UNIT I

Chapter - 1

Environment and Biodiversity

Syllabus

Definition, scope and importance of environment - need for public awareness. Eco-system and Energy flow - ecological succession. Types of biodiversity: genetic, species and ecosystem diversity - values of biodiversity, India as a mega-diversity nation - hot - spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man - wildlife conflicts - endangered and endemic species of India - conservation of biodiversity : In-situ and ex-situ.

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1.1 Definition, Scope and Importance of Environment

1.2 Need of Public Awareness

1.3 Ecosystems (Structure and Function)

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1.5 Energy Flow in Ecosystem

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1.8 Biodiversity

1.9 Values of Biodiversity

1.10 Hot-spots of Biodiversity

1.11 Threats to Biodiversity

1.12 Conservation of Biodiversity

1.13 Two Marks Questions with Answers

Definition, Scope and Importance of Environment

Definition, Scope and Importance of Environment

1. Definitions

Environment

• The environment is defined as, "the whole physical and biological system in which man and other organisms live". Environmental studies involves every issue that affects living organisms.

Environmental science

• Environmental science is a study that deals with the functioning of nature and interconnections between various things in the nature.

• Various interacting components of environment are biology, geology, chemistry, physics, engineering, sociology, health and economics. Positive and realistic planning is needed to balance them. Therefore, environmental science is essentially a multidisciplinary approach.

2. Scope

• Our natural landscape consists of forest, river, desert, rocks, minerals and soil. These landscapes are transformed into villages, town or cities by human beings. Even though we live in cities, the food grains are supplied from villages surrounding. It means that our daily life is linked with surrounding environment. We need water, air to survive and other day-to-day activities which are part of environment.

• Human beings are greatly depend on nature or environment. Therefore environmental resources like water, trees, minerals, food, energy, land must be preserved in their natural form.

• Now a days, because of technological advancements more foods can be grown by using fertilizers and pesticides, also construction of dams leads to environmental degradation.

• Most environmental resources like-water, minerals, petroleum products, wood etc. are being extracted continuously. Ecologists and environmental scientists have recognised that if these resources are consumed in this way it will degrade and deplete natural environment.

• A distinguishing characteristic of many environmental resources is that they are non producible : If the natural resource is exhausted, it is not possible to reproduce them in original form. If we continue to extract them, they may not be available for future generations.

3. Importance

• Environmental studies involves multidisciplinary approach. Environmental resources play a multifunctional role as they command market prices. Any scarce natural resource (rarely available) will cost more as its supply is less e.g. wood, water.

• Huge amount of nature's clean water is being polluted and wasted. Waste by products of chemical process pollute water and gases are polluting air.
• Deforestation (cutting of trees) leads to increasing environment temperature, dry rivers, unavailability of fresh air. The accumulated effect of all above factors causes unhealthy

atmosphere to human beings by giving variety of diseases.

• The misuse or waste of natural resources can be stopped by spreading awareness to preserve the nature or environment. All must contribute for safeguarding of environment and by preventing environmental damage.

• The Earth's natural resources are being exhausted rapidly and environment is degraded by human activities. We must not expect Governments alone to manage the safeguarding of the environment.

Need of Public Awareness on Environment

Need of Public Awareness

• The Earth's natural resources are being exhausted rapidly and environment is degraded by human activities. We must not expect Governments alone to manage the safeguarding of the environment.

• It is our responsibility that each of us must play an important role. One immediate thing we can do is to reduce the wastage of natural resources.

1. People in Environment

• People have always cared about the environment through their perceptions of environmental issues and their attitudes.

• The environmental movement has become concerned with all aspects of the natural environment, land, water, minerals, living organisms, life processes, the atmosphere, climate, oceans and outer space.

• The environmental movement has expanded its examination of the nature with international economic co-operation, covering issues of commodity prices, structural adjustments subsidies on products prepared from natural resources.

• Many environmentalist have contributed their views in the interest of protecting nature, wildlife, ecosystem, agriculture and environment laws. Few of them are Charles Darwin, Salim-Ali, Indira Gandhi, S.P.Godrej, Madhav Gadgil, M.C. Mehta, Medha Patkar, Sundarlal Bahuguna.

• People can participate by forming pressure groups, watch dog (observer), advisory council, reforcing environmental laws.

2. Institutions in Environment / NGOs

• Scientific groups and Non-Government Organisation (NGOs) have played a major role in the environmental movement.

• Environmental groups have a wide range of interests. Small groups are organised to fight local problems other deal with a specific issue on a national scale.

