elastin, fibronectin, and laminin, produced by fibroblasts are found in varying amounts within the extracellular matrix of different tissues but they aren't secreted in their finished form. Rather, they're released as 'precursor' molecule.

A **proteoglycan** is composed of a protein core surrounded by long chains of starch-like molecules called glycosaminoglycans.

#### Functions

- ❖ Provides support to the cell
- ❖ Segregates tissues from one another

- ❖ Regulates intercellular communication

## JUNCTIONAL COMPLEX

Sometimes the contact between cells results in a modification of the cell membrane. There are specialised regions in which there is firmer intercellular attachment. One type of contact found in some epithelial cells is called the **junctional complex**.

In epithelial cells, four types of junctional differentiation of cell membranes are present

1. The *tight junction* or *zonula occludens*
2. The *belt desmosome* or *intermediary junction*
3. The *spot desmosome* or *macula adherens*
4. The *gap junction*

### **Tight junction**

It is found near the free surface of cells. The plasma membrane of two adjacent cells are fused at a series of points containing sealing strands which form lines of attachment. Tight junction prevents free passage of substances across the epithelium. They are also essential for normal embryonic development.

### **Belt desmosome**

It is found just below the tight junction. It is in the form of band on the inner side of the cell membrane of epithelial cells. The filaments associated with belt desmosomes are 70Å in diameter and appear to contain *actin*. These filaments help to close gaps in the epithelium resulting from death of cells.

### **Spot desmosome**

These are disc-shaped points of contact between the plasma membranes of adjacent cells. The intercellular gap is about 300 – 500 Å.

Hemidesmosomes: in the basal region of some epithelial cells, only half desmosomes are present. Such structures are called hemidesmosomes. They serve as anchoring sites for bundles of tonofilaments and also for joining the cell membrane of epithelial cells to

underlying basement membrane.

## **Gap junction**

These are patch-like areas of close intercellular contact. The intercellular space is narrow (about 30Å) in the region of gap junction. The gap junction consists of a disc-shaped area on each cell membrane containing several hollow, cylindrical particles that are 70Å in diameter. Calcium ions regulate the permeability of gap junction channels.

## **Reference:**

Aminul Islam. 2014. Text book of cell biology. Arunabha sen publisher, Kolkata.

## **TRANSPORT OF MOLECULES**

Transport refers to the act or the means by which a molecule or ion is moved across the cell membrane or via the bloodstream. There are two types of transport: **passive transport, active transport.**

### **Passive transport**

The passage of molecules through the membrane from a high concentration to a low concentration region is called passive transport. Transfer of molecules takes place along the concentration gradient, and *no energy* is required.

**E.g.** Diffusion, osmosis

### **Simple diffusion**

- It is the movement of particles or molecules or ions from a region of higher concentration to a region of lower concentration.
- Diffusion is a passive process and requires no expenditure of energy.
- During diffusion each molecule diffuses down its own concentration gradient and becomes unaffected by concentration gradient of other molecules.

- It does not involve any stereo-specificity and is a slow process.

## Facilitated diffusion

- It resembles simple diffusion, in that it does not require energy and takes place along a concentration gradient but is facilitated by a protein. E.g. *porins*.
- It is very specific, it allows cell to select substances for uptake.
- The process is stereo specific.
- A carrier is required for transport across the membrane.

e.g. entry of glucose into erythrocytes

## Osmosis

It is the diffusion of molecules through a differentially permeable membrane or semi permeable membrane.

### Types of membrane:

**Impermeable:** do not allow any solvent or solute to pass through.

**Permeable:** allow solutes and solvents to pass through them.

**Semi permeable:** allow solvent but prevent solute to pass through them.

**Differentially permeable:** allows only certain substances to pass through them.

## Active transport

Transport of molecules takes place in the direction opposite to the concentration gradient, i.e. from low concentration region to high concentration region. Active transport requires *energy* and is dependent upon ATP supply in many cases. It is of two types, primary active transport and secondary active transport.

### Primary active transport



- It is directly related with chemical energy (ATP) or electric energy (electro flow).

**E.g.**  $\text{Na}^+$ ,  $\text{K}^+$  translocating ATPase in mammals and proton translocating ATPase of bacteria.

- The existence of sodium and potassium pumps has been demonstrated in many eukaryotic cells.  $\text{Na}^+$  is pumped out of the cell and  $\text{K}^+$  is pumped into the cell by a coupled process.
- ATPase functions as a monovalent ion pump that is found to be an integral plasma protein.
- The essential part of ion transport ATPase process is cyclic phosphorylation-dephosphorylation initiated by  $\text{Na}^+$  and  $\text{K}^+$  respectively.

## Secondary active transport

- It depends upon chemiosmotic energy (membrane potential and/or ion gradients).

**E.g.** *glucose* transport system of the intestinal epithelium of mammals and *lactose* permease system in *E.coli*.

- The free surface of the intestinal epithelium has numerous microvilli which are formed by projections of the brush border membrane.
- The electrochemical sodium ion gradient is utilized for secondary active transport of glucose into the cell against concentration gradient.
- The sodium pump maintains higher concentration of  $\text{Na}^+$  outside the cell than on the inner side. This results in a tendency for  $\text{Na}^+$  to enter the cell.

## Endocytosis

- It is a process by which large particles (phagocytosis) or small particles (pinocytosis) are engulfed by the membrane, which then forms vesicles around them.
- The passage is through membrane vesicles.

**E.g.** Ingestion of bacteria by white blood cells, nursing of human egg cells.

## **Phagocytosis**

It involves folding of plasma membrane around the material that is being engulfed and the subsequent formation of an intracellular vesicle (phagosome). The phagosome fuses with a primary lysosome to form secondary lysosome in which food material is digested by enzymes. This process is found in many protozoa, where it serves for the nutrition of the cell.

## **Pinocytosis**

It is the intake of fluid material into the cell by the formation of pinocytic vesicles or pinosomes. The fluid may contain organic molecules or other nutrient material in solution. The protein acts as a stimulus to pinocytosis.

## **Exocytosis**

- It is a process by which vesicle fuses with plasma membrane and ejects its contents.
- It is a reverse of Endocytosis.
- The passage is through membrane vesicle.

**E.g.** secretion of mucus.

## **Group translocation**

In this process the substrate is altered by the enzyme that catalyses membrane transport. Transport of a variety of sugars like glucose, fructose, and mannitol takes place across bacterial membranes through the *phosphotransferase system* (PTS).

The PTS always uses phosphoenol pyruvate (PEP) as the energy form.

## **Enzymes involved:**

- ❖ Heat stable protein (HPr).
- ❖ Enzyme I and II.

### ATP-Powered Pumps

These are pumps which transport ions and various small molecules against their concentration gradients. All ATP-powered pumps are transmembrane proteins with one or more binding sites for ATP located on the cytosolic face of the membrane and are commonly called *ATPases*.

### Classes of pumps

<p><b>P-class pumps</b></p> <ul style="list-style-type: none"> <li>• Plasma membrane of plants, fungi, bacteria (H<sup>+</sup> pump)</li> <li>• Plasma membrane of higher eukaryotes (Na<sup>+</sup>/K<sup>+</sup> pump)</li> <li>• Apical plasma membrane of mammalian stomach (H<sup>+</sup>/K<sup>+</sup> pump)</li> <li>• Plasma membrane of all eukaryotic cells (Ca<sup>2+</sup> pump)</li> <li>• Sarcoplasmic reticulum membrane in muscle cells (Ca<sup>2+</sup> pump)</li> </ul>	<p><b>V-class proton pumps</b></p> <ul style="list-style-type: none"> <li>• Vacuolar membranes in plants, yeast, other fungi</li> <li>• Endosomal and lysosomal membranes in animal cells</li> <li>• Plasma membrane of osteoclasts and some kidney tubule cells</li> </ul>
<p><b>F-class proton pumps</b></p> <ul style="list-style-type: none"> <li>• Bacterial plasma membrane</li> <li>• Inner mitochondrial membrane</li> <li>• Thylakoid membrane of chloroplast</li> </ul>	<p><b>ABC superfamily</b></p> <ul style="list-style-type: none"> <li>• Bacterial plasma membranes (amino acid, sugar, and peptide transporters)</li> <li>• Mammalian plasma membranes (transporters of phospholipids, small lipophilic drugs, cholesterol)</li> </ul>

### Permeases

The plasma membrane of many bacteria contains numerous *permeases* that belong to the ABC superfamily. These proteins use the energy released by hydrolysis of ATP to transport specific amino acids, sugars, vitamins, or even peptides into the cell. Bacterial permeases generally are inducible; that is, the quantity of a

transport protein in the cell membrane is regulated by both the concentration of the nutrient in the medium and the metabolic needs of the cell.

## **Voltage Gated Ion Channels**

- ✓ Opening of voltage-gated  $\text{Na}^+$  channels permits influx of  $\text{Na}^+$  ions for about 1 ms, causing a sudden large depolarization of a segment of the membrane. The channels then close and become unable to open (refractory) for several milliseconds, preventing further  $\text{Na}^+$  flow.
- ✓ As the action potential reaches its peak, opening of voltage-gated  $\text{K}^+$  channels permits efflux of  $\text{K}^+$  ions, which repolarizes and then hyperpolarizes the membrane. As these channels close, the membrane returns to its resting potential.
- ✓ The excess cytosolic cations associated with an action potential generated at one point on an axon spread passively to the adjacent segment, triggering opening of voltage-gated  $\text{Na}^+$  channels and movement of the action potential along the axon.
- ✓ Because of the absolute refractory period of the voltage gated  $\text{Na}^+$  channels and the brief hyperpolarization resulting from  $\text{K}^+$  efflux, the action potential is propagated in one direction only, toward the axon terminus.
- ✓ Voltage-gated  $\text{Na}^+$  and  $\text{Ca}^{2+}$  channels are monomeric proteins containing four domains that are structurally and functionally similar to each of the subunits in the tetrameric voltage gated  $\text{K}^+$  channels.

## **Reference:**

Aminul Islam. 2014. Text book of cell biology. Arunabha sen publisher, Kolkata.

## **SIGNAL TRANSDUCTION**

## **Signal transduction**

Signal transduction through membranes of receptors of the cells involves external reaction. The Ligand binds to the receptor and internal reaction is triggered. The process takes place in 4 steps:

- Signal amplification
- Signal transduction
- Molecular mimicry
- Molecular specificity

## **Extracellular signalling molecule**

It is produced by one cell and is capable of travelling to nearby cells.

## **Receptor protein**

It is a Cell receptor protein which binds to the signalling molecule and communicates to the cell.

## **Intracellular signalling protein**

These pass the signal to organelles of the cell. The signal molecule binds to the receptor protein which activates the intracellular signalling protein that induces cascade action.

## **Target protein**

The conformations of a target protein are altered when a signal pathway is active and change the behaviour of the cell.

## **Extracellular Signaling**

Extracellular signalling occurs in 6 steps:

1. Synthesis
2. Release of signalling molecule

3. Transport of signal to target cell
4. Detection of signal by a specific receptor protein
5. A change in cellular metabolism
6. Termination of cellular responses

Many eukaryotic organisms secrete molecules that coordinate the aggregation of living cells for differentiation. Under suitable conditions **chemo kinesis** activity of the organism alters behaviour of other organisms.

## **Cell Surface Receptors**

Cell surface receptors are divided into different types based on the function, structure, location, etc. It interacts with water soluble ligands and induces secondary messenger molecules.

There are mainly four classes of receptors:

### **1. G-protein coupled receptors**

Ligand binds to cell active G-protein and generate specific secondary messengers. It causes a change in membrane potential.

E.g. serotonin, glucagon

### **2. Ion-channel receptors**

Ligand binding changes the conformation of receptors as a result of specific ion flow through it and alter electric potential across the cell membrane.

E.g. acetylcholine receptor

### **3. Tyrosine kinase-linked receptors**

It acts as a intrinsic catalyst. Ligand binding stimulates formation of dimeric receptors and activate one or more cytosolic protein.

### **4. Receptors with intrinsic enzymatic activity**

These receptors are activated by binding of ligands. The active receptors catalyse

conversion of GTP to cGMP. Other active receptors such as phosphatases remove phosphate group.

## Cytokine Receptors

It can be divided into two major categories:

- Cytoplasmic receptors
- Nuclear receptors

## Cytoplasmic receptors

These receptors are present in the cytoplasm of the cell. A large number of surface protein receptors act as transducer, enzymes and receptor channels. It contains Ligand binding single pass transmembrane (helix) domain and cytosolic domain. It consists of six receptors:

- ✓ Receptor tyrosine kinases (RTK)
- ✓ Receptor tyrosine phosphatases (RTP)
- ✓ Receptor serine/threonine kinases (RSK)
- ✓ Tyrosine kinases linked receptors
- ✓ Receptor guanylate
- ✓ Surface proteases

The RTK and RSK are abundant in animals and also found in plants where they are called “**plant receptor kinase**”.

## Nuclear receptors

They are nonpolar hormones like steroids and testosterone. They are derived from vitamin A and D and initiate signal transduction through plasma membrane by passive diffusion.

The ligands bind to and signal reaches the receptor that can alter gene expression. The activated nuclear receptors attach to DNA at receptor-specific hormone responsive element

(HRE).

\*certain intracellular receptors of immune system are Cytoplasmic receptors recently identified.

## Classification of Receptors

Receptors are mainly classified into two types:

- External receptors (cell surface)
- Internal receptors (cytosolic)

Sensory receptors are classified into following types:

**Chemo receptors:** detects the presence of chemicals

**Mechano receptors:** detects mechanical forces

**Thermo receptors:** detects changes in temperature

**Photo receptors:** detects light during vision

e.g. proprioceptors, baroreceptors, hygroreceptors.

## Signaling molecules

Signals are transmitted from one cell to another cell by soluble substances secreted by cells. Cells secreting soluble substances are called cytokines. Cytokines are low molecular weight proteins that stimulate or inhibit the differentiation, proliferation or function of immune cells. The secretory molecules are classified into three types. They are:

- a) Autocrine
- b) Paracrine
- c) Endocrine

## Autocrine

These are cytokines that bind to receptor on the membrane of the same cell that



secreted it.

## **Paracrine**

These are cytokines that bind to receptors on a target cell in close proximity to the producer cell.

## **Endocrine**

These are cytokines that bind to target cells on distant part of the body.

## **Secondary messenger molecules**

These are substances that enter the cytoplasm and act within cell to trigger a response. It carries out intracellular signal transduction.

## **Properties**

- ✓ They are synthesized and broken down again in specific reaction by enzymes or ion channels.
- ✓ Some messengers like  $\text{Ca}^{2+}$  stored in special organelles are released quickly whenever required.
- ✓ Production and destruction of secondary messengers are localized, enabling the cell to limit space and time of signal activity.

## **TYPES OF SECOND MESSENGER MOLECULES**

Secondary messenger molecules are classified into three types:

- ✓ Hydrophobic molecules
- ✓ Hydrophilic molecules
- ✓ Gases

## **Hydrophobic molecules**

They are water insoluble molecule associated with membrane which diffuses from plasma membrane to the intermembrane space. It can reach and regulate membrane

associated with effector proteins. E.g. diacylglycerol.

## **Hydrophilic molecules**

They are water soluble molecule and are located in cytosol of the cell. E.g. cAMP, cGMP, IP<sub>3</sub> and Ca<sup>2+</sup>

## **Gases**

They can diffuse through cytosol and across the cellular membrane. E.g NO, CO, H<sub>2</sub>S.

## **Calcium**

It is released from ER to the cytosol and binds to signalling proteins for activation. Two combined ion channel proteins control the transport of calcium: **inositol triphosphate**.

## **Nitric oxide**

It is a free radical that is synthesized from arginine and oxygen. Some of them have redox mechanism while others facilitate covalent modification of protein. High concentration of NO is toxic and causes stroke.

## **Redox signalling**

In addition to NO, electronically activated species also transducer signal in a process called redox signalling.

e.g. H<sub>2</sub>O<sub>2</sub>, CO, H<sub>2</sub>S

## **Reference:**

Aminul Islam. 2014. Text book of cell biology. Arunabha sen publisher, Kolkata.

# ENVIRONMENTAL SCIENCE AND ENGINEERING

## UNIT I

### ENVIRONMENT ECOSYSTEMS AND BIODIVERSITY

#### Definitions:

**Environment** is derived from the French word **environ** which means to encircle or surround.

Environment is sum total of water, air, and land, inter-relationships among themselves and also with the human beings, other living organisms and property.

The above definition given in Environment Act, 1986 clearly indicates that environment includes all the physical and biological surroundings and their interactions.

#### 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

#### NEED FOR PUBLIC AWARENESS

Public awareness very essential to help understand environmental problems.

The United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 and popularly known as Earth summit followed by the world summit on sustainable Development in 2002, have highlighted key issues of global environmental concern.

Environmental pollution cannot be removed by laws alone. The proper implementation and especially public participation are important aspects.

Public participation is possible only when the public is aware about the ecological and environmental issues.

## **RISK AND HAZARDS IN THE ENVIRONMENT:**

### **HAZARD:**

A hazard is a situation that poses a level of threat to life, health, property, or environment, e.g., exposure to benzene may cause cancer.

### **Types of Hazards:**

1. Physical hazards, e.g., earthquakes, floods
2. Chemical hazards, e.g., mutagens, teratogens, carcinogens
3. Biological hazards, e.g., pathogens – viruses, bacteria, toxins and allergens

### **RISK:**

Risk is the probability of suffering harm from a hazard that can cause injury, disease, economic loss, or environmental damage. Risk is expressed in terms of probability of the likelihood of harm. For example, cigarette smokers are 12 times (for example) more likely to die of lung cancer than non-smokers.

**Ecosystem** - living things in a given area, non-living chemical and physical factors of their environment, linked together through nutrient cycle and energy flow

### **Types of Ecosystem**

- Natural
- Artificial/Man-made
- Terrestrial
- Aquatic
- Fresh water
- Marine

**Ecology** - Study of the distribution and abundance of organisms, the flows of energy and materials between abiotic and biotic components of ecosystems.

### **Structure of an ecosystem**

The structure of an ecosystem explains the relationship between the abiotic (nonliving) and the biotic (living) components.

- 1. Biotic Structure**
  - a.** The plants, animals and microorganisms present in an ecosystem form the biotic component.
  - b.** These organisms have different nutritional behaviour and status in the ecosystems and are accordingly known as Producers or Consumers, based on how they get their food.
- 2. Abiotic structure**
  - a.** The physical and chemical components of an ecosystem constitute its abiotic structure.

- b. It includes climatic factors, edaphic (soil) factors, geographical factors, energy, nutrients and toxic substances.

### **Functional Attributes**

Every ecosystem performs under natural conditions in a systematic way. It receives energy from the sun and passes it on through various biotic components and in fact, all life depends upon this flow of energy.

The major functional attributes of an ecosystem are as follows:

- 1) Food chain, food webs and trophic structure
- 2) Energy flow
- 3) Cycling of nutrients (Biogeochemical cycles)
- 4) Primary and Secondary production
- 5) Ecosystem development and regulation

### **Energy Flow in an Ecosystem**

Flow of energy in an ecosystem takes place through the food chain and it is this energy flow which keeps the ecosystem going. The most important feature of this energy flow is that it is unidirectional or one-way flow. Unlike the nutrients, (like carbon, nitrogen, phosphorus etc.) energy is not reused in the food chain. Also, the flow of energy follows the two laws of Thermodynamics.

**I law of thermodynamics** states that energy can neither be created nor be destroyed but it can be transferred from one form to another. The solar energy captured by the green plants (producers) gets converted into biochemical energy of plants and later into that of consumers.

**II law of Thermodynamics** states that energy dissipates as it is used or in other words, it gets converted from a more concentrated to dispersed form. As energy flows through the food chain, there occurs dissipation of energy at every trophic level.

### **Ecological Succession**

Ecological succession is defined as an orderly process of changes in the community structure and function with time mediated through modifications in the physical environment and ultimately culminating in a stabilized ecosystem known as climax. Ecological successions starting on different types of areas or substrata are named differently as follows:

(i) **Hydrarch or Hydrosere:** Starting in watery area like pond, swamp, bog

(ii) **Mesarch:** starting in an area of adequate moisture.

(iii) **Xerarch or Xerosere:** Starting in a dry area with little moisture. They can be of the following types:

Lithosere	:	starting on a bare rock
Psammosere	:	starting on sand
Halosere	:	starting on saline soil

## Process of Succession

The process of succession takes place in a systematic order of sequential steps as follows:

- i. **Nudation:** It is the development of a bare area, without any life form. The bare area may be caused due to several anthropogenic activities.
- ii. **Invasion:** It is the successful establishment of one or more species on a bare area through dispersal or migration, followed by ecesis or establishment.
- iii. **Competition and coaction:** As the number of individuals grows there is competition, for space, water and nutrition. They influence each other in a number of ways, known as coaction.
- iv. **Reaction :** The living organisms have a strong influence on the environment which is modified to a large extent and this is known as reaction.
- v. **Stabilization :** The succession ultimately culminates in a more or less stable community called climax which is in equilibrium with the environment.

Let us consider very briefly two types of succession.

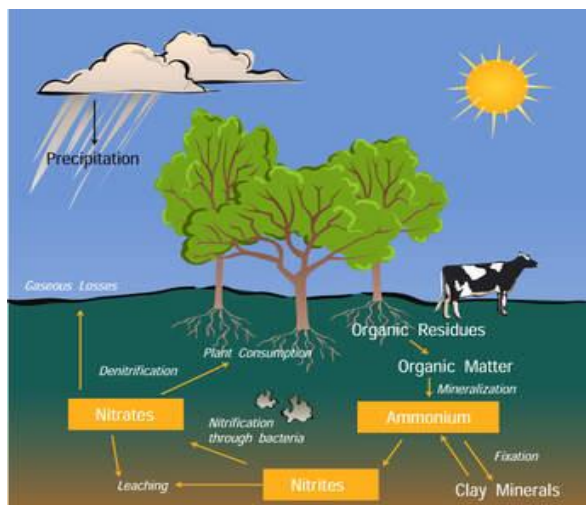
- A. **Hydrosere (Hydrarch) :** This type of succession starts in a water body like pond. A number of intermediate stages come and ultimately it culminates in a climax community which is a forest.
- B. **Xerosere (Xerarch) :** This type of succession originates on a bare rock, which lacks water and organic matter. Interestingly, here also the climax community is a forest, although the intermediate stages are very different.

## NUTRIENT FLOW

Cyclic flow of nutrients between the biotic and abiotic components is known as nutrient cycle or biogeochemical cycle.

### NITROGEN CYCLE:

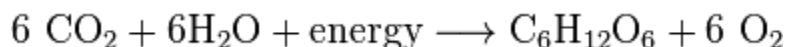
Nitrogen is one of the primary nutrients critical for the survival of all living organisms. Although nitrogen is very abundant in the atmosphere, it is largely inaccessible in this form to most organisms.

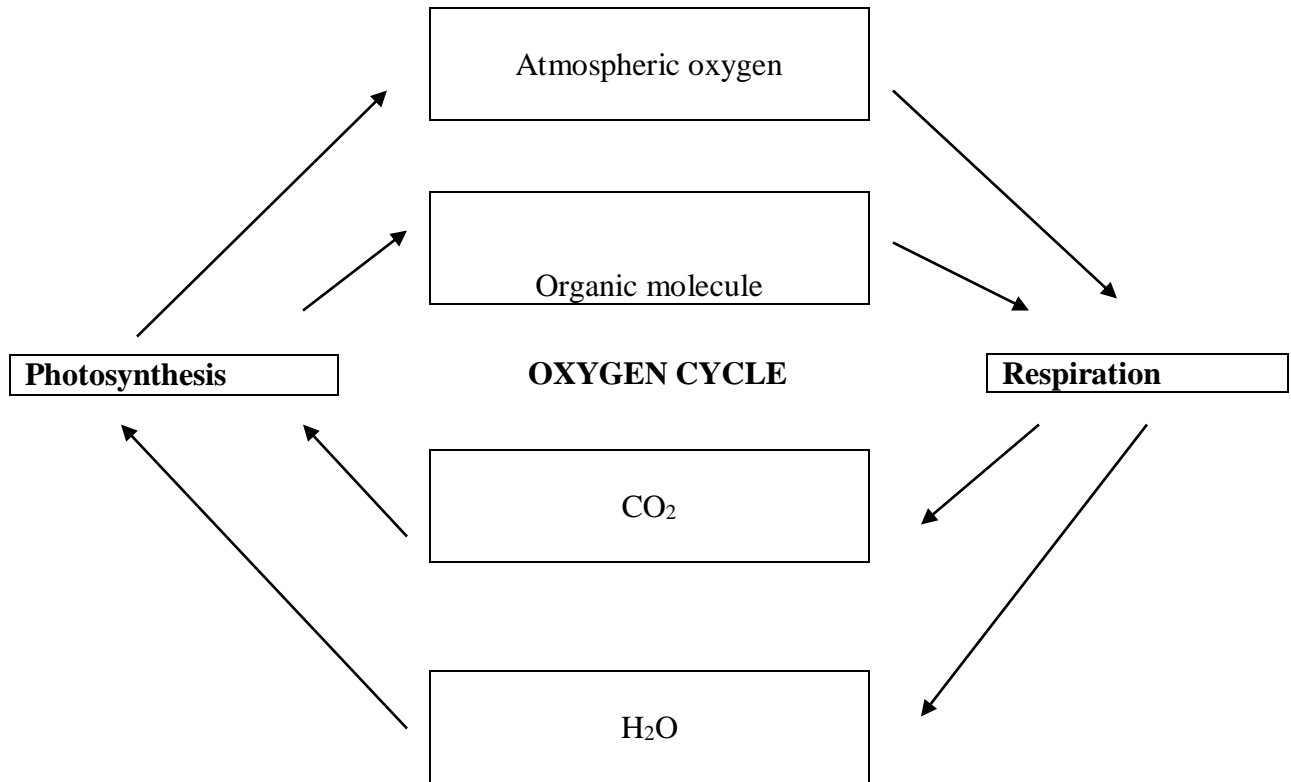


Nitrogen is present in the atmosphere in large amount (78%) and in the forms of food. Nitrogen from the atmosphere is taken up by the green plants as a raw material for biosynthesis of different foods and used in metabolic activity. This food move through the food chain. After death of the plants and animals the organic nitrogen in dead tissues is decomposed by several microorganisms into ammonia, nitrites and nitrates which are again used by the plants. Some bacteria convert nitrates into molecular nitrogen which is again released back into atmosphere and the cycle goes on.

### **OXYGEN CYCLE:**

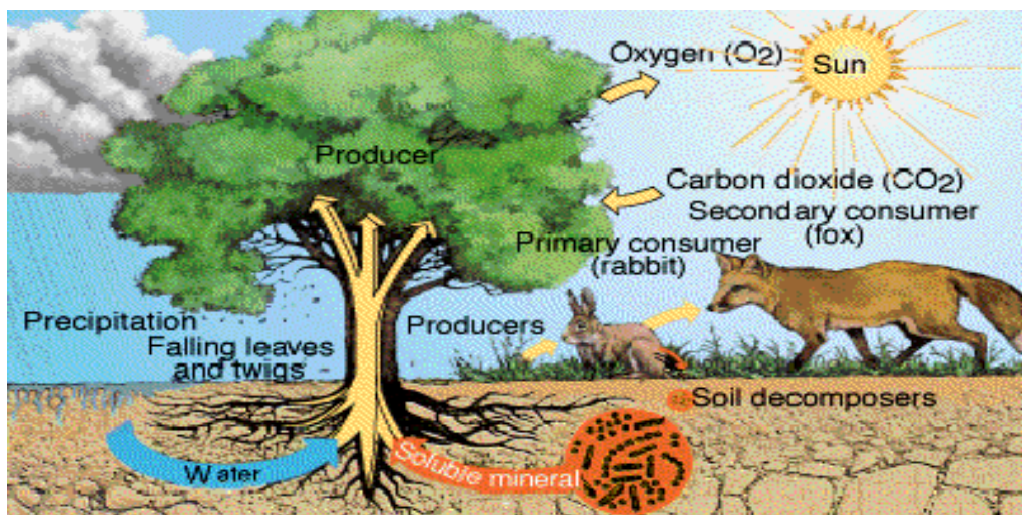
The **oxygen cycle** is the biogeochemical cycle that describes the movement of oxygen within its three main reservoirs: the atmosphere (air), the total content of biological matter within the biosphere (the global sum of all ecosystems), and the lithosphere (Earth's crust). The main driving factor of the oxygen cycle is photosynthesis which is responsible for the modern Earth's atmosphere and life on earth. The main source of atmospheric free oxygen is photosynthesis, which produces sugars and free oxygen from carbon dioxide and water:





**FOREST ECOSYSTEM**

**(TERRESTRIAL ECOSYSTEM)**





## **Introduction**

A forest is an area with a high density of trees.

World's total land area is 13,076 million hectares - (Source: FAO; 1989)

Of which total forests account for about 31% of the world's land area.

In India, the forest cover is roughly 19% of the total land area.

The forest ecosystems are of great concern from the environmental point of view

## **Depending upon the climate conditions, forest may be classified as:**

- (a) **Tropical Rain Forests:** They are evergreen broadleaf forests found near the equator. They are characterized by high temperature, high humidity and high rainfall, all of which favour the growth of trees.
- (b) **Tropical deciduous forests:** They are found a little away from the equator and are characterized by a warm climate the year round. Rain occurs only during monsoon.
- (c) **Tropical scrub forests:** They are found in areas where the day season is even longer.
- (d) **Temperate rain forests:** They are found in temperate areas with adequate rainfall. These are dominated by trees like pines, firs, redwoods etc.
- (e) **Temperate deciduous forests:** They are found in areas with moderate temperatures.
- (f) **Evergreen coniferous forests (Boreal Forests):** They are found just south of arctic tundra. Here winters are long, cold and dry. Sunlight is available for a few hours only.

## **Structure and Function of Forest Ecosystem**

### **I. Biotic components**

The various biotic components, representatives from the three functional groups, of a forest ecosystem are:

#### **1) Producer Organisms**

In a forest, the producers are mainly trees.

Trees are of different kinds depending upon the type of forest developed in that climate.

Apart from trees, climbers, epiphytes, shrubs and ground vegetation.

Dominant species of trees in major types of forest ecosystems are:

Tectona grandis, Acer, Betula, Picea, Pine, Cedrus.

#### **2) Consumers**

In a forest, consumers are of three main types;

##### **a) Primary Consumers**

These are herbivores which feed directly on producers.

Eg:

Ants, Beetles, Bugs, spiders etc. feeding on tree leaves.

Larger animals such as Elephants, Deer, giraffe etc. grazing on shoots and/or fruits of trees.

##### **b) Secondary Consumers**

These are carnivores and feed on primary consumers.

Eg: Birds, Lizards, Frogs, Snakes and Foxes

### c) Tertiary Consumers

These are secondary carnivores and feed on secondary consumers  
These include top carnivores like Lion, Tiger.

### 3) Decomposers

These include wide variety of saprotrophic micro-organism like;  
Bacteria (Bacillus Sp., Clostridium sp., pseudomonas.

Fungi (Aspergillus sp., Ganoderma sp., Fusarium.

Actinomycetes (Streptomyces).

They attract the dead or decayed bodies of organisms & thus decomposition takes place.

Therefore, nutrients are released for reuse.

## II. Abiotic components

These include basic inorganic & organic compounds present in the soil & atmosphere.

In addition dead organic debris is also found littered in forests.

## GRASSLAND ECOSYSTEM (TERRESTRIAL ECOSYSTEM)

### Introduction

Grasslands (also called Greenswards) are areas where the vegetation is dominated by grasses and other herbaceous (non-woody) plants.

Grasslands occupy about 24% of the earth's surface.

Grasslands occur in regions too dry for forests and too moist for deserts

The annual rainfall ranges between 25- 75 cm, usually seasonal

### Three types of grasslands are found to occur in different climatic regions:

- (a) **Tropical grasslands:** They occur near the borders of tropical rain forests in regions of high average temperature and low to moderate rainfall.
- (b) **Temperate grasslands:** They are usually found on flat, gentle sloped hills, winters are very cold but summers are hot and dry.
- (c) **Polar grass lands:** they are found in arctic polar region where severe cold and strong, frigid winds along with ice and snow create too harsh a climate for trees to grow

## 2.4.2 Structure and functions of Grassland Ecosystems

### I. Biotic components

#### 1) Producer Organisms

In grassland, producers are mainly grasses; though, a few herbs & shrubs also contribute to primary production of biomass.

Some of the most common species of grasses are:

Brachiaria sp., Cynodon sp., Desmodium sp., Digitaria sp.

## 2) Consumers

In grassland, consumers are of three main types;

### a) Primary Consumers

The primary consumers are herbivores feeding directly on grasses. These are grazing animals such as

Cows, Buffaloes, Sheep, Goats, Deer, Rabbits etc.

Besides them, numerous species of insects, termites, etc are also present.

### b) Secondary Consumers

These are carnivores that feed on primary consumers (Herbivores)

These include;-Frogs, Snakes, Lizards, Birds, Foxes, Jackals etc.

### c) Tertiary Consumers

These include hawks etc. which feed on secondary consumers.

## 3) Decomposers

These include wide variety of saprotrophic micro- organism like: Bacteria; Fungi; actinomycetes

They attract the dead or decayed bodies of organisms & thus decomposition takes place.

Therefore, nutrients are released for reuse by producers.

## II. Abiotic components

These include basic inorganic & organic compounds present in the soil & aerial environment.

The essential elements like C, H, N, O, P, S etc. are supplied by water, nitrogen, nitrates, sulphates, phosphates present in soil & atmosphere

## DESERT ECOSYSTEM

### Introduction

A desert is a landscape or region that receives almost no precipitation.

Deserts are defined as areas with an average annual precipitation of less than 250 millimeters per year.

It occupies about 17% of the earth's surface.

Deserts are characterized by hot days & cold nights.

The deserts of the world are mainly located in the

South- western United States, Mexico, North America, Asia (Thar, Gobi, Tibet) & west Asia.

Deserts are characterized by scanty flora & fauna.

Soils of deserts often have abundant nutrients but little or no organic matter.

## **Deserts are of three major types, based on climatic conditions:**

- i. Tropical deserts** like Sahara in Africa and Thar Desert, Rajasthan, India are the driest of all with only a few species.
- ii. Temperature deserts** like Mojave in Southern California where day time temperatures are very hot in summer but cool in winters.
- iii. Cold deserts** like Gobi desert in China have cold winters and warm summers.

## **Structure and Functions of Desert Ecosystems**

### **I. Biotic components**

#### **1) Producer Organisms**

In a desert, producers are mainly shrubs/bushes; some grasses & a few trees.

Dominant plant species include: Succulents (water - retaining plants adapted to arid climate or soil conditions) & hardy grasses.

Besides some lower plants such as lichens & xerophytic mosses are also present.

#### **2) Consumer Organisms**

These include animals such as insects, reptiles which are capable of living in xeric conditions

Besides some nocturnal rodents, birds & some mammalians like camel etc are also found.

#### **3) Decomposers**

Due to poor vegetation with very low amount of dead organic matter, decomposers are poor in desert ecosystem.

The common decomposers are some bacteria & fungi, most of which are thermophillic.

### **II. Abiotic components**

Due to high temperature & very low rainfall, the organic substances are poorly present in the soil. These include basic inorganic & organic compounds present in the soil & atmosphere. In addition dead organic debris is also found littered in forests.

## **AQUATIC ECOSYSTEM**

Aquatic ecosystems dealing with water bodies and the biotic communities present in them are either freshwater or marine. Let us consider some important aquatic ecosystems.

### **(i) Pond ecosystems:**

- a. It is a small freshwater aquatic ecosystem where water is stagnant.
- b. Ponds may be seasonal in nature i.e. receiving enough water during rainy season.
- c. Ponds are usually shallow water bodies which play a very important role in the villages where most of the activities center around ponds.
- d. They contain several types of algae, aquatic plants, insects, fishes, and birds.
- e. The ponds are, however, very often exposed to tremendous anthropogenic pressures.
- f. They are used for washing clothes, bathing, swimming, cattle bathing and drinking etc. and therefore get polluted.

(ii) **Lake ecosystems:**

- a. Lakes are usually big freshwater bodies with standing water.
- b. They have shallow water zone called Littoral zone, an open-water zone called Limnetic zone and deep bottom area where light penetration is negligible, known as profundal zone(Fig.4).

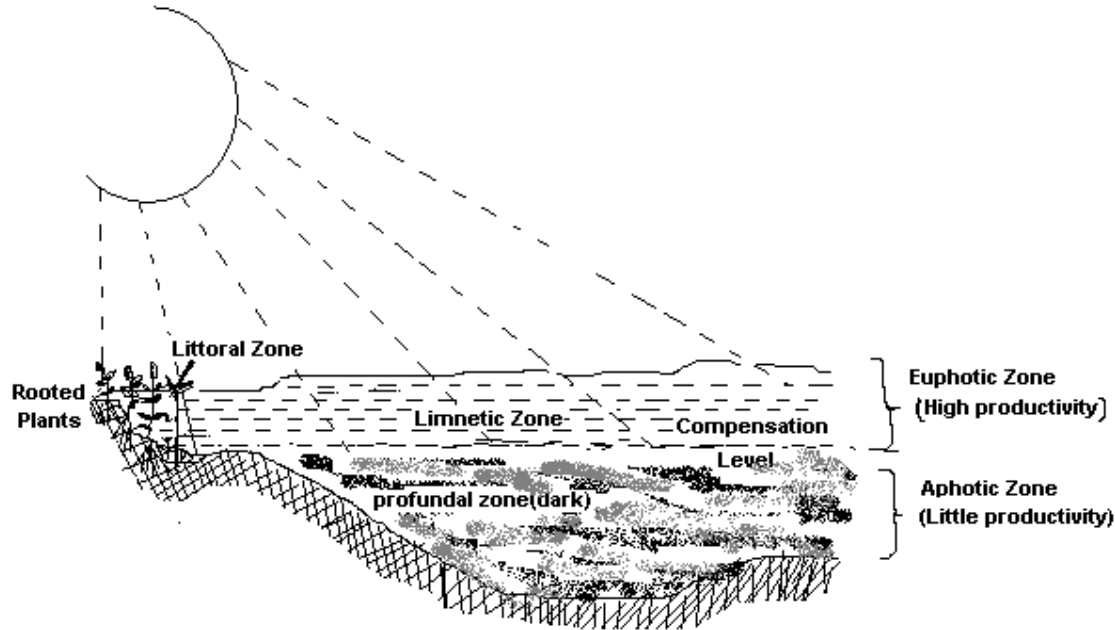


Fig:4 Zonation in a lake ecosystem

**Organisms:** Lakes have several types of organisms:

- (i) **Planktons** that float on the surface of waters e.g. phytoplanktons like algae and zooplanktons like rotifers.
- (ii) **Nektons** that swim e.g. fishes.
- (iii) **Neustons** that rest or swim on the surface.
- (iv) **Benthos** that are attached to bottom sediments e.g. snails.
- (v) **Periphytons** that are attached or clinging to other plants or any other surface e.g. crustaceans.

**Stratification:**

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

**Epylimnion:** Warm, lighter, circulating surface layer.

**Hypolimnion:** Cold, viscous, non-circulating bottom layer

**Types of lakes:**

- (a) **Oligotrophic lakes** which have low nutrient concentrations.

- (b) **Eutrophic lakes** which are over nourished by nutrients like nitrogen and phosphorus, usually as a result of agricultural run-off or municipal sewage discharge. They are covered with "algal blooms" e.g. Dal lake.
- (c) **Dystrophic lakes** that have low pH, high humic acid content and brown waters e.g. bog lakes.
- (d) **Endemic lakes** that are very ancient, deep and have endemic fauna which are restricted only to that lake e.g. the Lake Baikal in Russia.
- (e) **Artificial lakes or impoundments** that are created due to construction of dams e.g. Govindsagar Lake at Bhakra-Nangal.

(iii) Streams:

- ◆ These are freshwater aquatic ecosystems where water current is a major controlling factor, oxygen and nutrient in the water is more uniform and land-water exchange is more extensive.
- ◆ Although stream organisms have to face more extremes of temperature and action of currents as compared to pond or lake organisms, but they do not have to face oxygen deficiency under natural conditions.
- ◆ This is because the streams are shallow, have a large surface exposed to air and constant motion which churns the water and provides abundant oxygen.
- ◆ Their dissolved oxygen level is higher than that of ponds even though the green plants are much less in number.
- ◆ The stream animals usually have a narrow range of tolerance to oxygen.
- ◆ That is the reason why they are very susceptible to any organic pollution which depletes dissolved oxygen in the water.
- ◆ Thus, streams are the worst victims of industrial development.

(iv) River ecosystems:

- ♣ Rivers are large streams that flow downward from mountain highlands and flowing through the plains fall into the sea.
- ♣ So the river ecosystems show a series of different conditions.
- ♣ **The mountain highland** part has cold, clear waters rushing down as water falls with large amounts of dissolved oxygen.
- ♣ **In the second phase** on the gentle slopes, the waters are warmer and support a luxuriant growth of plants and less oxygen requiring fishes.

- ♣ **In the third phase**, the river waters are very rich in biotic diversity. Moving down the hills, rivers shape the land. They bring with them lots of silt rich in nutrients which are deposited in the plains and in the delta before reaching the ocean.

#### (v) Oceans:

- These are gigantic reservoirs of water covering more than 70% of our earth's surface and play a key role in the survival of about 2,50,000 marine species, serving as food for humans and other organisms, give a huge variety of sea-products and drugs.
- Oceans provide us iron, phosphorus, magnesium, oil, natural gas, sand and gravel.
- Oceans are the major sinks of carbon dioxide and play an important role in regulating many biogeochemical cycles and hydrological cycle, thereby regulating the earth's climate.

The oceans have two major life zones: (Fig:5)

**Coastal zone:** It is relatively warm, nutrient rich shallow water. Due to high nutrients and ample sunlight this is the zone of high primary productivity.