• Over the past decades, more international environmental NGOs have emerged including powerful bodies such as Friends of Earth, Greenpeace and World Wide Fund for Nature (WWF). Through environmental groups individuals can influence national and international policies.

• The media have been used as powerful instrument in public awareness of many environmental issues, but the media is usually reactive rather than innovative.

3. Environmental Education

• Environmental study and education is important in order to preserve

environment. **Scope of environmental studies**

1. Environmental studies creates awareness and sensitivity to the total environment and problems associated with it.

2. To participate actively in environment protection and improvement.

3. Developing skills to identify and solve environmental problems.

4. To know the need of conserving natural resources.

Importance of environmental studies

1. It helps to understand the concept of "need of development without destruction of environment".

2. It helps to understand different environmental hazards.

3. It helps to understand and demand for laws for protecting environment and enforcement system.

4. It helps to relate the quality of life with environment.

The multilayered gaseous envelope that surrounds the earth is called air or atmosphere.

Ecosystems (Structure and Function)

Ecosystems (Structure and Function)

• Ecology is study of interactions among organisms with their environment.

• The environment consists of both biotic components (living organisms) and abiotic components (non-living organisms).

• The terms ecosystems is combination of two words, where 'eco' implies the environment and 'system' implies an interacting, inter-dependent complex.

Definitions of Ecosystem

1. An ecosystem is a group of plants and animals along with physical environment with which it interacts.

2. An ecosystem is a community of different species interacting with one another and with their environment exchanging energy and matter.

3. An ecosystem is a community of living organisms (plants, animals and microbes) in conjunction with the non-living components of their environment (things like air, water and mineral soil), interacting as a system.

4. An ecosystem is a biological community of interacting organisms and their physical environment.

Example : Grassland ecosystem, aquatic ecosystem, dessert ecosystem

etc. **1. Scope and Importance of Ecosystem**

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2. Classification of Ecosystem

• On the basis of interference and noninterference by man, there exists two types of

ecosystem. I. Natural ecosystem. 2. Artificial ecosystem.

1. Natural ecosystem

• It operates under natural condition. There is no interference by man at all. It can be divided further on the basis of habitat.
i) Terrestrial ecosystem - Forest ecosystem, grassland ecosystem, dessert ecosystem.

ii) Aquatic ecosystem - It exists under water. It can be further divided into two types.

a) Fresh water ecosystem

- Running water (river), stream

- Standing water (lake, pond)

b) Marine ecosystem

- Salt water ecosystem.

2. Artificial / Man made ecosystem

• These ecosystems are maintained artificially by man where energy is added and manipulated through planning.

Examples : Cropland, gardens aquarium etc.

• Fig. 1.4.1 shows the ecosystem and its types.

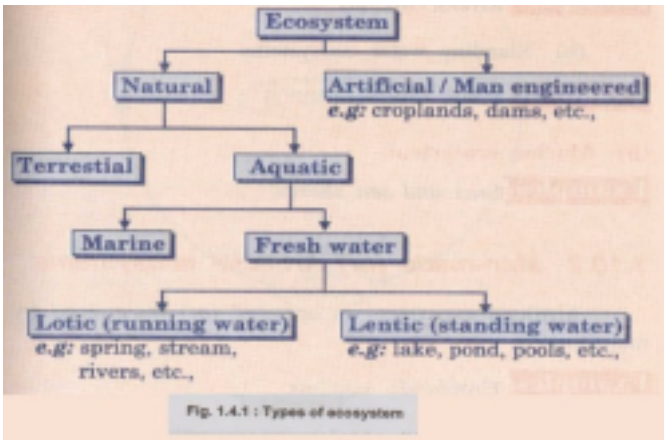

Fig. 1.4.1 : Types of ecosystem

3. Characteristics of Ecosystem

1. It is structural and functional unit of ecology.

2. Its structure is related to species diversity i.e. more complex ecosystem have high species diversity and simple ecosystem have low diversity.

3. Functions of ecosystem is related to energy flow and cycling of material involved and within ecosystem.

4. Ecosystem mature as we pass from less complex to more complex structure i.e. early stage has excess potential energy and relatively high energy flow per unit biomass than later stages. It reduces at energy stage.
5. Alterations in environment represent selective pressures upon populations to which it must adjust, those which are unable to adjust must disappear i.e. survival at fittest.

6. Environment and energy fixation in any ecosystem is limited and constant be exceeded without serious undesirable effects.

Review Question

1. Give the classification of ecosystem.

• The structure of an ecosystem indicates it's components (species diversity) and their interdependency for growth and survival.