**Open sea:** It is the deeper part of the ocean, away from the continental shelf. It is vertically divided into three regions:

- ✓ **Euphotic zone** which receives abundant light and shows high photosynthetic activity.
- ✓ **Bathyal zone** receives dim light and is usually geologically active.
- ✓ **Abyssal zone** is the dark zone, 2000 to 5000 meters deep. The abyssal zone has no primary source of energy i.e. solar energy. It is the world's largest ecological unit but it is an incomplete ecosystem.

#### Estuary

- ❖ Estuary is a partially enclosed coastal area at the mouth of a river where fresh water and salty seawater meet.
- ❖ These are the transition zones which are strongly affected by tidal action.
- ❖ Constant mixing of water stirs up the silt which makes the nutrients available for the primary producers.
- ❖ The organisms present in estuaries show a wide range of tolerance to temperature and salinity.

- ❖ Such organisms are known as eurythermal and euryhaline. Coastal bays and tidal marshes are examples of estuaries.
- ❖ Estuary has a rich biodiversity and many of the species are endemic.
- ❖ There are many migratory species of fishes like eels and salmons in which half of the life is spent in fresh water and half in salty water.
- ❖ For them estuaries are ideal places for resting during migration, where they also get abundant food.
- ❖ Estuaries are highly productive ecosystems.
- ❖ The river flow and tidal action provide energy for estuary thereby enhancing its productivity.
- ❖ Estuaries are of much use to human beings due to their high food potential.
- ❖ However, these ecosystems need to be managed judiciously and protected from pollution.

## **BIODIVERSITY**

### **Definition**

**Biodiversity** refers to the variety and variability among all groups of living organisms and the ecosystem in which they occur.

### **Types of Biodiversity:**

#### **Genetic diversity**

- ★ Genetic Diversity is the basic source of biodiversity.
- ★ When the genes within the same species show different versions due to new combinations, it is called genetic variability.
- ★ For example, all rice varieties belong to the species *oryza sativa*, but there are thousands of wild and cultivated varieties of rice which show variations at the genetic level and differ in their color, size, shape, aroma and nutrient content of the grain. This is the genetic diversity of rice

#### **Species diversity**

- ◆ Species Diversity is the variability found within the population of a species or between different species of a community.
- ◆ It represents broadly the species richness and their abundance in a community.
- ◆ There are two popular indices of measuring species diversity known as *Shannon-wiener index* and *Simpson index*.

#### **Ecosystem diversity**

- This diversity has developed over millions of years of evolution.
- If we destroy this diversity, it would disrupt the ecological balance.
- We cannot even replace the diversity of one ecosystem by that of another.



- Coniferous trees of boreal forests cannot take up the function of the trees of tropical deciduous forest lands and vice versa.

**Biogeographical classification of India:**

Biogeography comprising of phytogeography and zoogeography deals with the aspects of plants and animals. There are around ten biogeographic regions in India.

S.No	Biogeographic Zone	Biotic province	Total area (sq.km.)
1	Trans-Himalayan	Upper Regions	186200
2	Himalayan	North-West Himalayas	6900
		West Himalayas	720000
		central Himalayas	123000
		East Himalayas	83000
3	Desert	Kutch	45000
		Thar	180000
		Ladakh	NA
4	Semi-Arid	Central India	107600
		Gujarat-Rajwara	400400
5	Western Ghats	Malabar Coast	59700
		Western Ghat Mountains	99300
6	Deccan Peninsula	Deccan Plateau South	378000
		Central Plateau	341000
		Eastern Plateau	198000
		Chotta Nagpur	217000
		Central Highlands	287000
7	Gangetic Plain	Upper Gangetic Plain	206400
		Lower Gangetic Plain	153000

8	North-East India	Brahmaputra Valley	65200
		North-Eastern Hills	106200
9	Islands	Andaman Islands	6397
		Nicobar Islands	1930
		Lakshadweep Islands	180
10	Coast	West Coast	6500
		East Coast	6500

### **Value of biodiversity**

The value of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is enormous. The multiple uses of biodiversity value have been classified by McNeely et al in 1990 as follows:

- (i) **Consumptive use value:** these are direct use values where the biodiversity product can be harvested and consumed directly e.g. fuel, food, drugs, fibre etc.
  - a. **Food:** A large number of wild plants are consumed by human beings as food. About 80,000 edible plant species have been reported from wild. About 90% of present day food crops have been domesticated from wild tropical plants. A large number of wild animals are also our sources of food.
  - b. **Drugs and medicines:**
    - i. About 75% of the world's population depends upon plants or plant extracts for medicines.
    - ii. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium.
    - iii. Likewise, we get Tetracyclin from a bacterium. Quinine, the cure for malaria is obtained from the bark of Cinchona tree, while Digitalin is obtained from foxglove which is an effective cure for heart ailments.
    - iv. Recently vinblastin and vincristine, two anticancer drugs, have been obtained from periwinkle plant, which possesses anticancer alkaloids.
- (ii) **Productive use values:**
  - a. These are the commercially usable values where the product is marketed and sold.
  - b. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, lac from lac insects etc, all of which are traded in the market.
  - c. Many industries are dependent upon the productive use values of biodiversity e.g. –the paper and pulp industry, plywood industry, railway sleeper industry, silk industry, ivory-works, leather industry, pearl industry etc.

- (iii) **Social value:**
  - a. These are the values associated with the social life, customs, and religion of the people.
  - b. Many of the plants are considered holy and sacred in our country like Tulsi, peepul, Mango, and Lotus etc.
  - c. The leaves, fruits or flowers of these plants are used in worship or the plant itself is worshipped.
  - d. Many animals like Cow, Snake, and Peacock also have significant place in our psycho-spiritual arena.
  
- (iv) **Ethical value:**
  - a. It is also sometimes known as existence value. It involves ethical issues like "all life must be preserved".
  - b. The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure.
  - c. We are not deriving anything direct from Kangaroo, Zebra or Giraffe, but we all strongly feel that these species should exist in nature.
  
- (v) **Aesthetic value:**
  - a. No one of us would like to visit vast stretches of barren lands with no signs of visible life.
  - b. People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity and this type of tourism is now known as eco-tourism.
  - c. Ecotourism is estimated to generate about 12 billion dollars of revenue annually.
  
- (vi) **Option values:**
  - a. These values include the potentials of biodiversity that are presently unknown and need to be explored.
  - b. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depths of a marine ecosystem, or a tropical rain forest.
  - c. Thus option value is the value of knowing that there are biological resources existing on this biosphere that may one day prove to be an effective option for something important in the future.

## **Global Biodiversity**

- ❖ Following the 1992 "Earth summit" at Rio de Janeiro, it became evident that there is a growing need to know and scientifically name, the huge number of species which are still unknown on this earth.
- ❖ Tropical deforestation alone is reducing the biodiversity by half a percentage every year.
- ❖ Terrestrial biodiversity of the earth is best described as biomes, which are the largest ecological units present in different geographic areas and are named after the dominant vegetation e.g. the tropical rainforests, tall grass prairies, savannas, desert, tundra etc.
- ❖ Out of the 3000 plants identified by National Cancer Research Institute as sources of cancer fighting chemicals, 70% come from tropical rain forests.
- ❖ There is an estimated 1,25,000 flowering plant species in tropical forests.
- ❖ However, till now we know only 1-3% of these species.

- ❖ Temperature forests have much less biodiversity, but there is much better documentation of the species. Globally, we have roughly 1,70,000 flowering plants, 30,000 vertebrates and about 2,50,000 other groups of species that have been described.
- ❖ Table 1 shows the estimated number of some known living species in different taxonomic groups:

Table:1 Living species estimates (World Resource Institute, 1999)

<b>Taxonomic group</b>	<b>Number</b>
Bacteria & Cyanobacteria	5,000
Protozoans	31,000
Algae	27,000
Jelly fish, Corals etc.	10,000
Amphibians	4,000
Reptiles	5,000
Birds	9,000
Mammals	4,000

### **Biological diversity at National Level**

- ◆ Every country is characterized by its own biodiversity depending mainly on its climate.
- ◆ India has a rich biological diversity of flora and fauna. Overall six percent of the global species are found in India.
- ◆ It is estimated that India ranks 10<sup>th</sup> among the plant rich countries of the world, 11<sup>th</sup> in terms of number of endemic species of higher vertebrates and 6<sup>th</sup> among the centers of diversity and origin of agricultural crops.
- ◆ The total number of living species identified in our country is 1,50,000.
- ◆ Out of a total 25 biodiversity hot-spots in the world, India possesses two.
- ◆ India is also one of the 12 mega-biodiversity countries in the world.

### **Regional or local biodiversity**

Biodiversity at regional level is better understood by categorizing species richness into four types, based upon their spatial distribution as discussed below:

- (i) **Point richness** refers to the number of species that can be found at a single point in a given space.

- (ii) **Alpha ( $\alpha$ ) richness** refers to the number of species found in a small homogenous area.
- (iii) **Beta ( $\beta$ ) richness** refers to the rate of change in species composition across different habitats.
- (iv) **Gamma ( $\gamma$ ) richness** refers to the rate of change across large landscape gradients.

$\alpha$ - richness is strongly correlated with physical environmental variables.  $\beta$ - richness means that the cumulative number of species increases as more heterogenous habitats are taken into consideration.

### **India as mega diversity nation**

India is one of the 12 mega diversity countries in the world. The Ministry of Environment and forests, Govt. of India (2000) records 47,000 species of plants and 81,000 species of animals which is about 7% and 6.5% respectively of global flora and fauna.

**Endemism:** Species, which are restricted only to a particular area, are known as endemic. India shows a good number of endemic species.

**Center of origin:** A large number of species are known to have originated in India. Nearly 5000 species of flowering plants had their origin in India.

**Marine diversity:** Along 7500 km long coastline of our country in the mangroves, estuaries, coral reefs, back waters etc. there exists a rich biodiversity. More than 340 species of corals of the world are found here.

A large proportion of the Indian Biodiversity is still unexplored. There are about 93 major wet lands, coral reefs and mangroves which need to be studied in detail.

### **Hot spots of biodiversity**

- ♣ Areas, which exhibit high species richness as well as high species endemism, are termed as hot spots of biodiversity.
- ♣ The term was introduced by Myers (1988).
- ♣ There are 25 such hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats.
- ♣ These hot spots covering less than 2% of the world's land are found to have about 50% of the terrestrial biodiversity.
- ♣ About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots.

#### **(a) Eastern Himalayas:**

- a. They display an ultra-varied topography that fosters species diversity and endemism.
- b. Certain species like *Sapria himalayana*, a parasitic angiosperm was sighted only twice in this region in the last 70 years.
- c. Out of the world's recorded flora 30% are endemic to India of which 35,000 are in the Himalayas.

**(b) Western Ghats:**

- a. It extends along a 17,000 Km<sup>2</sup> strip of forests in Maharashtra, Karnataka, Tamil Nadu and Kerala and has 40% of the total endemic plant species.
- b. 62% amphibians and 50% lizards are endemic to Western Ghats.
- c. The major centers of diversity are Agastyamalai Hills and Silent Valley- the New Amambalam Reserve Basin.
- d. It is reported that only 6.8% of the original forests are existing today while the rest has been deforested or degraded.
- e. Although the hotspots are characterized by endemism, interestingly, a few species are common to both the hotspots in India.

**Threats to Biodiversity**

- ✓ Extinction or elimination of a species is a natural process of evolution.
- ✓ In the geologic period the earth has experienced mass extinctions.
- ✓ During evolution, species have died out and have been replaced by others.
- ✓ The process of extinction has become particularly fast in the recent years of human civilization.
- ✓ One of the estimates by the noted ecologist, E.O. Wilson puts the figure of extinction at 10,000 species per year or 27 per day! This startling figure raises an alarm regarding the serious threat to biodiversity.

Let us consider some of the major causes and issues related to threats to biodiversity.

**(i) Loss of Habitat**

- Destruction and loss of natural habitat is the single largest cause of biodiversity loss. Billions of hectares of forests and grasslands have been cleared over the past 10,000 years for conversion into agriculture lands, pastures, settlement areas or development projects.
- There has been a rapid disappearance of tropical forests in our country also, at a rate of about 0.6% per year.
- With the current rate of loss of forest habitat, it is estimated that 20-25% of the global flora would be lost within a few years.
- Marine biodiversity is also under serious threat due to large scale destruction of the fragile breeding and feeding grounds of our oceanic fish and other species, as a result of human intervention.

**(ii) Poaching**

- ❖ Illegal trade of wildlife products by killing prohibited endangered animals i.e. poaching is another threat to wildlife.
- ❖ Despite international ban on trade in products from endangered species, smuggling of wild life items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues.

- ❖ The cost of elephant tusks can go up to \$100 per kg; the leopard fur coat is sold at \$ 100,000 in Japan while bird catchers can fetch up to \$ 10,000 for a rare hyacinth macaw, a beautiful coloured bird, from Brazil.

### **(iii) Man-Wildlife conflict**

- ◆ Instances of man animal conflicts keep on coming to lime light from several states in our country.
- ◆ In Sambalpur, Orissa 195 humans were killed in the last 5 years by elephants.
- ◆ In retaliation the villagers killed 98 elephants and badly injured 30 elephants.
- ◆ Several instances of killing of elephants in the border regions of Kote-Chamarajanagar belt in Mysore have been reported recently.
- ◆ The man-elephant conflict in this region has arisen because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops.
- ◆ The agonized villagers electrocute the elephants and sometimes hide explosives in the sugarcane fields, which explode as the elephants intrude into their fields.
- ◆ In the early 2004, a man-eating tiger was reported to kill 16 Nepalese people and one 4-year old child inside the Royal Chitwan National Park of Kathmandu.
- ◆ In June, 2004 two men were killed by the leopards in Powai, Mumbai.

### **Cause of Man-animal conflicts:**

- (i) Dwindling habitats of tigers, elephants and bears due to shrinking forest cover compels them to move outside the forest and attack the field or sometimes even humans.
- (ii) Usually the ill, weak and injured animals have tendency to attack man. Also, the female tigress attacks the human if she feels that her newborn cubs are in danger. But the biggest problem is that if human-flesh is tasted once then the tiger does not eat any other animal.
- (iii) Earlier, forest departments used to cultivate paddy, sugarcane etc. within the sanctuaries when the favourite staple food of elephants i.e. bamboo leaves were not available. Now due to lack of such practices the animals move out of the forest in search of food.
- (iv) Very often the villagers put electric wiring around their ripe crop fields. The elephants get injured, suffer in pain and turn violent.
- (v) The cash compensation paid by the government in lieu of the damage caused to the farmers crop is not enough. The agonized farmer therefore gets revengeful and kills the wild animals.

### **Remedial Measures to Curb the Conflict:**

- (i) Tiger Conservation Project (TCP) has made provisions for making available vehicles, tranquillizer guns, and binoculars to tactfully deal with any imminent danger.
- (ii) Adequate crop compensation and cattle compensation scheme must be started.
- (iii) Solar powered fencing should be provided along with electric current proof trenches to prevent the animals from straying fields.

- (iv) Cropping pattern should be changed near forest borders and adequate fruits and water should be made available for the elephants within forest zones.
- (v) Wild life corridors should be provided for mass migration of big animals during unfavorable periods.

### Endangered species of India

- ♣ The International Union for Conservation of Nature and Natural Resources (IUCN) publishes the Red Data Book which includes the list of endangered species of plants and animals.
- ♣ The red data symbolizes the warning signal for those species which are endangered and if not protected are likely to become extinct in near future.
- ♣ In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare.
- ♣ Existence of about 150 mammals and 150 species of birds is estimated to be threatened while an unknown number of species of insects are endangered.
- ♣ A few species of endangered reptiles, birds, mammals and plants are given below:
  - **Reptiles:** Green sea turtle, tortoise, python
  - **Birds:** Great Indian bustard, Peacock, Pelican, Great Indian Hornbill, Siberian
  - **Carnivorous Mammals:** Indian wolf, red fox, red panda, tiger, leopard, Indian, lion, golden cat, desert cat
  - **Primates:** Hoolock gibbon, capped monkey, golden monkey
  - **Plants:** A large number of species of orchids, Rododendrons, medicinal plants like Rauwolfia serpentina, the sandal, wood tree santalum, cycas beddonei etc

The Zoological Survey of India reported that Cheetah, Pink headed duck and mountain quail have already become extinct from India.

- A species is said to be extinct when it is not seen in the wild for 50 years at a stretch eg. Dodo, Passenger pigeon.
- A species is said to be endangered when its number has been reduced to a critical level. If such a species is not protected and conserved, it is in immediate danger of extinction.
- A species is said to be in vulnerable category if its population is facing continuous decline due to overexploitation or habitat destruction.
- Species which are not endangered or vulnerable at present, but are at a risk are categorized as rare species.

### Endemic species:

- The species are only found among a particular people or in a particular region are known as endemic species.
- Out of about 47,000 species of plants in our country 7000 are endemic.
- Some of the important endemic flora includes orchids and species like sapria himalayana, Uvaria lureda, Nepenthes khasiana etc.
- A large number out of total of 81,000 species of animals in our country is endemic.
- The western ghats are particularly rich in amphibians and reptiles.



- About 62% amphibians and 50% lizards are endemic to Western Ghats.
- Different species of monitor lizard, reticulated python are some important endemic species of our country.

### **Conservation of Biodiversity**

The enormous value of biodiversity due to their genetic, commercial, medical, esthetic, ecological and optional importance emphasizes the need to conserve biodiversity.

There are two approaches of biodiversity conservation:

**(a) In situ conservation (within habitat):** This is achieved by protection of wild flora and fauna in nature itself. E.g. Biosphere Reserves, National Parks, Sanctuaries, Reserve Forests etc.

**(b) Ex situ conservation (outside habitats):** This is done by establishment of gene banks, seed banks, zoos, botanical gardens, culture collections etc.

### **In Situ conservation:**

At present in our country we have:

- ★ 7 major Biosphere reserves,
- ★ 80 National Parks,
- ★ 420 wild-life sanctuaries and
- ★ 120 Botanical gardens
- ★ They totally cover 4% of the geographic area.

**The Biosphere Reserves** conserve some representative ecosystems as a whole for long-term in situ conservation. In India we have:

- ✓ Nanda Devi (U.P.),
- ✓ Nokrek (Meghalaya),
- ✓ Manas (Assam),
- ✓ Sunderbans (West Bengal),
- ✓ Gulf of Mannar (Tamil Nadu),
- ✓ Nilgiri (Karnataka, Kerala, Tamil Nadu),
- ✓ Great Nicobars and Similipal (Orissa)

**A National Park** is an area dedicated for the conservation of wildlife along with its environment. It is also meant for enjoyment through tourism but without impairing the environment. Grazing of domestic animals, all private rights and forestry activities are prohibited within a National Park. Each National Park usually aims at conservation specifically of some particular species of wildlife along with others.

Some major National Parks of our country are enlisted in the Table 2 below:

Table 2 Some important National parks in India

<b>Name of National Park</b>	<b>State</b>	<b>Important Wildlife</b>
Kaziranga	Assam	One horned Rhino
Gir National Park	Gujarat	Indian Lion
Bandipur	Karnataka	Elephant
Periyar	Kerala	Elephant, Tiger
Sariska	Rajasthan	Tiger

**Wildlife sanctuaries** are also protected areas where killing, hunting, shooting or capturing of wildlife is prohibited except under the control of highest authority. Some major wildlife sanctuaries of our country are shown in table 3.

Table 3 Some Important Wildlife Sanctuaries of India

<b>Name of Sanctuary</b>	<b>State</b>	<b>Major Wild Life</b>
Ghana Bird Sanctuary	Rajasthan	300 species of birds (including migratory)
Sultanpur Bird Sanctuary	Haryana	Migratory birds
Mudamalai Wildlife Sanctuary	Tamil Nadu	Tiger, elephant, Leopard
Vedanthangal Bird Sanctuary	Tamil Nadu	Water birds
Wild Ass Sanctuary	Gujarat	Wild ass, wolf, nilgai, chinkara

For plants, there is one gene sanctuary for Citrus (Lemon family) and one for pitcher plant (an insect eating plant) in Northeast India.

**Ex Situ Conservation:**

This type of conservation is mainly done for conservation of crop varieties. In India, we have the following important gene bank/seed bank facilities:

- (i) National Bureau of Plant Genetic Resources (NBPGR) is located in New Delhi. Here agricultural and horticultural crops and their wild relatives are preserved by cryo-preservation of seeds, pollen etc. by using liquid nitrogen at a temperature as low as – 196 degree Celsius. Varieties of rice, turnip, radish, tomato, onion, carrot, chilli, tobacco etc. have been preserved successfully in liquid nitrogen for several years without losing seed viability.
- (ii) National Bureau of Animal Genetic Resources (NBAGR) located at Karnal, Haryana. It preserves the semen of domesticated bovine animals.
- (iii) National Facility for Plant Tissue Culture Repository (NFPTCR) for the development of a facility of conservation of varieties of crop plants/trees by tissue culture. This facility has been created within the NBPGR.

For the protection and conservation of certain animals, there have been specific projects in our country e.g. Project Tiger, Girl Lion Project, Crocodile Breeding Project, Project Elephant, Snow Leopard Project etc.

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**UNIT 2: ENVIRONMENTAL POLLUTION****ENVIRONMENTAL POLLUTION-DEFINITION:-**

Any undesirable change in the physical, chemical or biological characteristics of any component of the environment (air, water, soil) which can cause harmful effects on various forms of life or property.