Structure and Components of an Ecosystem

Structure and Components of an Ecosystem

• The structure of an ecosystem indicates it's components (species diversity) and their interdependency for growth and survival.

• An ecosystem has two types of components.

1. Abiotic component (non-living).

2. Biotic component (living).

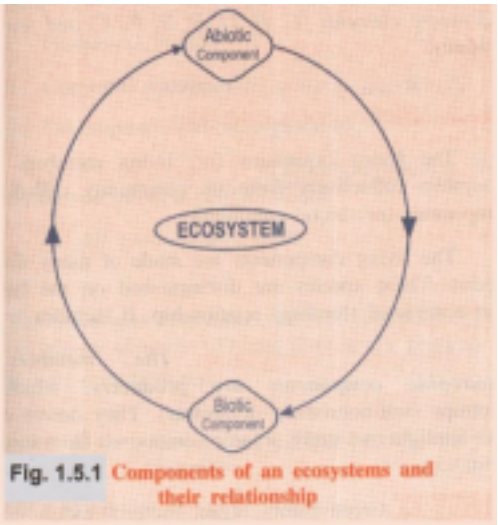

Fig. 1.5.1 Components of an ecosystems and their relationship

1. Abiotic (Non-Living) Components

• The abiotic components determine the type of organisms can live in specific area. Abiotic components can be physical components or chemical components.

1. Physical Components

• Physical components usually include sunlight, water, soil, temperature etc. These are necessary growth of species.

Examples

• Sunlight - Necessary for photosynthesis.

• Water - Essential for living things.

• Temperature - Necessary for survival.

• Soil - Provides base and nutrients.

2. Chemical Components

• Chemical components provide necessary nutrients to the organism.

Examples : Carbohydrates, proteins, liquids, nitrogen, phosphorous, potassium and oxygen. **2. Biotic Components**

• Biotic components are living organisms of the ecosystem. Biotic component includes- plants, animals, fungi, bacteria and there living organisms.

• The biotic components of an ecosystems can be categorized into three categories, these are 1. Producers or autotrophs.

2. Consumers or heterotrophs.

3. Decomposers or detrivores.

a. Producers / Autotrophs

• The producers use energy from the sun and like nitrogen and phosphorus from the soil to produce high-energy chemical compounds by the process of photosynthesis.

• The energy from the sun is stored in the molecular structure of the these compounds. Producers are often referred to as being in the first rophic (growth) level and are called autotrophs.

Example : All green plants and algae.

b. Consumers / Heterotrophs

• Consumers use the energy (food) stored by the producers. Different categories of consumers are : Herbivores, carnivores and omnivores.
• Herbivores or primary consumers are those who eat producers directly. **Examples :** Man, elephant, rabbit.

• Carnivores or secondary consumers eat primary consumers (animals). **Examples :** Tiger, lion.

• Omnivores eat both producers and animals.

Examples : Fox, frog etc.

c. Decomposers

• Decomposers are- very important in ecosystem as they are responsible for recycling of nutrients.

• Decomposers attacks on dead producers, animals and animal wastes making them simple stable compound. These compounds can then be used as nutrients by the producers.

Examples : Bacteria and fungi.

Review Questions

1. Define the terms producers, consumers, decomposers and

detrivores. 2. Explain the structure of an ecosystem.

Energy Flow in Ecosystem

The energy needed for the function of ecosystems comes from an external source, the sun. The solar energy is transformed into chemical energy by using photo-synthesis. This chemical energy is nothing but carbohydrates and oxygen.

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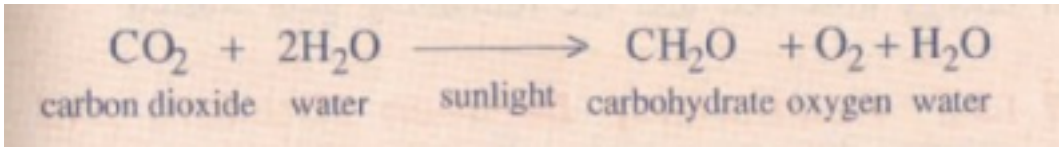
Photosynthesis equation



• A part of chemical energy is utilized by the producers (plants) for their growth and remaining energy is transferred to consumers.

• The decomposer utilizes the energy with consumer producing inorganic nutrient. This nutrient is again used by producer to produce food for consumer. Fig. 1.6.1 shows flow of energy and nutrients.