Types of environmental pollution:-

- a) Air pollution
- b) Water pollution
- c) Soil pollution
- d) Marine pollution
- e) Noise pollution
- f) Thermal pollution
- g) Nuclear hazards

**a)AIR POLLUTION:**

It is an atmospheric condition where certain substances are present in conc. which can cause undesirable effects on man and his environment.

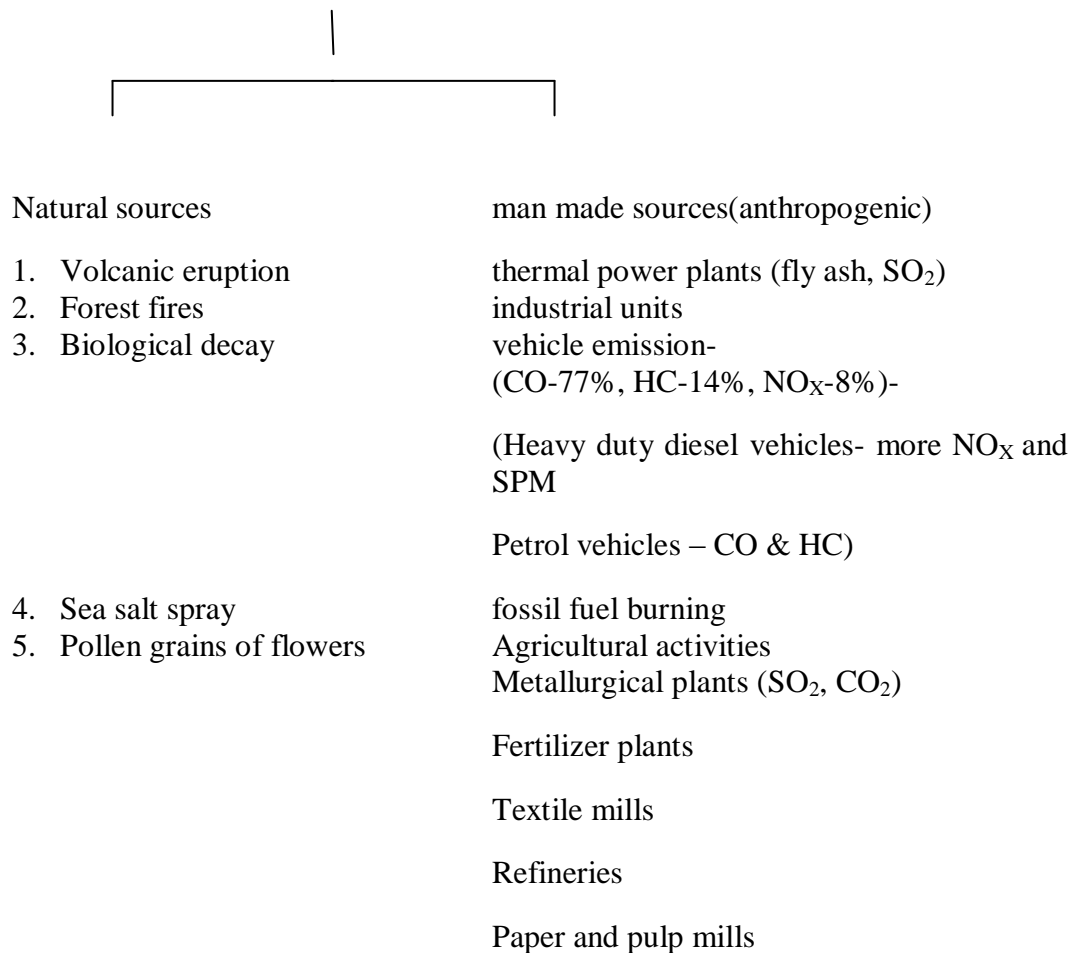
Ex. Gases, particulate matter, radioactive substances etc.

Gaseous pollutants – sulphur oxides, nitrogen oxides, carbon oxides, volatile organic compounds

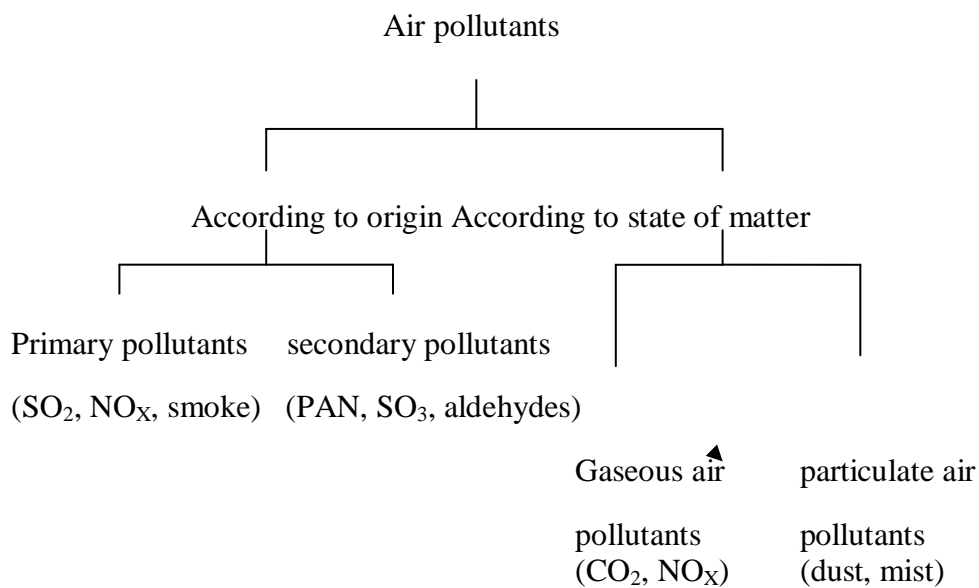
Particulate pollutants – smoke, dust, soot, fumes, aerosol, liquid droplets, pollen grains

Radio active pollutants – Radon 222, Iodine 131, Sr 90

Sources of air pollution



Classification of air pollutants:



Indoor air pollution:

Radon is an important air pollutant. It can be emitted from building materials like bricks, concrete, tiles etc. which are derived from soil containing radium. Burning of fuel produce pollutants like CO, SO<sub>2</sub>, soot and many other like formaldehyde, benzo(a)pyrene (BAP) are toxic and harmful for health. BAP is also found in cigarette smoke and is considered to cause cancer. A person using wood as fuel for cooking inhales BAP equivalent to 20 packets of cigarette a day.

Effects of air pollution:

Effects on human:

Human respiratory system has a number of mechanisms for protection from air pollution. Bigger particles (> 10 micro m) can be trapped by the hairs and sticky mucus lining in the nose.

S. No.	Pollutant	Sources	Effects on human
1	Aldehydes	Thermal decomposition of fats and oils	Irritates nasal and respiratory tracts
2	Ammonia	Chemical processes, dye making, explosives and fertilizers	Upper respiratory passage
3	Arsenic	Coal and oil furnaces	Damages kidney, cause jaundice, lung and skin cancer
4	Carbon Monoxide	Motor exhausts, oil and coal furnaces	damages lungs and heart
5	Cadmium	oil and coal furnaces	Damages kidney
6	Chlorine	Chemical industries	Attacks respiratory tracks, mucous membranes
7	Hydrocarbons	Unburnt gasoline vapours	Fog formed with combination of NO <sub>x</sub> affects respiratory system
8	Hydrogen Sulfide	Sewage treatment, refineries	Irritates eyes, causes nausea, bad odour
9	Nitrogen oxides	Motor vehicle exhaust	Bronchitis

10	Ozone	Photochemical reactions	Eye irritation, aggressive asthma
11	Sulphur dioxide	Coal and oil combustion	Obstructs breathing, irritates eyes
12	Suspended solids	Industrial manufactures	Eye irritation, asthma, air suffocation, lung cancer

Control of air pollution:

1. Using non conventional energy
2. Using bio filters
3. Planting more trees
4. Reducing vehicle exhausts
5. Using less polluting fuels
6. Using mass transport
7. Removal of particulate matter using electrostatic precipitator, cyclone filter etc.
8. Setting of industries of EIA
9. Removal of NO<sub>x</sub> from vehicle exhaust

### **b)WATER POLLUTION:**

Presence of foreign impurities (organic, inorganic, biological) in such quantities so as to constitute a health hazard by lowering the water quality and making it unfit for use.

Causes:

Point source Ex: flow of water pollutants from sewerage system, industrial effluent etc.

Non-point source Ex: agricultural land (pesticides, fertilizers, mining, construction sites)

Classification of water pollutants:

1. suspended matter
2. thermal discharge
3. pathogens (bacteria, fungi, protozoa fungi)
4. natural organic pollutants
5. synthetic organic pollutants
6. inorganic chemicals
7. radioactive waste, oil, sediments

### Effects of water pollution

1. Objectionable colour and odour is unacceptable and unsuitable for drinking and other purposes.
2. highly turbid and very hard water is unpleasant to drink, food processing
3. acid and alkaline water cause serious health problem
4. water borne infectious enteric disease like typhoid, cholera, dysentery, are the predominant health hazard arising from drinking contaminated water
5. radioactive pollution enter human body through food and get accumulated in thyroid gland, liver, bones and muscles
6. biodegradable waster deplete D O in the receiving stream, affect the flora cause creates anaerobic conditions
7. non biodegradable waste and pesticides travel the food chain and ultimately reach human where they accumulate in fatty tissues
8. thermal discharge in stream depletes D O
9. phosphate, nitrate, promote the growth of algae and encourage eutrophication
10. Industrial effluents result in addition of poisonous chemicals such as arsenic, mercury, lead may reach human body through contaminated food.

### Control measures of water pollution

1. lay down standard for
  - a. drinking water
  - b. disposal of waste water into water course/sewer/land
2. monitoring
3. treatment
  - a. domestic treatment
    - screening
    - sedimentation
    - filtration, pH adjustment
    - disinfection
  - b. waste water treatment
    - preliminary treatment
    - primary treatment
    - secondary treatment
    - advanced treatment



**C) SOIL POLLUTION:-**

The contamination of soil by human and natural activities which may cause harmful effects on living beings.

Causes:-

- Industrial waste
- Urban waste
- Agricultural practices
- Radioactive pollutants
- Biological agent

Effects:-

- ❖ Affect human health
- ❖ Affect soil fertility
- ❖ Reduce soil productivity
- ❖ Cause abnormalities

Control measures:-

- ❖ Properly collect solid waste
- ❖ Microbial degradation
- ❖ Recovery of products from waste
- ❖ For methane generation, use cattle dung
- ❖ For biogas generation, use biodegradable organic waste

**d) MARINE POLLUTION:-**

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.

Causes:-

- Rivers
- Catchment area
- Oil drilling and shipment.

Sources:

- waste disposal
- oil spill
- thermal pollution (plants located nearby coastal areas)
- ship breaking activities
- aquaculture practices
- nuclear test conducted in seas and oceans

Effects:

- disturb entire aquatic or marine ecosystem
- oil has suffocation effect on most aquatic animals

- smaller animals can be caught in oil envelope and die
- thermal
- Pollution may increase the temp. of water and DO may be depleted which causes danger.
- There may be chances for bioaccumulation and bio magnification in the food chain due to the disposal of non-degradable wastes
- Oil promotes anaerobic conditions by preventing diffusion of oxygen from air
- Disposal of radio active wastes cause chronic, acute and genetic damage
- Affects the recreational activity along the beaches
- Affect sensitive flora and fauna
- Loss of buoyancy
- Affect phytoplankton, zooplankton, algal species, coral reefs, fish, birds and mammals.

Control measures:-

- Ban to dump the toxic, hazards waste and sewage sludge.
- Prevent sewer overflows
- Minimize coastal developmental activities
- Oil ballast should not be dumped into sea.

#### e)\_NOISE POLLUTION:-

Sound is mechanical energy from a vibrating source

Unpleasant and unwanted sound is called noise

Sound can propagate through air, liquid or solid

Sound is pressure perturbation in the medium through which it travels. Sound pressure creates alternate compression and rarefaction. The number of c and r per unit time is called frequency.

Sound pressure does not produce linear impact on human. A logarithmic scale has been devised. Noise is measure in terms of SPL which is a log ratio of sound P to a std. P. It has a dimensionless unit decibel (dB). The international reference P is  $2 \times 10^{-5}$  Pa. Sound can affect ears either by loudness or by pitch (frequency). The CPCB has recommended the permissible noise levels for various places.

Area	Permissible noise level(dB)	
	Day	Night
Industrial	75	70
Commercial	65	55
Residential	55	45
Silent Zone	50	40

Sounds and their decibel scale:

1. Rocket engine – 180 dB
2. Jet plane take off – 150 dB
3. Threshold of pain – 140 dB
4. Recorded music (max) – 130 dB
5. Construction works, news paper press – 100 dB
6. Motor cycle – 90 dB
7. Ordinary conversation – 70/80 dB
8. Air conditioning unit/ Light traffic – 60 dB
9. Normal living room – 50 dB
10. Library or soft whisper – 30 dB
11. Threshold of hearing – 0 dB

Sources of noise pollution:

1. Industrial units
2. Transportation modes
3. Construction activities
4. Celebrations
5. Electric home appliances

Nanjing – 105 dB

Rome – 90 dB

Calcutta – 85 dB

Mumbai – 82 dB

Delhi – 80 dB

Effects of noise pollution:

- ❖ Interferes communication
- ❖ Hearing damage (90 dB)
- ❖ Physiological and Psychological disorders

Noise pollution during Diwali:

The environmental (protection) (2<sup>nd</sup> amendment) Rule 1999 has given the permissible limit of noise level produced from fire crackers to be 125 dB. According to recent test reports on fire crackers by National Physical Laboratory, the fire crackers available in the market produce noise beyond the permissible limit.

Atom bomb – 135-138 dB

Hydrogen bomb – ”

The Union Government and all the state governments shall follow the guidelines of amendment 89 of env. (Protection) Rule 1986 framed under Env. (Protection) Act 1986 which says

1. The manufacture, sale or use of fire crackers generating noise level exceeding 125dB shall be prohibited.
2. For joined fire crackers the limit is taken as  $5 \log_{10} (N)$  dB; where N= no. of crackers joined together
3. The use of fire crackers shall not be permitted except between 6.00a.m and 10p.m.
4. No crackers burning is permitted in/near silent zone – areas near hospitals, educational institutions, courts, religious places, etc.
5. The State Education Resource Centre shall take appropriate steps to educate students about the ill effects of air and noise pollution.

Control of noise pollution:

- Reduction in source of noise]
- Noise making machines should be kept in containers with sound absorbing media
- Proper oiling will reduce noise from machinery
- Using silencers – fibrous material
- Planting trees
- Legislation can prevent excess sound production, unnecessary horn blowing etc.

#### **f) THERMAL POLLUTION:-**

Addition of excess undesirable heat to water

Causes:-

- Nuclear power plant
- Domestic sewage
- Hydro electric power

Effects:-

- Reduction in dissolved oxygen
- Increase in toxicity

- Direct mortality

Control measures:-

The following methods should be adopted to control thermal pollution

- Cooling towers
- Cooling ponds
- Spray ponds

### **g) NUCLEAR HAZARDS:- OR RADIO ACTIVE POLLUTION**

The physical pollution of air, water and soil by radio materials.

Causes:-

I) Natural causes:

- ❖ Solar rays
- ❖ Radio nuclides in earth's crust
- ❖ Environmental radiation

II)Anthrogeneic causes:-

- ❖ Medical X-rays
- ❖ Radio isotopes
- ❖ Nuclear test
- ❖ Nuclear installations
- ❖ Nuclear reactor

Effects:-

- ❖ Causes skin burns, loss of teeth, vomiting anemia
- ❖ Blood cancer
- ❖ Brain damage

Control measures:-

- ❖ Radiation exposure protection
- ❖ Radiation contamination protection
- ❖ Controlled area
- ❖ Disposal of radioactive waste

### **SOLID WASTE MANAGEMENT:-**

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

Types:-

- ❖ Garbage or food waste
- ❖ Rubbish
- ❖ Agricultural waste

- ❖ Industrial waste
- ❖ Hazardous waste

Cause:-

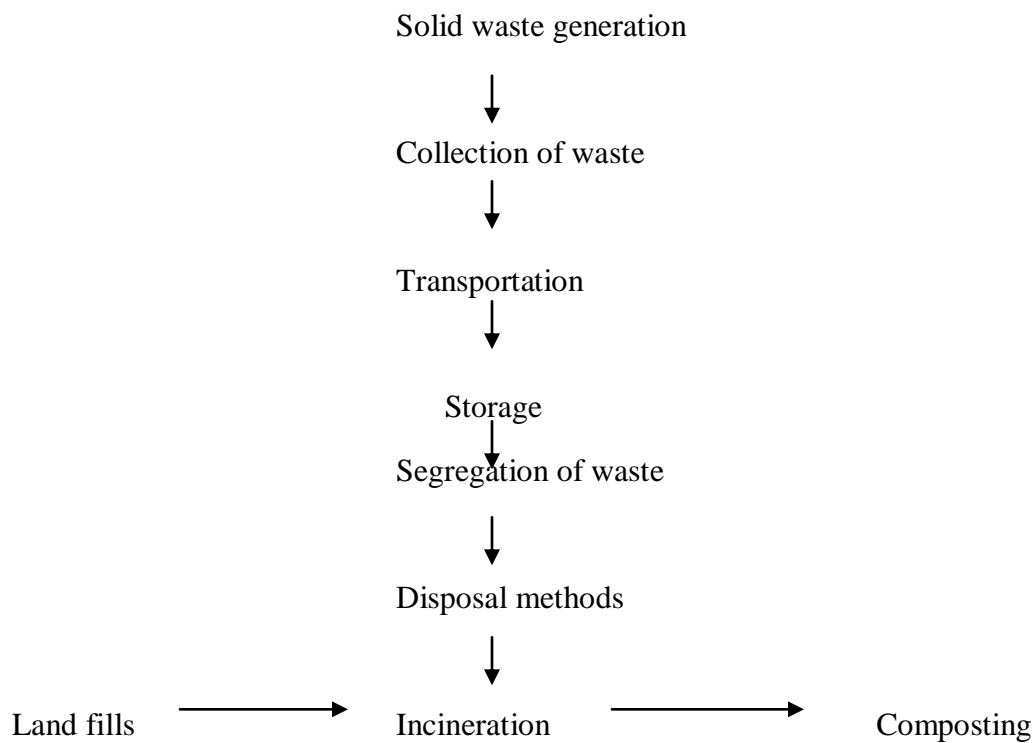
- ❖ Over population
- ❖ Affluence
- ❖ Technology

Effects:-

- ❖ Health hazard
- ❖ Environmental impact

Control measures:-

Solid waste management include the waste generation



- ❖ Collection of solid waste
- ❖ Disposal of solid waste

Land fill- Disposal of municipal waste in the upper layers of the earth's mantle.

Incineration- Burn highly combustible wastes at very high temperature,

Composting or Bio degradation- Decompose the organic components of the municipal solid wastes.

- ❖ Waste utilization
  - Reuse
  - Recycling
  - Reclamation

Role of an individual in prevention of pollution;-

- ❖ Use stairs instead of elevators
- ❖ Use public transportation walk or ride a bicycle
- ❖ Plant trees around building
- ❖ Turn off lights, television sets and computer when not in use.
- ❖ Pay immediate attention to leaks in pipes.
- ❖ Install waste saving equipments.
- ❖ Recycle glass metal and paper.
- ❖ Compost garden waste
- ❖ Segregate waste and recycle
- ❖ Buy locally made long lasting material
- ❖ Buy environmentally degradable products.
- ❖ Take some bag from home to market to purchase.

### **POLLUTION CASE STUDIES:-**

1. Bhopal gas tragedy:- (Air Pollution)

Pesticide factory-Union Carbide- corporation leak large volume of methyl isocyanate –atmosphere Bhopal- India-midnight on December 3,1984-city- change-gas chamber-within a week 10,000 people died – 1000 people turned blind-lakhs of people still continue to suffer various diseases

2. Gulf War: (Marine Pollution)

Gulf war was fought between Iraq and US-Period of 6 weeks in 1991-American fighters dropped a lakh of bombs-force the Iraq army to withdraw from Kuwait-retreat of Iraq-burning of 700 oil wells-near sea shore –oil from well spills out into the sea-the floating oil over sea water nearly 80 km long-burning of oil wells nearly 10 months-released huge amounts of pollutants like  $\text{CO}_2$  and  $\text{SO}_2$  into the atmosphere-1 million birds killed.

3. Chernobyl Disaster : ( Nuclear pollution)

Occur at Chernobyl in USSR 28 th April,1986-the reactor exploded- result of uncontrolled nuclear reactions-radioactive fuel spread out in to the surrounding areas –killed at least 20,000 people-damage to soil, water and vegetation around 60 km.

4. Minamata Disease :( Marine Pollution)

Minamata- Small coastal village in Japan –Chicago-chemical company produces Vinyl polymer plastics-industry release its effluent into Minamata sea-Effluents

containing mercury ions-converted into methyl mercury- highly toxic consumed by fishes –affect human being through food chain-damage central nervous system-loss of vision and hearing-loss of muscular coordination and severe headache- nervous disorders

## **DISASTER MANAGEMENT;**

### **FLOOD:**

Submergence of waste areas of land under water for many days in continuation

Causes: 1.Heavy rainfall

2. Sudden Snow melt

3. Clearing of forest for agriculture

4, Industries increase the value and rate of water discharge after a storm

Effects:

1. Damage to building and property
2. Soil erosion is the major loss of agriculture
3. Any product submerged by flood water cannot be rescued

Control measures:

1. Building wall prevent spilling out the flood water over flood plains
2. advance meteorological information will prevent flood damage
3. reduction of run off by increasing infiltration through appropriate forestation  
eg.flood in Bangladesh 1974

### **EARTHQUAKE:**

Earthquake is the motion of the ground surface caused by wave motion starting from a focal point

Causes:

1. Underground nuclear testing
2. Volcanic eruption
3. Pressure of manmade dams, reservoir and lakes
4. movements of plates of earth

Effects:

1. Cause Tsunami
2. Deformation of ground surface
3. In hilly and mountain areas may cause land slides which damage the settlement and transport system
4. Depending on the severity of the quake collapses house and people died in 1000  
eg. Earthquake in Bhuj town



Control measures:

1. Government can inform the earthquake prone zone and caution residence
2. building should be designed to withstand tremors

### **CYCLONE:**

Cyclone is meteorological phenomena intense depressions forming over the open oceans and moving towards the land

Effects:

1. Depends on the intensity of the cyclone
2. Damage to human life crops roads, transport, communication could be very heavy

Control measures:

1. planting more trees on coastal areas
2. construction of dams
3. Radar system is used to detect cyclone eg.Cyclone in AP

### **LANDSLIDES;**

The movement of earth materials like coherent rock, mud, soil and debris from higher region to lower due to gravitational pull is called landslide

Causes:

1. Earthquake, shock, vibration
2. Deep water ground mining
3. movement of heavy vehicles on the unstable steep region

Effects:

1. Increase erosion of soil
2. block the roads
3. damage the houses, crop yield, life stock

Control measures:

1. Planting of deep rooted vegetation
2. Encouragement for construction of bridges water ways
3. Create national parks, sanctuaries biosphere.e.g.land slides in U.P

**Review questions**

1. Give any three methods of air pollution control equipment
  - Catalytic converters
  - Cyclone collectors
  - Electrostatic precipitators

2. What is smog?

It is a mixture of smoke and fog which forms droplets that remain suspended in the air.

3. What is point source of water pollution?

Point source is discharge pollutants at specific locations through pipes, ditches into bodies of surface waters.

4. When a sound causes noise pollution?

Noise beyond 120 dB

5. What are the types of solid waste?

- Municipal waste
- Industrial waste
- Hazardous waste

What is waste minimization?

Industrial manufacturing system the primary concern should be reducing the quantities of waste materials produced. This avoids the necessity to treat and disposal of such materials.

6. Name the chemical constituent of gas that caused death in Bhopal gas tragedy in India.

Methyl isocyanide.

7. Define the term Tsunami.

It is a large wave that are generated in a water body where the sea floor deformed by seismic activity. This activity displaces the overlying water in the ocean

**UNIT 3:NATURAL RESOURCES**

Any component of the env. Which has intrinsic value of its own is called as resource. Any component which can be transferred in a way such that it becomes more valuable and useful is termed as resource.

<b>Resources</b>			
Renewable Eg. Clean air, clean water	Non renewable Ground water, minerals	Continuous Solar energy, wind energy	Extrinsic Human skills
Considered to be renewable with considerable life span-as long as they have the capacity to renew – unless they are affected by catastrophes or anthropogenic activity.	Available only in finite quantity – their rate of renewal is so slow that they are considered as non-renewable	Considered to be available always.	

**FOREST RESOURCES:**

Forests are one of the most important resources of the world. Apart from having high commercial importance they provide high environmental services also. They act as a blanket on the surface of the earth.

Around 1/3<sup>rd</sup> of world land area was found to be forests. 1/5<sup>th</sup> of world forests were found in Brazil and 6-7% was in Canada and USA. But the matter under high concern is the declination of forest cover year by year.

**USES OF FOREST:**

Commercial uses: Forests provide timber, fire wood, food material, resin, gum, non edible oils, drugs, medicine, rubber, fibers, bamboo and many other important items.

**Ecological uses:**

1. Production of Oxygen: Photosynthesis – earth's lungs
2. Reducing global warming – sink for carbon di oxide
3. Wild life habitat – 7 million species in tropical forests alone
4. Regulation of hydrological cycle – prevent surface run off – giant sponges – 50-80% moisture

5. Soil conservation – hold solid particles tightly and prevent soil erosion – wind breaks
6. Pollution moderators: absorb toxic gases and purify air reduce noise pollution

### **OVER EXPLOITATION OF FORESTS:**

Human beings depend heavily on forests for food, shelter, wood, fuel and medicine with growing civilization etc. shoot up resulting in large scale mining, road building and clearing of forests.

Excessive use of charcoal, fuel wood, expansion of urban, agricultural and industrial areas and overgrazing have led to over exploitation and rapid degradation of forests.

### **DEFORESTATION:**

The total forest area of the world in 1900 was 7000 million hectares -1975 – 2900 mha – 2000 – 2300 mha.

Deforestation rate in temperate countries are relatively moderate. But it is alarming in tropical countries. It is estimated that in next 60 years we would lose more than 90% of our tropical forest.

### **INDIAN STATUS:**

Stabilized since 1982, with about 0.04% declaration per year between 1982 - 90. During this period it is estimated that about 1.44 mha land was brought under afforestation. As per our NFP, we have a target of achieving 33% forest area. But we still have only 19.27% of our land area covered by forests (satellite data).

### **MAJOR CAUSES OF DEFORESTATION:**

1. Shifting of Cultivation – 300 million people – 5 lakh hectares of forest for slash and burn culture
2. fuel requirement
3. raw materials for industrial use
4. developmental projects
5. growing food needs
6. overgrazing

### **CONSEQUENCES OF DEFORESTATION**

1. threatens many wild life species due to destruction of natural habitat
2. biodiversity is lost along with that genetic diversity
3. hilly regions are made prone to landslides
4. soil erosion and loss of soil fertility
5. hydrological cycle is affected  
(loss of rainfall, flood, drought etc)

**TIMBER EXTRACTION AND MINING:**

The major activities in forest area are 1. timber extraction 2. mining

The important effects of timber extraction are

- i) thinning of forests
- ii) loss of biodiversity, particularly tree breeding species
- iii) soil erosion and loss of soil fertility
- iv) migration of tribal people from one place to another in search of new forest
- v) extinction of tribal people and their culture

**MINING:**

Mining is a process of removing ores from area which is very much below the ground level. Mining is done for the extraction of several minerals of metals like Fe, Mn, Au, Ag, etc. The minerals are especially found in thick forests.

Mining can be carried out in two ways

1. Surface mining
2. underground mining or sub-surface mining

The effects of under ground mining on forest reserves is comparatively less than that of surface mining

Relation between forest and climate change:

Forests both influence and influenced by climate change. They play an important role in the carbon cycle and the way we manage forests could significantly affect global warming.

Forests hold more than 50 per cent of the carbon that is stored in terrestrial vegetation and soil organic matter. Hence, deforestation contributes significantly to net emissions of carbon dioxide into the atm.

If the predicted global warming occurs, the impact on forests is likely to be regionally varied, dramatic, and long-lasting. Even now, we can see how any extreme weather has great impact on forests. For example, the 1999 storms in Europe caused heavy damage to forests and also to trees outside forest areas.

The Kyoto Protocol on climate change may have a great impact on forest management. Under the Protocol, a country with forests earns emission credits, since its forests absorb carbon dioxide. These credits are tradable, that is, a developing country can sell its credits to an industrialized country that has exceeded its quota of emissions. The latter would invest in afforestation and reforestation projects in the developing country.

## DAMS – BENEFITS AND PROBLEMS

River valley projects with big dams are considered to play a key role in the development of a country. India has large number of river valley projects

1. These dams are regarded as symbol of national development.
2. provides large scale employment of tribal people and increase the std. of living of them
3. contribute for economic uplift and growth
4. help in checking flood
5. generate electricity
6. reduce power and water shortage
7. provide irrigation water
8. provide drinking water to remote areas
9. promote navigation and fishery.

Environmental problems:

The environmental problems can be at upstream as well as downstream

Level

Upstream problems

1. Displacement of tribal people
2. Loss of flora and fauna
3. siltation and sedimentation near reservoir
4. stagnation and water logging near reservoir
5. growth of aquatic weeds
6. micro climatic changes
7. RIS causes earthquakes
8. breeding of disease vectors

Downstream problems

1. Water logging and salinity due to over irrigation
2. micro climatic changes
3. salt water intrusion at river mouth
4. loss of fertility due to sediment deposits
5. out break of vector born diseases.

## WATER RESOURCES

Water is an indispensable resource. Around 97% of world surface is covered with water. Most of the animals and plants have 60-65% of water in their body.

Unique features of water

1. High specific heat
2. High latent heat of vapourisation
3. Good solvent for oxygen, nutrients and pollutants
4. Anomalous expansion on freezing
5. High surface tension

Global distribution of water is very much random depending on the geographical conditions. The availability of water decreases in the following order.

1. Tropical rain forest
2. Temperate regions
3. Deserts

Water is used for domestic, irrigation and also industrial purposes

Out of the total available water 75% is used for agriculture, 20% for industrial usage. In our country ~93% of water is used for agricultural purposes.

Ground water:

9.86% of fresh water is ground water and it is 35-50% greater than surface water.

Aquifer: The layer of soil which is permeable has the ability to store water is called an aquifer. It is generally made up of gravel, sand etc.

Unconfined aquifer: it is covered by permeable layer. The recharge of this layer is by rainfall or snowmelt.

Confined aquifer: sandwiched between impermeable layers. The recharge is through unconfined aquifer layers.

Over utilization of ground water:

Over utilization of water leads to rapid depletion of water resources, ground subsidence, lowering of water table and water logging.

Effects of over utilization of ground water:

Reasons: Economic development, rapid industrial growth and population explosion

The use of ground water and surface water rates which are higher than that of recharge ultimately leads to

- Water scarcity
- Water logging
- Salination
- alkalization

- water pollution or contamination
  - ✚ creates declining of water levels
  - ✚ crops failure and reduction in agricultural production
  - ✚ over pumping of ground water create drought, famine and food shortage
  - ✚ over pumping of ground water sea water intrusion in coastal aquifers
  - ✚ land subsidence may due to over pumping of ground water
  - ✚ river pollution due to industrial activities and dumping of waste into rivers, which in turn force to utilize the ground water, ultimately leads to over pumping

Clean water is universal right. It is the responsibility of everyone to ensure the purity of water. Water is a valuable commodity and it has to be conserved.

Surface water:

When evaporation and transpiration rates are lower than the rainfall, surface water body like lake, river, pond, streams etc. are formed.

Flood: over flow of water, whenever the water in flow is greater than the carrying capacity of the channels flood occurs.

Causes:

1. heavy rainfall, snow melt, sudden release of water from dams.
2. Prolonged down pour leading to overflowing of rivers and lakes
3. Reduction in carrying capacity due to obstructions or sediments etc.
4. Deforestation, overgrazing, mining increases water run off
5. Removal of dense forests from hilly regions

Effects:

1. Submerges the flooded area
2. Loss of soil fertility due to soil erosion
3. Extinction of civilization at costal area

Flood management:

1. Dams and reservoirs can be constructed
2. Embankments and proper channel management
3. Flood way should not be encroached
4. Forecasting or flood warning
5. Decrease of run off by infiltration through afforestation or rain water harvesting etc.



**Drought :**

Unpredictable delay in climatic condition occurring due to monsoon rain failure.

Types:

Meteorological : in order of month or year, actual moisture supply at a given place consistently falls below critical level.

Hydrological: deficiency in surface and subsurface water supplies

Agricultural: inadequate soil moisture to meet the need of a particular crop at particular time or susceptibility of crops during different stages in its development

Socioeconomic: reduction in the availability of food and social securing of people

Causes:

- Deforestation and lesser rainfalls coupled with cutting of trees for timber leads to desertification.
- Over drafting of ground water, subsidence of soil, drying of wetlands
- Pollution of soil with solid waste, industrial effluents etc makes land useless and dry
- Population explosion in man and livestock leads to enhanced requirement of timber, fuel wood, grazing
- Shifting cultivation

Effects:

- Increase of water in stream pond
- Ground water table get declined
- Loss of agricultural crops
- Loss of biodiversity
- Government spent a lot of money as drought relief fund

Control measures

- Rain water harvesting
- Watershed management
- Prevent deforestation
- Encourage afforestation

## CONFLICTS OVER WATER

Due to increase in population and decrease in water resources conflicts over water starts

Conflicts over the water around world was classified as

- Control of water resources
- Military food resources
- Political resources
- Terrorism
- Military targets
- Development disputes

Causes:

- Conflicts through use 1. Shipping traffic in international water .2 dam construction
- Construction of power stations on
- Conflicts through pollution-rhine river,Europe
- Distributional conflict-relative storage
- Euphrates, Nile, Ganges - plataneous in upper basin, reduced in lower basin due to extensive use.
- Anatolian dam project by turkey Farakka dam in India

Distributional conflict: Absolute shortage. Colorada and Rio Grande, Jordan

Conflicts management:

- Enact laws to check practices to control water pollution
- Sharing river solved by interlinking river
- Power must be given to national water authority and river basin authority and river s-basin authority for equitable distribution of basin water-demand foOr nateralization of water needs

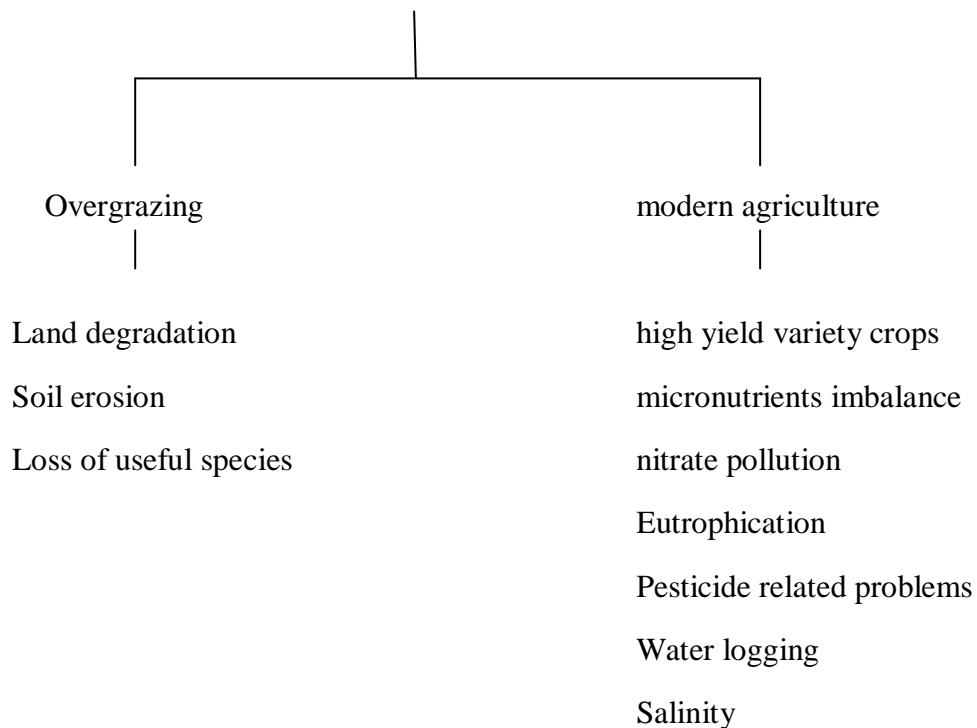
## MINERAL RESOURCES

- ✓ Environmental impacts of over extraction of mineral resources:
  - Depending on the conditions of terrain and depth of ore deposits 2 types of mining operations are carried out. 1. open cast mining and 2. underground mining. In both types each steps in mining processing produce several environmental effects such as,
  - Deforestation takes place due to removal of vegetal covers.
  - Great volume of debris has been generated which disrupt the surface and ground water circulation. It also reduces the water carrying capacity of streams very close to mining area
  - The stacking of over burden and building of soil banks creates problems of landslides
  - Under ground fire in coalmines is a hazard that is difficult to control
  - Mining and ore processing normally causes air pollution and water pollution
  - The acid water generated in coalmines can pose a serious problem of water pollution, which adversely affects the flora and fauna.
  - Deeper excavation of ground causes lowering of water table, which leads to drying of wells or sea water intrusion
  - In stone quarries, blasting of rocks not only annoying the people nearby, but also cause hazard from fly rocks and dusts and damage to buildings due to vibrations

The disposal of waste material produced after concentrations of ore create increase concentration of heavy metals and toxic elements in the environment.

## FOOD RESOURCES:

### PROBLEMS FACED BY FOOD RESOURCES



**WORLD FOOD PROBLEMS:**

- Problems mainly under nutrition and malnutrition
- Natural calamities:-famine, drought, earthquake, flood, gale, storm
- Disease and medical facilities
- Pest damage:-insects, bacteria, viruses, parasites consume 60% of world's food production
- Hunger
- Population explosion in rural areas
- Environmental pollution
- Lack of water for irrigation
- Less rainfall due to deforestation
- Livestock overgrazing
- Overfishing

**CHANGES CAUSED BY OVERGRAZING AND AGRICULTURE:****Overgrazing:**

Process of eating away the vegetation along with its roots without giving a chance to regenerate

- Land degradation-leads to organically poor, dry, compacted soil cannot be used for further cultivation
- Soil erosion-cover of vegetation gets removed from soil
- Loss of useful species-good quality grasses and herbs with high nutritive value, when grazed lose even the root stocks which carry the reserve food for regeneration get destroyed which gives raise to secondary species like parthenium, Lantane, Xanthium etc
- To prevent –match the forage supplement to the herd's requirement.eg.Switch grass

**Modern agriculture:**

The practice through which specific plant species are cared and managed so as to obtain maximum yield of consumable parts of plants –agriculture

Makes use of hybrid seeds and selected and single crop variety, high tech equipment and lots of energy subsidies in the form of fertilizers, pesticides and irrigation water e.g. green revolution

- Damage to soil
- Water contamination
- Water scarcity
- Global climate change
- Water logging-results when soil is over irrigated
- Soil salinity-increase plant productivity, interferes with water uptake by plants
- Fossil fuels and pesticides produce air pollution

Impacts related to high yielding varieties:

- Monoculture ie the same genotype is grown over vast areas. Disease spread easily
- Micronutrient imbalance e.g Zinc deficiency-affect soil productivity

- Nitrate pollution-nitrogenous fertilizers applied deep soil contaminates ground water. cause blue baby syndrome methaemoglobinemia- affects infants
- Eutrophication: Over nourishment of lakes due to agriculture field wash out-leads to algal bloom-dead organic matters increases due to decomposition-leads to oxygen demand

Problems associated with pesticide use:

- Evolution of genetic resistance
- Imbalance in ecosystem
- Creation of new pest
- Persistence, Bioaccumulation and Biomagnification
- Mobility through soil, water, air, washed away into rivers, streams, when it rains can harm fishes
- Creating super pest
- Death of non target organisms
- Salinity
- Water logging

### **Water logging / salinisation:**

Saturation of soil with irrigation water or excessive precipitation. So that water table rises close to surface.

Water logging results when soils are over irrigated without drainage. Occurs in clayey soil, soil root zone becomes saturated with so much water blocking oxygen supply for growth and soil becomes unsuitable. Carbondioxide and ethylene accumulate around roots and affects plants

### **ENERGY RESOURCES**

Growing energy needs:

Population explosion, Luxurious life, Industries, Agriculture, mining, transportation, lighting, cooling, heating, building all need energy. Fossil fuels like coal, oil, natural gas produce 95% of energy

Sources of energy

Primary-

Renewable energy-resources which can be generated continuously in nature and are in exhaustible and can be used again endlessly.wood, Tidal, Solar, wind, hydropower, biomass, biofuel, geothermal, hydrogen

Non – renewable energy- Resources which have accumulated in nature over a long span of time and cannot be quickly replenished when exhausted.coal, petroleum, natural gas

Secondary-petrol, electrical energy, coal burning

Energy renewable	Advantage	Disadvantage
	<ol style="list-style-type: none"> <li>1. Wide availability</li> <li>2. Low cost</li> <li>3. Decentralized power production</li> <li>4. Low pollution</li> <li>5. Available for the future</li> </ol>	<ol style="list-style-type: none"> <li>1. Unreliable supply</li> <li>2. Produced in small quantity</li> <li>3. Difficult to store</li> <li>4. Cost more</li> </ol>
Energy non renewable	<ol style="list-style-type: none"> <li>1. Available in high concentrated form</li> <li>2. Easy to store</li> <li>3. Reliable supply</li> <li>4. Lower cost</li> </ol>	<ol style="list-style-type: none"> <li>1. highly pollution</li> </ol> <p>Available only in few places High running cost Limited supply and will one day get exhausted</p>

Use of alternate energy sources:

Refers to energy sources which are not based on the burning of fossil fuels or the splitting of atoms.