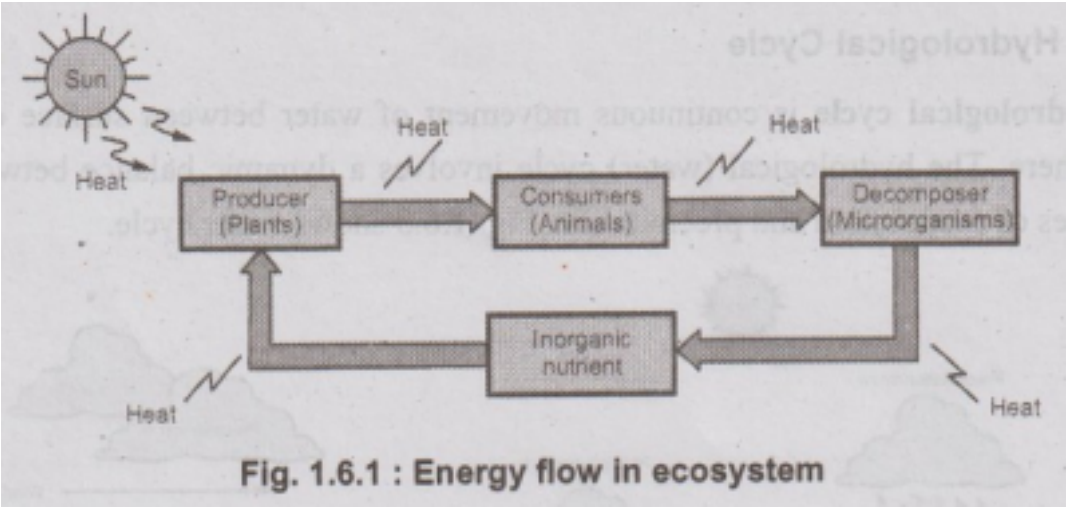


Fig. 1.6.1 : Energy flow in ecosystem

Nutrient cycle

• The producers use nutrients for preparing food and which is consumed by consumers and then decomposer recover the nutrients from consumer.

• Therefore, nutrients flow between biotic and abiotic components repeatedly, it is called as nutrient cycle or biogeochemical cycle.

1. Biogeochemical Cycle

• In an ecosystem the cycling of nutrient involves both biotic and abiotic components. The biogeochemical cycle involves

1. Hydrological cycle (Water cycle).

2. Oxygen cycle.

3. Nitrogen cycle.

4. Carbon cycle.

5. Phosphorous cycle.

2. Relationship between Structure and Function or Flow Model

• In an ecosystem the biotic components and abiotic components are linked together energy flow and nutrient cycling.