### **Solar energy:**

Total energy from sun per year-35,000 times the energy used by man

Used to run car, power plants and spaceships

Energy harvesting devices:

Solar heat collectors

Solar cells

Solar cooker

Solar water heater

Solar furnace

Solar power plants

### **Wind energy:**

Average wind velocity of earth -9 m/sec and power produced when a windmill is facing the wind of 10 miles/hr-50 watts.eg.largest wind farm-Kanyakumari in tamilnadu is generating 380 MW electricity

Hydro power:

- Comes from damming of rivers and utilization of high pressure, its kinetic energy is transformed into turbine blades and used to generate electricity
- Minimum water falls height-10 m
- Hydro power potential of India- $4 \times 10^{11}$  KW/Hr

### **Tidal Energy**

Uses the natural motion of tides to fill reservoirs which are then slowly discharged through electricity producing turbines

### **Ocean thermal energy**

Energy available due to the difference in water temperature. The surface of the tropical ocean and at deeper level is called OTE. A difference of  $20^{\circ}\text{C}$  or more is required for operating OTE power plants.

### **Geothermal energy**

Energy harvested from the hot rocks inside earth. eg. natural geysers in Manikaran, Kullu, Sohana

### **Biomass energy**

Organic matter produced by plants

Types:

1. Energy plantations:

Solar energy is trapped by green plants through photosynthesis and converted to biomass e.g. Leucaena, Sugarcane, sweet sorghum, Sweet beet aquatic weeds like hyacinth, Sea weeds, potato, cereal-energy plantations

Produce energy by burning directly or by getting converted into burnable gas or converted to fuels by fermentation.

Petro crops

Latex containing plants Euphorbias, oil palms rich in hydrocarbons and yield oil like substance under high temperature and pressure-refined to form gasoline

## **LAND RESOURCE**

Land is critically important national resource which supports all living organisms including plants and animals. The soil profile of land determines its ability to serve socio-economic needs.

It has been estimated that more than 5000 million tonnes of top soil is eroded annually along with 5 million tonnes of nutrients. 'About 1/3 of this is lost in sea while the rest in reservoirs and rivers leading to flood.

About 38% of the area in India suffers from moderate to high degree of water based erosion. The per capita availability of land in the country has declined from 1.37 hectare in 1901 to 0.33 hectare in 2000. All these lands cannot be utilized for agricultural purpose. Some land would be required for other activities (to maintain urban area).

Effective steps have to be taken for preventing diversion of land suitable for sustainable farming to non-farm uses. Simultaneously, degraded lands and waste lands have to be improved by ecological restoration. The Department of Land Resources was setup in April 1999 by ministry of Rural Development to act as nodal agency for land resource management.

### **Land Degradation:**

Land degradation is defined as the reduction in soil capacity to produce in terms of quality, quantity goods and services. The definition is also based on

1. sustainability or ability to produce continuously and indefinitely.
2. quality of land resource that makes it sustainable or resistant to degradation
3. carrying capacity or the number of people and animals the land can normally support without significant stress.

Landscapes generally undergo degradation but are usually compensated by nature's inherent recovering ability. Whenever degradation occur exceeding nature's restorative capacity, the result will be a disaster.

### **Man induced landslides:**

The hill slopes are prone to land slides, landslips, rockslides etc. These hazardous features have reduced the overall progress of the region as they obstruct the roads, communication media and water flow. There are two types of slides

1. slides due to natural factors
2. slides induced by man and his activities

Some of the human activities that cause land sliding are

- massive deforestation
- erratic agricultural practices
- road building
- Unscientific quarrying etc.
- Engineering. Constructions

### **Soil erosion:**

1. Terracing: Terracing reduces soil erosion on steep slopes by concerting the land into a series of broad, level terraces. This retains water for crops at each level and reduces soil erosion by water run off.
2. Contour Farming: This method is adopted for gently sloped land. This involves planting crops in rows across the contour of gently sloped land.



3. Alley Cropping or Agro forestry: In this method crops are planted together in strips or alleys between trees and shrubs that can provide fruits and fuel wood. The trees and shrubs provide shade which reduce water loss by evaporation and preserve soil moisture.

Wind Breaks or Shelter Belts: Wind breaks and shelter belts or trees are established to reduce wind erosion and also for retaining soil moisture.

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

Natural resources-forest,water,soil,food,mineral and energy

Overuse of these resources cause problems

Conserve water:

- Don't keep water taps running
- Install water saving toilets
- Check for water leaks
- Reuse soapy water
- Use drip and sprinkling irrigation
- Conserve energy
- Turn off lights, fan when not in use
- Use solar cooker for cooking
- Try riding bicycle

Protect soil:

- Don't uproot plants
- Grow grass which binds soil and prevent erosion
- Make compost
- Use green manure
- Don't over irrigate
- Use mixed cropping

### **EQUITABLE USE OF RESOURCES FOR SUSTAINABLE LIFE STYLE:**

- Most developed countries like USA, Canada, Japan, Australia have 22% of natural resources, use 88%.73% of its energy and command 85% of its income
- Less developed countries has 78% of population, 12% Usage of natural resources, 27% of energy, 15% of income
- Gap arises due to increase in population distribution of resources and wealth
- Problem solved by equitable distribution of resources and wealth
- Global consensus has to be reached for more balanced distribution of basic resources like safe drinking water, food, fuel etc. So poor low developed countries able to sustain their life
- Two basic cause of unsustainability are over population in poor countries and over consumption of resources by rich countries generate wastes
- Rich countries lower down their consumption level
- Poor countries fulfilled by providing them resources

### **Review questions**

1. What is artesian well?

A well or hole in aquifer flows freely at the surface

2. What is wetland? give examples and use

Wetlands are the natural water storage bodies on ground surface

Eg. Swamps, Meadows, Marshes

3. State the major process which have major environmental impact while processing of minerals.

Smelting, chemical extractions

4. What is salinization?

During over irrigation, all the water is not absorbed in the soil. such water evaporates leaving behind a thin crust of dissolved salts in the top soil.

5. Give two examples of primary and secondary sources of energy?

Primary source-fossil fuels, hydro energy

Secondary source-petrol, electrical energy

6. What is ocean thermal energy conversation?

In oceans, a thermal gradient (i.e., the temperature difference) of about 200C exists between surface water heated by sun and colder deep water. This difference can be harnessed to produce power. This concept is OTEC.

7. Give any four environmental benefits of dam

- Source of cleaner and safer power
- For irrigation of agricultural lands
- Helps in recharging of ground water
- Habitat for many fishes and wildlife

8. What are the sources of water

Ground water, surface water, sea water, rain water

9. What is sardar sarovar Narmada project?

It is a multipurpose project on river Narmada, bringing the benefits of irrigation, power and drinking water to Gujarat, Mathya Pradesh and Rajasthan.

10. What is integrated pest management?

The process of controlling crop pests using ecological system

## **UNIT 4: SOCIAL ISSUES AND THE ENVIRONMENT**

From unsustainable to sustainable development:

Brundland commission describes sustainable development as the development that meet needs of present generation without compromising ability of future generations to meet their own need

Concept of sustainable development

- A symbiotic relationship between consumer human race and producer natural system
- Compatibility between ecology and economics

Aim of sustainable development:

- Inter generational equity
- Intra generational technology

Significance of sustainable development:

- Developing appropriate technology
- Reduce , reuse, recycle of natural resources
- Providing environmental education and awareness
- Consumption of renewable resources
- Conservation of nonrenewable resources
- Population control

### **Urban problems related to energy:**

Urbanization:

Movement of human population from rural areas top urban areas for betterment of education, communication, health, employment etc

Causes;

Cities are main centers of economic growth, trade, transportation, education, medical facilities and employment

Urban sprawl:

Urban growth is fast , so difficult to accommodate with their limited area .So cities spread into rural areas

- Urban energy requirement:
- Residential and commercial lighting
- Public and private transportation
- Electrical and electronic appliances

Solution:

Use public transport instead of motor cycles

Energy consumption must be minimized

Use solar and wind energy

Impose strict laws, penalty, and energy audit

### **Water conservation:**

Process of saving water for future utilization

Water source:

- Fresh water
- River
- Stream
- Pond
- Ocean

Need for water conservation:

- Population increases water requirement also increases
- Due to deforestation annual rainfall decreases
- Over exploitation of ground water

Ways of water conservation

- Reducing evaporation loss
  - Reducing irrigation loss
  - Reuse water
  - Avoid sewage discharge
- Water conservation method
- Rain water harvesting
  - Watershed management

### **Rain water harvesting**

Objective:

To meet increasing demands of water

Raise water table by recharging ground water

Reduce ground water contamination from salt water intrusion

Roof top rainwater harvesting

- Involves collecting water that falls on roof of house
  - Rainwater from roof top, road surface, play ground diverted to surface tank
- Advantages of rainwater harvesting

- 
- Increases the well water availability

- Raise ground water level
- Minimizes soil erosion

### **Watershed management:**

It is defined as land area bounded by divide line from which water drains under influence of gravity in to stream, lakes, reservoir.

Eg. Pits, dams, Farm, ponds, Himalaya.

Types

1. Micro
2. Mini
3. Macro

Watershed  
Management;

The management of rainfall & resultant runoff.

Forestry

Halt deforestation, provide vegetative cover, degraded land and supplement fodder and fuel wood resources available to rural communities

Agriculture

- Aims to increase agricultural productivity in sustained manner and to diversify crop production
- Major objective shall be achieved through organizing farmers, training camps and exposure visits.
- Construct check dams, water harvesting tanks, storage tanks and channels , repair of old

channels , implementing measures to check soil erosion Horticulture

- establishment of private orchard

- Rejuvenation of existing orchards
- Distribution of horticulture plant for home garden planting.
- Animal husbandry
- Energy conservation
- Community participation
- Training and awareness programme

#### Advantages of Watershed projects

- Improved access to drinking water in project areas during drought
- Increase in cultivation area leading to increase in employment
- Increase in crop yield, resulting better income to rural population
- Improved availability of fodder for animals and increase in milk yield
- Increase in employment & involvement of women
- Increase in net returns from all crops.
- Decrease in soil erosion.
- Restoration of ecological balance.

#### **Resettlement and Rehabilitation of people:**

Resettlement – simple relocation or displacement of human population.

Rehabilitation – making, system to work again by allowing, system to function naturally. Includes replacing the lost economic assets, Safeguard Employment, Provide safe land for building

Repair damaged infrastructure.

#### Effects:

- Loss of land
- Loss of recourse
- Unsatisfactory compensation
- Social and cultural problems
- Changes in tradition of indigenous people
- Spread of disease
- Submergence of valuable forest
- Waterlogging
- Extinction of wild life

#### **Environmental ethics:-**

Over exploitation of forests, land, water as well as various living components of biosphere and failure to tackle the problem of pollution and environmental degradation are exposing the humanly to the thread of a global environment crisis.

It emphasizes that real development cannot occur unless the strategies which are formulated and implemented are environmentally sustainable. Even though our government is formulating several rules, regulations, policies, laws, it is the duty of each and every one to protect our nature.

Therefore human beings are ethically responsible for the preservation of the world's ecological integrity. Environmental ethics literally means conscious efforts to protect the environment and to maintain its stability from the pollutants. Following are some of the ways to safeguard the environment.

1. To sacrifice the consumption of some of the good which reduces environmental quality
2. Minimize the resource utilization and conservation
3. Adopt sustainable and eco friendly development. (e.g) reduction of waste, recycling,



waste management and harvesting non conventional energy

If we change as individuals then the society will also change by itself. The society is nothing but an extension of the individual.

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### **Green House Effect and Global Warming:**

The raise of earth's surface temperature due to intense green house effect is called global warming.

Causes:

Over the last century, the level of carbon dioxide in the atm. Has increase by 25%, the level of nitrous oxide by 19% and the level of methane by 100%. These 3 major global warming gases are released into the atm. by burning of fossil fuels, industrialization, mining, deforestation, exhaust from increasing automobiles and other anthropogenic activities.

Effects:

1. Increase evaporation of surface water – influence climate change
2. Leads to declining biodiversity
3. Melting of mountain glaciers and polar ice, which cause rise in sea level
4. Change the climate and rainfall – reduction in food production
5. The biological productivity of ocean also decreased due to warming of earth's surface
6. With more carbon dioxide in the air, the plants will grow bigger with increase in yield and resulting in the soils getting poor quality
7. If proper precautions are not taken, the conc. Of green house gases may double in the atom. with in next 50 years, and will makes the average global temp. to 45<sup>0</sup> C.

### **Ozone layer depletion:**

Ozone is an important chemical species present in the stratosphere. Its conc. is about 10 ppm. It acts as a protective shield for the life on the earth. Ozone is produced and also broken down by photochemical reactions, thus maintaining equilibrium.

Causes for ozone layer depletion:

1. Chlorine released from CFC and Bromine released from halogens are the most important chemicals associated with ozone layer depletion
2. The halogens are used in fire extinguishers and CFC are extensively used in air conditioners and refrigerators.
3. Methyl bromide used during packaging of fruits to prevent bacterial action flows out into the atmosphere as soon as the packing is opened. This causes heavy damage to ozone.
4. High altitude aircrafts and chemicals emitted by industrial plants and automobiles.

Effects:

1. Marked rise in cause skin cancer
  2. Damage immune system
  3. Eye ailment such as cataract
  4. Shorter life of paints and plastics
  5. Restricted growth and crop damage
- 

6. Destruction of aquatic life

### **Waste land reclamation:**

Any land which is not put to optimal use is defined as waste land. The waste land does not fulfill their life sustain potential wasteland contributes about 20.17% of the total geographical area of India.

Reasons for formation

- Over grazing and over exploitation
- Toxic effluent discharged from sewage and industrial wastes
- Mining activities destroy forest and cultivable land
- Use of pesticides also produce wasteland
- Erosion, desertification, water logging also degrade land

Wastelands can be reclaimed by the following way

- Conserving the soil – land is brought under vegetal cover. This can be done by growing grasses and shrubs
- To reclaim the land/soil, effective participation of the people, voluntary agencies and government is very important

### **Consumerism and Waste Products**

Consumerism refers to the consumption of resources by the people. Early human societies used to consume much less resources. But the consumerism has increased to a very large extent. Consumerism is related to both population size and increase in demands due to change in life style.

Population has increased tremendously. World Bank estimates our population to reach 11 billion by 2045. Two types of conditions of population and consumerism exists.

1. People over – population: When there are more people than available food, water and other resources in an area – causes degradation of limited resources – poverty and under nourishments. Low Developed Countries (LDC) are more prone to these conditions. There is less per capita consumption although the overall consumption is high.
2. Consumption over – population: These conditions occur in more developed countries (MDC). Population size is smaller but the resource consumption is high due to luxurious life style (i.e.) per capita consumption is high. More consumption of resources lead to high waste generation – greater is the degradation of the environment.

According to Paul Ehrlich and John Hodlren model

Overall environmental impact = no. of people x per capita use of resources x waste generated per unit of resources

Parameter	MDC	LDC
No. of people	low	High
Per capita consumption of resources	high	Low
Waste generated	high	Low

Over all environmental impact of these two types of consumerism may be same or even greater in case of MDC.

Comparison of consumption and waste generation

Parameter	Global value %	
	USA	India
Population	4.7	16
Production of goods	21	1
Energy use	25	3
Pollutants and wastes	25	3
CFC Production	22	0.7

### **Environment (Protection) Act, 1986**

CG is to take action to protect and improve environment and SG to co ordinate actions. CG to set up

1. Std of quality of air, water or soil

2. Maximum permissible limits of concentration of pollutants (including noise pollutant)
3. procedures and safe guard for handling hazardous items
4. Prohibition of using hazardous items
5. Prohibition and restriction of certain industries in certain area
6. Procedure and safe guard for prevention of accidents

Environment (Protection) Rules, 1986

SPCB is to follow the guidelines provided in schedule VI. Some are as follows

1. Advises industries for treating the waste water and gases – use of technology – achieve prescribed std.
2. Encourage recycling and reusing the wastes
3. Encourage recovery of biogas, energy and reusable matter
4. Discharge of effluents and emissions into environment is permitted by SPCB after taking into account capacity of the receiving water body
5. To emphasize clean technology to increase fuel efficiency and decrease environmental pollutants

The act provides for environmental Audit for checking complying with the environmental laws and regulations.

### **Air (Prevention & Control of Pollution) Act, 1981**

Salient features

1. Prevention, control and abatement of air pollution
2. Air pollution has been defined as the presence of any solid, liquid or gaseous substance (including noise) in the atmosphere in such a concentration that may be or tend to be harmful to human being or any other living creature or plants or property or environment.
3. Noise pollution – inserted in 1987
4. CPCB & SPCB similar to water pollution board
5. Section 20 provides for emission std to auto mobile

6. Section 19 provides for SG to declare „air pollution control area" in consultation with SPCB
7. Direction of PCB can be appealed in the appellate authority.

### **Water (prevention and control of pollution) Act 1974:**

Maintaining and restoring the wholesomeness of water by preventing and controlling its pollution. The salient features and provisions of Act are summed as follows.

1. Maintenance and Restoration of Quality – surface and ground water
2. Establishment of central PCB and state PCB
3. Confers powers and functions to CPCB and SPCB
4. The act provides for funds, budgets, accounts and audits of the CPCB & SPCB
5. The act provides penalties for the defaulters and duties and powers

### **Wildlife [protection] act, 1972:**

Land mark in the history of wildlife legislation.

1976 the powers are transferred from state to central government.

[I B of W L] was created in 1952 in our country which after WLA, 1972, took up the task of setting National parks and sanctuaries.

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### **Wildlife [protection] Act**

- 1 Defines wild life related terminology.
- 2 Provide appointments of advisory Board, wildlife warden, their powers & duties etc.
- 3 Prohibition of hunting of endangered species [was first] mentioned.
- 4 List of endangered species is provided.
- 5 Guides central 200 authorities.
- 6 Provides grants for setting up of national parks, wild life sanctuaries

etc. 7 The Act imposes ban on trade & commerce of scheduled animals.

8 Provides legal powers to officers to punish the offenders.

9 Provide captive breeding programme for endangered species.

Many conservation projects for endangered species were started under this act. Lion 1972;

Tigers 1973

Crocodile [1974];

Deer 1981.

### **Forest (conservation) Act, 1980**

It deals with conservation of forest and includes reserve forest, protected forest and any forest land irrespective of ownership.

Salient features

1. State government can use forest only forestry purpose.
2. Provision for conservation of all types of forests. Advisory committee appointed for funding conservation
3. Illegal non-forest activity within a forest area can be immediately stopped under this act. Non forest activity means clearing land for cash-crop agriculture, mining etc.

However construction in forest for wild life or forest management is exempted from non forestry activity.

1992 Amendment:

1. This amendment allows transmission lines, seismic surveys, exploration drilling and hydro electric project in forest area without cutting trees or with limited cutting of trees – prior approval CG to be sought.

- 
2. Wild life sanctuaries, National parks etc. are prohibited from exploration except with CG prior approval.
  3. Cultivation of coffee, rubber, tea (cash crop), fruit bearing trees, oil yielding trees, trees of medicinal values are also prohibited in reserved forest area with out prior approval from CG. Has this may create imbalance to ecology of the forest.
  4. Tusser (a type of silk yielding insect) cultivation in forest area is allowed since it discourages monoculture practices in forests and improves biodiversity.
  5. Plantation of mulberry for rearing silk worm is prohibited.
  6. Proposal sent to CG for non-forestry activity must have a cost benefit analysis and environmental impact statement (EIS).

### **Environmental Legislation**

1972 June 5<sup>th</sup> – Environment was first discussed as an agenda in UN conference on Human Environment. There after every year 5<sup>th</sup> June is celebrated as Environment Day.

Constitutional Provisions:

Added in 1976 – Article 48A – “The state shall endeavor to protect and improve the environment and to safeguard forests and wildlife of the country”

Article 51A (g): “It shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures”.

By these two articles one constitution makes environment protection and conservation as one of our fundamental duties.

### **Central and state pollution control Board:**

Central pollution control Board (CPCB):

1. Advices CG in matters – prevention and control of water pollution
2. Co ordinates SPCB and provide technical assistance and guidance



3. Training programs for prevention and control of pollution by mass media and other ways
4. Publishes statistical and technical details about pollution
5. Prepares manual for treatment and disposal of sewerage and trade effluents
6. Lays std for water quality parameters
7. plans nation-wide programs for prevention, control or abatement of pollution
8. Laboratories for analysis of water, sewage or trade effluents

State pollution control Board (SPCB):

SPCB has similar functions as SPCB and governed by CPCB

1. SPCB advises state government w.r.t. location of any industry that might pollute
2. Lays std for effluents to take samples from streams, wells or trade effluents or sewage passing through an industry. Samples taken are analysed at recognized labs. If the sample is not confirming to the water quality std, then the unit is neglected
3. Every industry to obtain consent from PCB before commencing an effluent unit by applying in prescribed form with fee.

### **Enforcement of environmental legislation – major issues**

1. Target of 33% of land to be covered by forest not achieved
2. Rivers turning to open sewers
3. Big towns and cities polluted
4. Wild life endangered
5. EFP (Effluent Treatment Plant) or Air Pollution Control devices are expensive – leads to closure of units. Government should provide subsidy for small units.
6. Pollution control laws not backed up by policy pronouncements or guidelines
7. Chairman of PCB – political nominee. Hence political interference.
8. Involving public in decision making envisaged by policy statement of the ministry of

environment and forest (1992) is only in paper.

Draw backs of wild life (protection) act

- Fall out of Stockholm conference not localized
- Ownership certificate of animals article – illegal trading
- Trade through J & K. This act not applicable to J&K
- Offender to get just 3 years imprisonment and or Rs.25000/- fine.

Draw backs of the forest (conservation) act 1980

- Inheritance of exploitative and consumerist elements of the British period
- Tribal people (i.e.) inhabitants of forest are left by the act
- Instead of attracting public support (tribal) it has intrigued in the human rights.
- Protection of trees, birds and animals have marginalized poor people.

# Unit -5

## HUMAN POPULATION AND THE ENVIRONMENT

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### EVS LECTURE NOTES for III and V sem 2015-16

#### POPULATION

It is defined as a group of individuals belonging to the same species, which live in a given area at a given time.

#### Population Density

It is expressed as the number of individuals of the population per unit area (or) per unit volume. This varies in response to changes in the environment and introduction with other living organisms.

#### Parameters affecting population size

Changes in population are governed by 4 main parameters. They are

1. **Birth rate (or) Natality:** It is the number of live birth per 1000 people in a population in a given year.
2. **Death rate (or) Mortality:** It is the number of deaths per 1000 people in a population in a given year.
3. **Immigration:** It denotes the arrival of individuals from neighbouring population.
4. **Emigration:** It denotes the dispersal of individuals from the original population to new areas.

#### POPULATION GROWTH

The rapid growth of the global's population for the past 100 years results from the differences between the rate of birth and death. In 1980, the global population was about 1 billion people. It took about 130 years (in 1930) to reach 2 billion. But the population reached in 4 billion within 45 years (in 1975). Now we have already crossed 6 billion and may have to reach about 10 billion by 2050 as per the World Bank calculations.

#### Causes of rapid population growth

1. The rapid population growth is due to decrease in death rate and increase in birth rate.
2. The availability of antibiotics, clean water and air decreases the famine-related deaths and infant mortality.
3. In agricultural based countries childrens are required to help parents in the fields that is why population increased in the developing countries.

### Characteristics of Population Growth

1. **Exponential growth:** Now 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.
2. **Doubling Time:** It is the time required for a population to double its size at a constant annual rate. It is calculated as follows.  

$$T_d (\text{Doubling time}) = 70/r$$
 Where  $r$  = annual growth rate  
 (OR)  
 It is the number of years needed for a population to double its size  
 If the nation has 2% annual growth its population will double in next 35 years.  
 The doubling time for India is about 28 years.
3. **Infant mortality rate:** It is the percentage of infants died out of those born in one year. Eventhough this rate has decreased in the last 50 years, the pattern differs widely in developing and developed countries.
4. **Total fertility rates(TFR):** It is the average number of children delivered by a women in her life time. The TFR value varies from 2 in developed countries to 4.7 in developing countries.
5. **Replacement level:** Two parents bearing two children will be replaced by their off spring. Due to infant mortality this replacement level is changed. But, due to high infant mortality the replacemnt level is generally high in developing countries.
6. **Male-Female ration:** The ratio of girls and boys should be fairly balanced in a society to flourish. But the ratio has been upset in many countries including China and India. In China the ratio of girls and boys is 100:140.
7. **Demographic transition:** Population growth is generally related to economic development. The death rates and birth rates fall due to improved living conditions. This results in low population growth This phenomenon is referred to as demographic transition.

### Problems (environmental issues) of population growth

1. Increasing demands for food and natural resources.
2. Inadequate housing and health services.
3. Loss of agricultural lands.
4. Unemployment and socio-political unrest.
5. Environmental pollution

### VARIATION OF POPULATION AMONG NATIONS

Different regions of the world find themselves at different stages of demographic transition from high to low mortality and fertility. Their growth path also differ considerably, resulting in significant shifts in the geographical distribution of world population.

At present the world's population has crossed 6 billions. This existing population is also not evenly distributed, less developed countries have 80% population while the developed countries have only 20%.

Less developed countries (Africa, Asia, South America) have 80% of the total world population and occupy less than 20% of the total land area.

In the most developed countries like U.S.A., Canada, Australia, the population increases at the rate of less than 1% per year. But in less developed countries like South America, Africa and Asia, the population increases at the rate greater than 1% per year.

Kenya is the fastest population growing country in the world where 20 million people are residing. If the current rate of increase continues, the population would double by 2005.

China and India's population was above 1000 million in 2000 year. Its share is about one-third of the world's population.

Europe and North America accounts for 14% of world's population.

### **Variation of Population based on Age structure.**

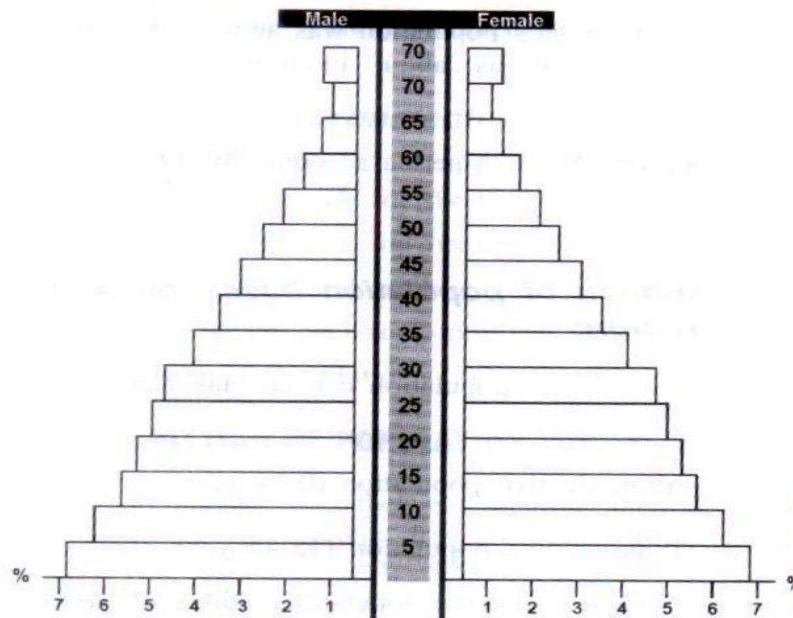
Age structure of population can be classified into three classes.

- (i) Pre-productive population (0-14 years).
- (ii) Reproductive population (15-44 years)
- (iii) Post reproductive population (above 45 years)

**Variation of population is now explained based on the above three classes.**

#### **1. Pyramid shaped variation of population (Increase)**

**Example:** India, Bangladesh, Ethiopia, Nigeria etc.,

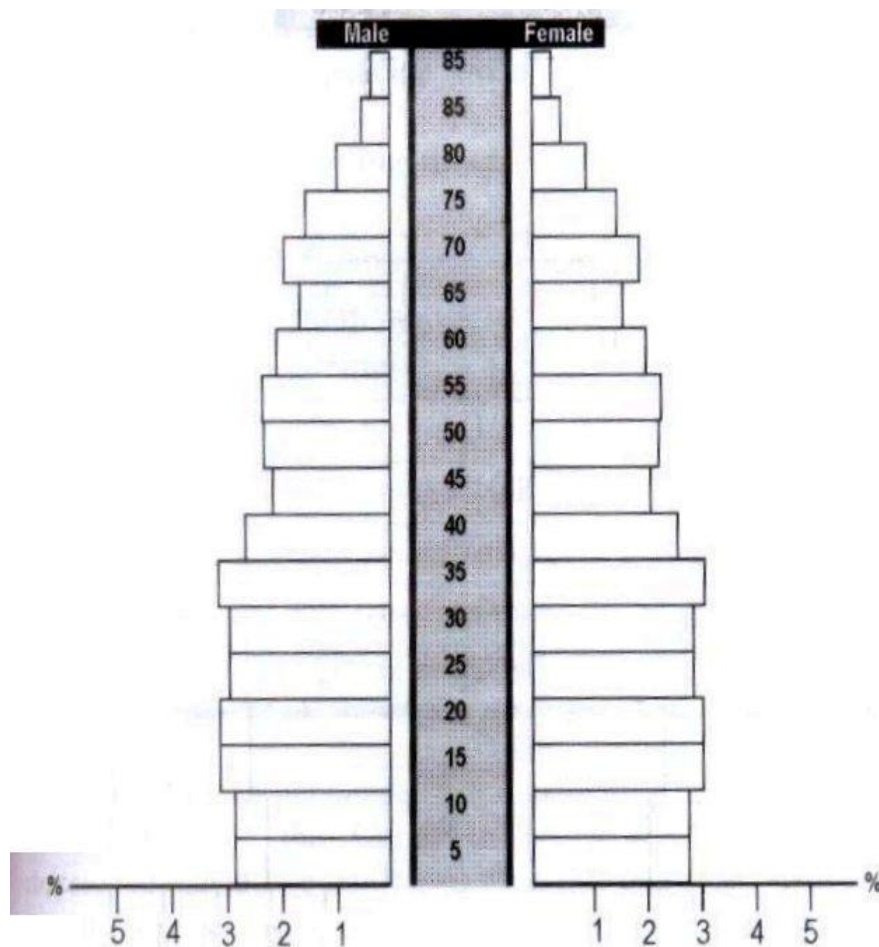


**Fig. 7.2 Pyramid shaped variation of population**

The fig7.2 shows that the pre-productive age group population (0-14 years) is more, indicated at the base of pyramid and post reproductive age group population (above 45 years) is less, indicated at the top of pyramid. The large number of young age people will soon enter into reproductive age group population (15-44 years), which **increases the population growth**. But the less number of old age people indicates less loss of population due to death.

## 2. Bell shaped variation of population (Stable)

**Example:** France, U.S.A., U.K. Canada etc.,



**Fig. 7.3 Bell shaped variation of population**

The fig 7.3 shows that the pre-productive age group population (0-14 years) and reproductive age group population (15-44 years) are more or less equal. So, the people entering into the reproductive age group will not change the population and thus the population growth is stable.

### 3. Urn Shaped Variation of Population (decrease)

Examples: Germany, Italy, Sweden, Japan etc.,

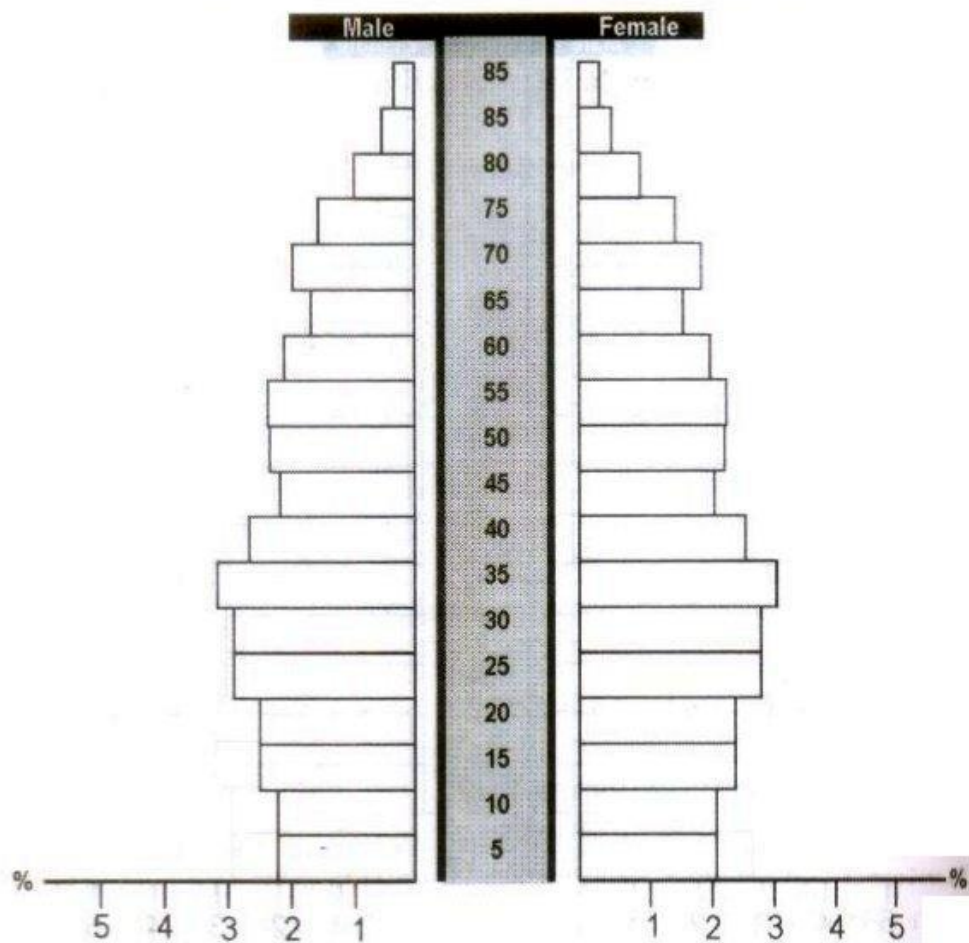


Fig. 7.4 Urn shaped variation of population

The fig 7.4 shows that the pre-productive age group population (0-14 years) is smaller than the reproductive age group population (15-44 years). In the next 10 years, the number of people in the reproductive age group is less than the before, resulting in a **decrease of population growth**.

### POPULATION EXPLOSION

#### Definition:

The enormous increase in population due to low death rate (mortality) and high birth rate (Natality), is termed as **population explosion**. The human population is not increasing at a uniform rate in all parts of the world.

#### Doubling Time

Population explosion can be better understood by considering the doubling time, i.e., the **number of years needed for a population to double in size**. The table below shows the doubling times of population growth.

**Table: 7.1 Doubling times of population growth**

<b>Less developed Country</b>		<b>Developed Country</b>	
<b>Country</b>	<b>Doubling Time</b>	<b>Country</b>	<b>Doubling Time</b>
India	28 yrs	United State	87 yrs
Turkey	28 yrs	U.K.	231 yrs
Nigeria	27 yrs	Italy	99 yrs
Saudi Arabia	25 yrs	France	117 yrs
Pakistan	21 yrs	Japan	58 yrs

The human population is not increasing at a uniform rate in all parts of the world. In many non-industrial, poor developed called **less developed countries** like Asia, Africa and South America shows higher growth rate. In contrast the population of industrialized **developed countries** like U.S. A. U.K., France, Italy, Soviet Union the growth rate is low.

#### **Causes (or) reasons of population explosion**

1. Invention of modern medical facilities reduces the death rate (mortality) and increases the birth rate (Natality), which leads to population explosion.
2. Increase of life expectancy is another important reason for the population explosion.  
**Example:** In 1950, the average life expectancy of the human being was 40 years. But now it is 61 years.
3. Illiteracy is one of the reasons for the population explosion.

#### **Effect of population Explosion**

##### **(or) Environmental and Social impacts of growing population.**

##### **1. Poverty:**

Infant mortality is one of the most tragic indicators of poverty. There are still 34 developing countries where more than 1 in 10 children die before he (or) she reaches the age of five. In developing countries few mothers opt for smaller families in the face of such high infant mortality rates. Efforts to keep children alive and healthy are one of the keys to reduce population growth rate.

2. Population explosion leads to environmental degradation.
3. Population explosion causes over exploitation of natural resources. Therefore there will be a shortage of resources for the future generation
4. Many of the renewable resources like forests, grasslands, are also under threat.
5. The increase in population will increase disease, economic inequity and communal war.
6. Over crowding of cities leads to development of slums.
7. Lack of basic amenities like water supply and sanitation, education, health etc.
8. Unemployment and low living standard of people.



**Remedy**

We should immediately reduce the fertility rate through birth control programs.

**Family Welfare Programme**

Family Welfare Programme was implemented by the Government of India as a voluntary programme. It is an integral part of overall national policy of growth covering human health, maternity, family welfare, child care and women's right.

**Objectives of Family Welfare programme**

1. Slowing down the population explosion by reducing the fertility
2. Pressure on the environment due to over exploitation of natural resources is reduced.

**Population stabilization ratio**

The ratio is derived by dividing crude birth rate by crude death rate.

**Developed countries:** The stabilization ratio of the developed countries is 1, which is more or less stabilized indicating zero population growth.

**Developing Countries:** The stabilization ratio of the developing countries is nearing 3, which is expected to lower down by 2025.

Stabilisation in developing countries is possible only through various family welfare programmes.

**FAMILY PLANNING PROGRAMME**

Family planning provides educational and clinical services that help couples to choose how many children to have? And when to have them? Such program vary from culture to culture, but it provides information on birth spacing, birth control and health care for pregnant women and infants. It also has reduced the number of legal and illegal abortion per year and decreased the risk of death from pregnancy.

**Objectives of Family Planning Programmes**

(OR)

**Factors influencing family size.**

1. Reduce infant mortality rate to below 30 per 1000 infants.
2. Achieve 100% registration of birth, deaths, marriage and pregnancy.
3. Encourage late marriages and later child-bearing.
4. Encouraging breast feeding.
5. Enables to improve women's health, education, employment.
6. Making family planning available to all women, also wanted to choose the number of children and the spacing of births.
7. Constraint the spread of AID / HIV.
8. Prevent and control of communicable diseases.
9. Promote vigorously the small family norms.
10. Making school education upto age 14 free and compulsory.

## **Fertility control methods**

### **(or) Methods of family planning (Sterilization)**

#### **1. Traditional method**

It includes some traditions like taboos and folk medicine

#### **2. Modern Method**

- (i) **Permanent method:** Permanent method (or) sterilization is done by 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 disturb any functions in the woman's life.
  - (c) **Oral contraceptive pills** and injectable drugs are available that prevent sperms from fertilizing the ovum.

## **Family planning Programme in India**

1. In 1952, India started the family planning programme.
2. In 1970's Indian Government forced family planning programme.
3. In 1978, the government legally raised the minimum age of marriage for men from 18 to 21 years and for women 15 to 18 years.
4. In 1981, census report showed that there was no drop in population. Since then funding for family planning programmes has been increased further.

## **ENVIRONMENT AND HUMAN HEALTH**

Human health and environment are two inseparable entities. If one get disturbed other will be automatically disturbed. A person is not suffering from any disease is called a healthy person. But the factors like nutritional, biological, chemical or psychological which causes harmful changes to the body conditions are called disease

### **Factors Influencing human health**

Human health is influenced by

1. Nutritional factors
2. Biological factors
3. Chemical factors
4. Psychological factors

### **Environmental degradation due to population explosion**

It is caused by dramatic increase in the world population and population densities in different parts of the world. 15% of the world's population controls 85% of the natural resources. This leads to more exploitation of natural resources. People living in urban areas

produce little food but consume more natural resources and generate more wastes, polluting the environment. Earth surface and the surrounding environment is very important to human health. The environment is polluted due to man-made activities, millions of people die every year due to illness caused by environment pollution.

### **Important Hazards and their Health effects**

#### **(OR) Deterioration of environment and Health effect**

#### **Physical hazards and their health effects**

<b>S.No:</b>	<b>Physical hazards</b>	<b>Health effects</b>
1	Radioactive radiations	i) Affects the cells in the body and the function of glands and organs ii) Suffer from cancer
2	UV radiation	Skin cancer
3	Global warming	Temperature increases cause famine, mortality
4	Noise	Painful and irreparable damage to human ear

#### **Chemical hazards and health effects**

<b>S.No</b> <b>:</b>	<b>chemical hazards</b>	<b>Health effects</b>
1	Combustion of fossil fuels: Liberates SO <sub>2</sub> , NO <sub>2</sub> , CO <sub>2</sub> and particulate matters	Asthma, bronchitis and other lung disorders
2	Industrial effluents (toxic)	Kill cells and cause cancer and death
3	Pesticides like DDT and chlorinated pesticides	Affect the food chain
4	Heavy metals like Hg, Cd, Pb, fluoride, nitrate	Contaminate water, cause ill effects
5	Chloro fluorocarbons	Damage O <sub>3</sub> layer, allows more UV rays, cause skin cancer

#### **Biological hazards**

<b>S.No:</b>	<b>Biological hazards</b>	<b>Health effects</b>
1	Bacteria, viruses and parasites	Diarrohea, malaria, parasitic worms, anaemia, respiratory diseases, cholera

#### **Preventive measures**

1. Always wash your hands before eating
2. Cut short and clean your nails
3. Maintaining the skin, tooth, hair of our body

4. Drinking chemically treated and filtered water
5. Before cooking wash the raw vegetables and fruits with clean water
6. Try to avoid plastic containers and aluminium vessels
7. Do physical exercise to have proper blood circulation in the body.

### **NIMBY Syndrome**

**NIMBY** means Not In My Back Yard, which describes the opposition of residents to the nearby location of something they consider undesirable even if it is clearly a benefit for many.

**Example:** An incinerator, an ethanol plant, a nuclear power plant, a prison.

An airport is a typical example of a NIMBY complex. It benefits a city economically, but no-one wants it near them because of the noise pollution and traffic it generates.

### **HUMAN RIGHTS**

**Human rights are the fundamental rights which are possessed by all human beings irrespective of their caste, nationality, sex and language.**

These rights cannot be taken away by any legislation or any government act. As natural rights they are seen as belonging to men and women by their very nature.

India is a democratic country. The aim of our government is to ensure happiness to all the citizens with equal rights, opportunities and comforts. Every citizen must enjoy certain rights and also has certain duties towards the country.

### **Universal Declaration of Human Rights**

**Universal Declaration of Human Rights (UNDHR)** by the UN was established in 1948.

Some of the declarations of Human Rights which are globally accepted are as follows:

1. Human right to freedom
2. Human right to property
3. Human right to freedom of religion
4. Human right to culture and education
5. Human right to constitutional remedies
6. Human right to equality
7. Human right against exploitation
8. Human right to food and environment
9. Human right to good health

### **Human right to freedom**

1. Every citizen has the freedom to express his views
2. They have freedom to form unions or association
3. They have freedom to build their houses
4. They have full right to start any profession

**Human right to property:** Every human beings has the right to earn property.

**Human right to freedom of religion:** Every citizen has the freedom to choose their religion according to his wishes. All religions are equal before the law.

**Human right to culture and education:** All the citizens have equal rights both in culture and education. The minority communities like christians, muslims have their own rights to conserve the culture, language and to establish educational institutions of their own choice.

**Human right to constitutional remedies:** If a citizen is denied any of these fundamental rights, he or she can go to the court for protection. The court has the power to protect the basic rights of the citizen.

**Human right to equality:** All citizens are equal before the law. There is no any discrimination on grounds of religion, caste, sex (or) place of birth. All are given equal opportunity for employment.

**Human right against exploitation:** Children should not be employed as labours. Every citizen has the right to fight against exploitation.

**Human right to food and environment:** All human beings have the right to get sufficient healthy food, safe drinking water and healthy environment

**Human right to good health:** All human beings have the right to have very good physical and mental health.

## INDIAN CONSTITUTION

Indian constitution provides for civil, social, cultural, educational and political rights including the right to judicial enforceability.

1. **Article 14:** It provides for equality before law.
2. **Article 15:** It prohibits discrimination on the grounds of race, religion, caste,sex or place of birth.
3. **Article 16:** It provides for equal opportunity for all citizens in matters related to employment.
4. **Article 19:** It provides for freedom of speech and expression, forming associatios and unions and so on.
5. **Article 20:** It provides for protection from conviction except in accordance with the law of the land.
6. **Article 22:** It lays down the rights of a person in custody
7. **Article 23:** It prohibits traffic in human beings and all other forms of forced labour.
8. **Article 24:** It prohibits the explosion of labour children.
9. **Article 25:** It guarantees freedom t profess, practice and propagate a religion of one's choice.
10. **Article 26:** It authorize the right to establish and maintain chariatable and religious institutions.
11. **Article 27:** It prohibits compulsion for pay any tax meant for promotion of any religion etc.,
12. **Article 28:** It guarantees the secular character of instruction in educational institutions etc.,
13. **Article 29:** It guarantees to the minorities , the right to conserve their language etc.,
14. **Article 30:** It guarantees the right of linguistic minority and religions to establish and administer educational institution etc.
15. **Article 32:** It provides for right to constitutional remedies for the enforcemnt of fundamental rights by appropriate proceeding in the Supreme court of India.

Consistent with these provisions, the Central and State governments have framed a number of laws to preserve and safeguard basic human rights. Government of India has set up national institutions such as National Commission for Scheduled Castes and Scheduled Tribes. National Commission for Women, Minority Commission etc., for the promotion and protection of the interests of most vulnerable section of society.

## VALUE EDUCATION

**Education:** It is nothing but learning through which knowledge about the particular thing can be acquired. With the help of our knowledge and experience we can identify our values to understand ourselves and our relationship with others and their environment.

### Types of Education:

1. **Formal education:** All learning process in formal education are self related. All people will read, write, will get good jobs and tackle any problem only with the help of formal education.
2. **Value education:** It is an instrument used to analyze our behaviour and provide proper direction to our youths. It teaches them the distinction between right and wrong, to be compassionate, helpful, loving, generous and tolerant. So that a youth can move towards the sustainable future.

**Example:** If a person is highly qualified, well employed and rich living style, sometimes he does not know to behave properly with his environment. But, value education does this properly with his environment. But, value education does this.

3. **Value-based environmental education:** Environmental education provide knowledge about the principles of ecology, fundamentals of environment and biodiversity. It creates a sense of duty to care for the natural resources and to manage them in a sustainable way.

When environment gets degraded it affects our health, well-being and our future. So, it is important to know all about the environment and also have a right to safe and clean environment.

### Objectives (or) Importance of Value education

1. To improve the integral growth of human being.
2. To create attitudes and improvement towards sustainable lifestyle
3. To increase awareness about our national history, our cultural heritage, constitutional rights, national integration, community development and environment.
4. To create and develop awareness about the values and their significance and role.
5. To understand about our natural environment in which how land, air and water are interlinked.
6. To know about various living and non-living organisms and their interaction with environment.

### Concept of Value education

The following are the concepts of values in environmental education.

1. Why and how can we use less resources and energy?
2. Why do we need to keep our surroundings clean?
3. Why should we use less fertilizers and pesticides in farms.
4. Why it is important for us to save water and keep our water sources clean.
5. Separate our garbage into degradable and non-degradable types before disposal.

### Methods (Elements) of imparting value education

1. **Telling:** It is a process of developing values to enable a pupil to have a clear picture of a value-laden situation by means of his own narration of the situation.
2. **Modeling:** It is a method in which a certain individual perceived as ideal values is presented to the learners as a model
3. **Role playing:** Acting out the true feelings of the actor/actors by taking the role of another person but without the risk of reprisals.
4. **Problem solving:** It is a method when a dilemma is presented to the learners asking them what decisions they are going to take.
5. **Studying biographies of great man:** This method makes use of the lives of the great man as the subject matter for trying to elicit their good deeds and thoughts worthy for emulation.

### Types of Values

1. **Universal values (or) Social values:** Universal values tell us about the importance of the human condition. These values are reflected in life, joy, love, compassion, tolerance, service, truth etc..
2. **Cultural values:** It varies with respect to time and place. These values are concerned with right and wrong, good and bad, true and false and behaviour of human beings. It is reflected in language, aesthetics, education, law, economics, philosophy etc.
3. **Individual values:** Individual values are our personal principles and the result of individual personality and experiences. Parents and teachers are the main key to shape our individual values. It is reflected in individual goals, relationships, commitments etc.
4. **Global Values:** Global values stress the concept, that the human civilization is a part of the planet and similarly nature and natural phenomena over the earth are interconnected and inter-linked with special bonds of harmony. If this harmony is disturbed anywhere there will be an ecological imbalance leading to catastrophic results.
5. **Spiritual Values:** It promotes conservatism and transform our consumeristic approach. It is reflected in self-restraint, self-discipline, contentment, reduction of wants.etc.

## **HIV/AIDS**

**AIDS** is the abbreviated form for **Acquired Immune Deficiency Syndrome** caused by a virus called **HIV ( Human Immune deficiency Virus)**. Many myths have been spread about AIDS and it is very important for every one to know the facts about

### **HIV and AIDS.**

#### **Origin of HIV / AIDS**

AIDS was discovered in 1983. Through sufficient knowledge has been gained about the disease, yet a definite source of this virus could not be identified. But the following theories have been suggested.

##### **1. Through African Monkey:**

Most of the evidence have been suggested that the AIDS has spread from Africa. It has been believed that the HIV has transferred to human from African monkey (or) Chimpanzees.

##### **2. Through Vaccine Programmes**

- (i) HIV has spread in Africa through HIV contaminated polio vaccine prepared from monkey's kidney.
- (ii) It had spread through hepatitis-B viral vaccine in Los Angels and New York.
- (iii) It had 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 in Africa, almost all states of African countries were affected by HIV. About 3 million people so far died due to HIV/AIDS in 2003. AIDS is rapidly spreading in eastern Europe and Asia.

India ranks 2<sup>nd</sup> in the world with 5.1 million HIV/AIDS affected people. The percentage is lower than Thailand, Myanmar and South Africs.

### **Scenario in India:**

The largest number of infected cases have been found in Maharashtra and TamilNadu, followed by Delhi, U.P., Karnataka and Goa. In TamilNadu alone, till September 2003 a total of 24,667 cases of AIDs have been found out.

## **Factors influencing modes of Transmission of HIV**

HIV is spreading due to the following activities.

1. HIV from infected person can pass to anormal person through blood contact, generally during unprotected sex with infected person.
2. Using needles or syringes contaminated with small quantities of blood from HIV positive person also transmit HIV to others.
3. HIV can also pass from infected mothers to their babies during pregnancy delivery or breast feeding.
4. Blood transfusion from the infected person at the time of accidents or pregnancy also result in HIV/AIDS
5. HIV is 2 to 4 times more efficient than female to male transmission.
6. Women around 18-20 years are at more risk, since their cervical tissue is more vulnerable to invading HIV



7. Since, the majority of HIV infections occur in women of child-bearing age, transmission of HIV to their new born babies happen easily.

### **Factors Not influencing transmission of HIV**

HIV is not spreading by the following activities

Tears, food and air, cough, handshake, mosquito, flies, insect bites, urine, saliva during normal kissing, sharing of utensils, clothes toilet, bathroom etc.,

### **Functions of HIV in Human Body**

AIDS itself does not kill humans. The death occur due to the attack by diseases because of the weakening of immune system.

White Blood Cell (WBC) responsible in the formation of antibodies are called **T-helper cells**, T-helper cells are the key infection fighters in the immune system. The HIV enter into the human body and destroys the T-cells as a result of which various types of infection diseases occur. Even cancer can easily develop in the HIV infected persons.

### **Symptoms (or) Diagnosis of HIV/AIDS**

Many people have no symptoms when they are first infected with HIV. But some people get fever, headache, fatigue. During this time, HIV is present in large amounts in semen and vaginal fluids and it is very easy to pass the infection to another person.

HIV is very active inside a person's body. The virus multiplies and kills more and more T-cells of the immune systems.

Consumption of alcohol increases, the susceptibility to infection and progress of AIDS.

### **Minor Symptoms**

1. Persistent cough for more than one month.
2. General skin disease
3. Viral Infection
4. Fungus infection in mouth and throat
5. Frequent fever, headache, fatigue.

### **Major Symptoms**

1. Fever , Diarrhea for more than one month
2. Cough and TB for more than 6 months
3. Fall of hairs from the head
4. 10% body weight get reduced within a short period

### **Control and Preventive measures of AIDS**

Once a person is infected with HIV the person remain infected for life. There is neither cure nor a vaccine but can be prevented. "Prevention is better than cure" is a slogan for all of us.

### **The basic approaches to control AIDS are**

1. **Education:** Health education enables people to avoid indiscriminate sex and encourages the use of condoms. One should avoid the use of sharing razors, needles and syringes.

2. **Prevention of Blood borne HIV Transmission:** People in high risk groups should not donate blood. Blood should be screened for HIV before transmission and strict sterilization practices should be followed in hospitals.
3. **Primary Health Care:** AIDS awareness programmes should be encouraged. Voluntary health agencies should participate in large. Training programmes to doctors and paramedical workers should be conducted.
4. **Counselling Services:** Counselling services should be provided either in person or through telephone.
5. **Drug Treatment:** Testing HIV positive does not mean the end. They can still stay healthy leading productive lives for many years. Seeking early medical care and staying active are very vital in managing HIV. The immune system has to be kept boosted by taking nutritious diet and maintaining a stress-free mind.

#### **Effects of HIV/AIDS**

1. Large number of death occurs which affect environment and natural resources.
2. Due to large number of deaths, there is loss of labour and level of production decreases.
3. More water is required for maintaining hygiene in AIDS affected locality.
4. The people affected by HIV cannot perform work well due to lack of energy and frequent fever and sweating.

#### **WOMEN 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 for women welfare**

Generally women faces the following problems in the society.

1. Generally women suffer gender discrimination and devaluation at home, at workplace, in matrimony, in public life and power.
2. High number of cases of dowry deaths, rape, domestic violence, criminal offences and mental torture to women.
3. The human rights of women are violated in the male dominated society.
4. Generally in policy making and decision making process women are neglected.

#### **Objectives of Women welfare**

**(OR)**

#### **Necessity of formation of women self help group**

To overcome the above problems, a sound national strategy is needed with the following objectives.

1. To provide education
2. To impart vocational training
3. To generate awareness of the environment
4. To improve the employment opportunities
5. To know the problems of population
6. To restore the dignity, status, equality and respect for women.

### **Objectives of a National Commission for Women created by Government of India**

A National commission for Women has been created by Government of India, its main objectives are:

1. To examine constitutional and legal rights for women
2. To review existing legislations
3. To sensitize the enforcement and administrative machinery to women's causes.

### **Environmental Degradation and Women welfare**

The development work not only affects the natural environment but also affects the traditional, social, cultural and family life of women.

**Example1:** For various developmental activities like construction of dams , losing the forest cover, men generally migrate to towns for some job while the women are left h migrate to towns for some job while the women are left behind to look after their family with little resources.

**Example 2:** Mining projects play havoc with the life of rural women. Men can still work in the mines or migrate to towns for same job after getting compensation from the government. The displaced women are the worst affected as they do not get any compensation and depend on the men for wages.

Thus, the issues related to their dignity and honour h havoc with the life of rural women.

Men can still work in the mines or migrate to towns for same job after getting compensation from the government. The displaced women are the worst affected as they do not get any compensation and depend on the men for wages.

Thus, the issues related to their dignity and honour have not yet received any attention.

### **Measures (or) Various schemes of various Organizations towards Women Welfare**

1. **The National Network for women And Mining. (NNWM):** It is fighting for a "gender audit" of India's mining companies.
2. **Unitd Nations Decade for Women:** It witnessed inclusion of several women welfare related issues on international agenda.
3. **International Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW):** It has created an international standard for the protection and promotion of women's human and socio-economic upliftment.
4. **Non-Government Organizations (NGO's) as Mahila Mandals:** It creates awareness among women of remote villages to empower them, train them, educate them and help them to become economically self-dependent.
5. **Ministry for Women And Child Development:** It aims to work for the upliftment of women by family planning, health care, education and 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, pottery industry

### **Reason for Child Labour**

1. **Poverty:** It is the main reason to force these children to work in unhealthy conditions.
2. **Want of Money:** Parents require money for their family so they are in a position to send their children for work.

### **Measures (or) Various schemes of various Organizations towards Child welfare**

1. **UN convention on Rights of Child (or) International Law:** It formulated a set of international standards and measures to promote and protect the well being of children in our society.

**Rights of the Child:** The international law defines right of the child to Survival, participation, development and protection.

- (a) **The right to survival:** It emphasizes on good standards of living, good standards of living, good nutrition and health.
  - (b) **The right to participation:** It means freedom of thought and appropriate information to the child.
  - (c) **The right to development:** It ensures access to education, childhood care and support, social security and recreation.
  - (d) **The right to protection:** It means freedom from exploitation, inhuman treatment and neglect.
1. **World summit on children:** It had focused agenda for the well being of the children targeted to be achieved in the beginning of the new millennium.
  2. **Ministry of Human Resource Development (MHRD):** It concentrates on child's health, education, nutrition, clean and safe drinking water, sanitation and environment.

**Environmental degradation and child welfare:** Children are most affected due to environmental pollution

Water borne diseases are the biggest threat to children. Around 6 million children are affected by these disease in India. Even the child growing in the mother's womb get affected by environmental toxins.

**Centre for Science and Environment (CSE):** Its scientific report says "children consume more water, food and air than adults and hence, more susceptible to any environmental contamination".

So, it s essential to keep the cleaner environment to our children for the better and healthy life.

### **ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

**EIA** is defined as a formal process of predicting the environmental consequences of any development projects. It is used to identify the environmental, social and economic impacts of the project prior to decision making.

**Objectives of EIA**

1. To identify the main issues and problems of the parties.
2. To identify who is the party.
3. To identify what are the problems of the parties.
4. To identify why are the problems arise.

**Benefits of EIA**

1. Cost and time of the project is reduced.
2. Performance of the project is improved.
3. Waste treatment and cleaning expenses are minimised.
4. Usages of resources are decreased.
5. Biodiversity is maintained.
6. Human health is improved.

**The key elements used in the process of EIA are**

1. Scoping
  2. Screening
  3. Identifying and evaluating alternatives
  4. Mitigating measures dealing with uncertainty
  5. Issuing environmental statements
1. **Scoping:** It is used to identify the key issues of the concern in the planning process at an early stage. It is also used to aid site selection and identify any possible alternatives.
  2. **Screening:** It is used to decide whether an EIA is required or not based on the information collected.
  3. **Identifying and evaluating alternatives:** It involves knowing alternative sites and alternative techniques and their impacts.
  4. **Mitigating measures dealing with uncertainty:** It reviews the action taken to prevent (or) minimize the adverse effects of a project.
  5. **Environmental statements:** This is the final stage of the EIA process. It reports the findings of the EIA.

**ROLE OF INFORMATION TECHNOLOGY IN ENVIRONMENT**

Information technology means collection, processing, storage and dissemination of information. A number of software have been developed to study about the environment.

The internet facilities, information through satellites, world wide web and Geographical information systems provide us up-to-date information on various aspects of environment and weather.

**Softwares for environment education**

1. Remote Sensing is used to gather information about an object without actually coming in contact with it. Any force field like accoustic, gravity, magnetic, electromagnetic etc could be used for remote sensing from laboratory to astronomy. At present the term "remote sensing is used more commonly to denote identifications of earth feature by detecting the

characteristics electromagnetic radiation that is reflected/emitted by the earth. Remote sensing data images have been used to derive thematic information on various natural resources and environment. The type and level of information extracted depends on the expertise of the analyst and what he is looking in the data.

**Example:**

The remote sensing image of land can be used to derive information of vegetation cover, water sources, land use, pattern, geological features, soil etc.,

**Application of remote sensing**

1. **In agriculture:** In India sector sustains the livelihood of around 70% of the population and contributes to about 35% of the net national product. We require judicious and optimal management of both land and water resources along with the use of high yielding variety seeds, optimal fertilizer input, post-harvest etc. Remote sensing can provide valuable information for land and water management.
2. **In forestry:** Sustainable forest management requires reliable information on the type, density and extent of forest cover, wood volume and biomass, forest fire, pest and disease induced losses, encroachment etc., Remote sensing provides all such information clearly.
3. **In Land cover:** Spatial information on land use is required at different scales depending upon the use. Remote sensing data is converted to map, the spatial resolution plays a role in the scale of mapping.
4. **Water resources:** Remote sensing data has been used in many applications related to water resources such as surface water body mapping, ground water targeting, wetland, inventory, flood monitoring, reservoir sedimentation, water quality monitoring, runoff modeling, Snowcover monitoring, irrigation water management and many more.

**2. Database**

It is the collection of inter-related data on various subjects. In the computer the information of data base is arranged in a systematic manner that is easily manageable and can be very quickly retrieved.

**Applications of database**

**(a) The Ministry of Environment and Forest**

- (i) They are compiling a database on various biotic communities.
- (ii) Database is also available for diseases like HIV/AIDS, Malaria, Fluorosis etc.,

**(b) National Management Information System (NMIS)**

They compiled a database on R & D projects along with information about research scientists and personnel involved.

**© Environmental Information System (ENVIS)**

It functions in 25 centres all over the country. They generate a network of database in areas like pollution control, clean technologies, remote sensing, biodiversity, environmental management, desertification etc.,

### 3. Geographical Information System (GIS)

“GIS is a technique of superimposing various thematic maps using digital data on a large number of inter-related aspects.”

#### Application of GIS

1. Different thematic maps containing digital information on various aspects like water resources, soil type, forest land, cropland, grassland are superimposed on a layered form in computer using softwares.
2. Interpretation of polluted zone, degraded lands can be made based on GIS.
3. GIS can be used to check unplanned growth and related environmental problems.

### 4. Satellite Data

1. Satellite data helps in providing correct and reliable information about forest-cover.
2. It also provides information of atmospheric phenomena like monsoon, ozone layer depletion, smog, etc.,
3. From the satellite data many new reserves of oil, minerals can be discovered.

### 5. World wide web

More current data is available on world wide web.

#### Important on-line learning Centre

1. [www.mhhe.com/](http://www.mhhe.com/) environmental science.
2. Multimedia Digital Content Manager (DCM) in the form of CD-ROM.

#### Applications

1. These on-line learning centre provides the current and relevant information on principles, problems, queries, application of environmental science.
2. It has digital files of photos, power-point lecture presentation, animations, web-exercises and quiz. These are useful to both students and teachers of environmental studies.

## ROLE OF INFORMATION TECHNOLOGY IN HUMAN HEALTH PROTECTION

### Introduction

Information Technology plays a key role in human health. It has changed the human life style completely. Many health organizations are turning to package solution of IT for streamlining service oriented work in an effective manner.

The health service technology mainly involves three systems. They are:

1. Finance and accounting
2. Pathology
3. Patient administration: Clinical system

#### Applications of IT in health services.

1. With the help of IT packages, the data regarding birth and death rates, immunisation and sanitation programme are maintained more accurately.
2. It helps the doctor to monitor the health of the people effectively.
3. The information regarding the out break of epidemic diseases can be conveyed easily.

4. On-line help of exper doctors can be consulted to provide better treatment and services to the patient.
5. With a central control system the hospital can run effectively.
6. Drugs and its replacement can be administered efficiently.