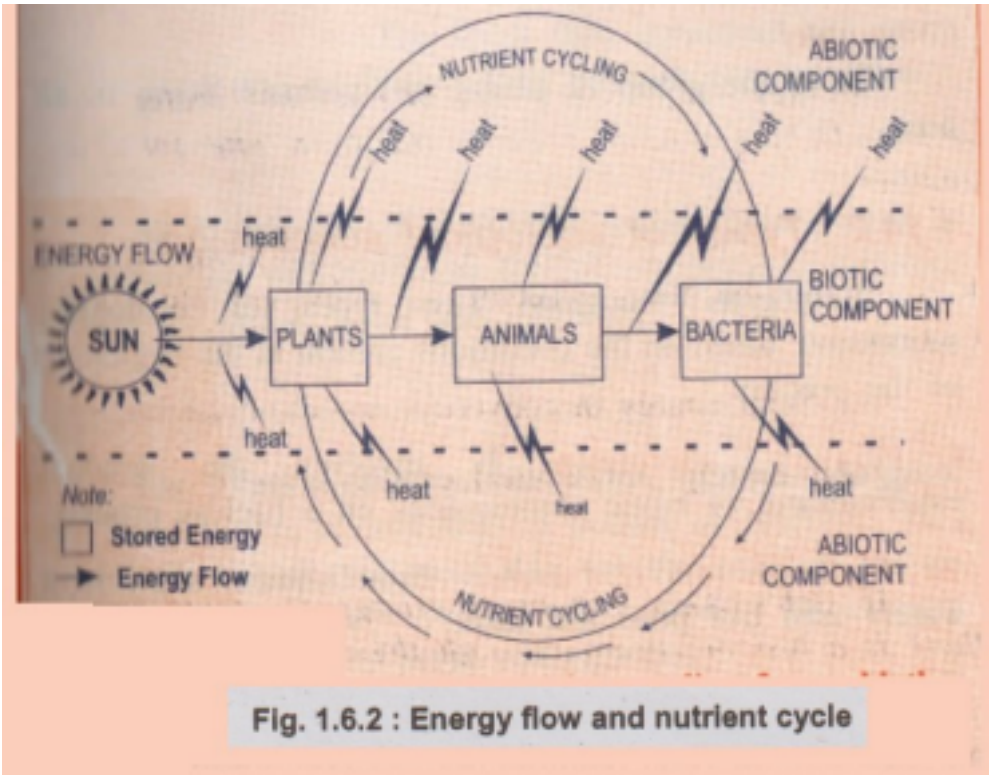


Fig. 1.6.2 : Energy flow and nutrient cycle

3. Hydrological Cycle

• The hydrological cycle is continuous movement of water between surface of earth and atmosphere. The hydrological (water) cycle involves a dynamic balance between the two processes of evaporation and precipitation. Fig. 1.6.3 shows water cycle.

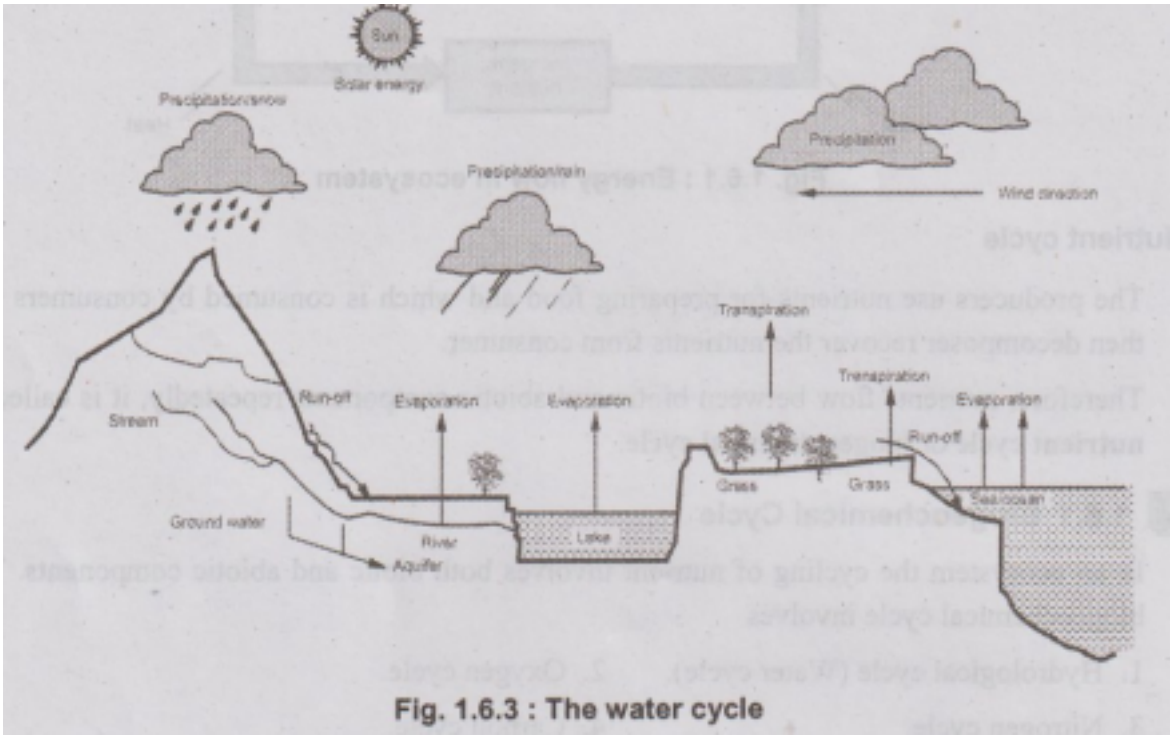


Fig. 1.6.3 : The water cycle

• Water is evaporated from the surfaces of both water bodies and land surfaces. It is also transpired from living plant cells.

• The water vapour produced is circulated throughout the atmosphere, where it is eventually precipitated as show and rain. Snow and rain are the ultimate sources of all drinkable water.

4. Carbon Cycle

• Carbon is an important element in all the biological or organic compounds. The carbon is found in all biotic components in different forms as food.

Examples : Proteins, carbohydrates, fats and amino acids. .

• In atmosphere, carbon dioxide (CO_2) is present as carbon element. The CO_2 is removed by photosynthesis process of green plants.

• The photosynthesis makes food for the plant. This food moves through food chain and finally the carbon present in dead matter is returned to atmosphere as CO_2.

Fig. 1.6.4 : Carbon cycle

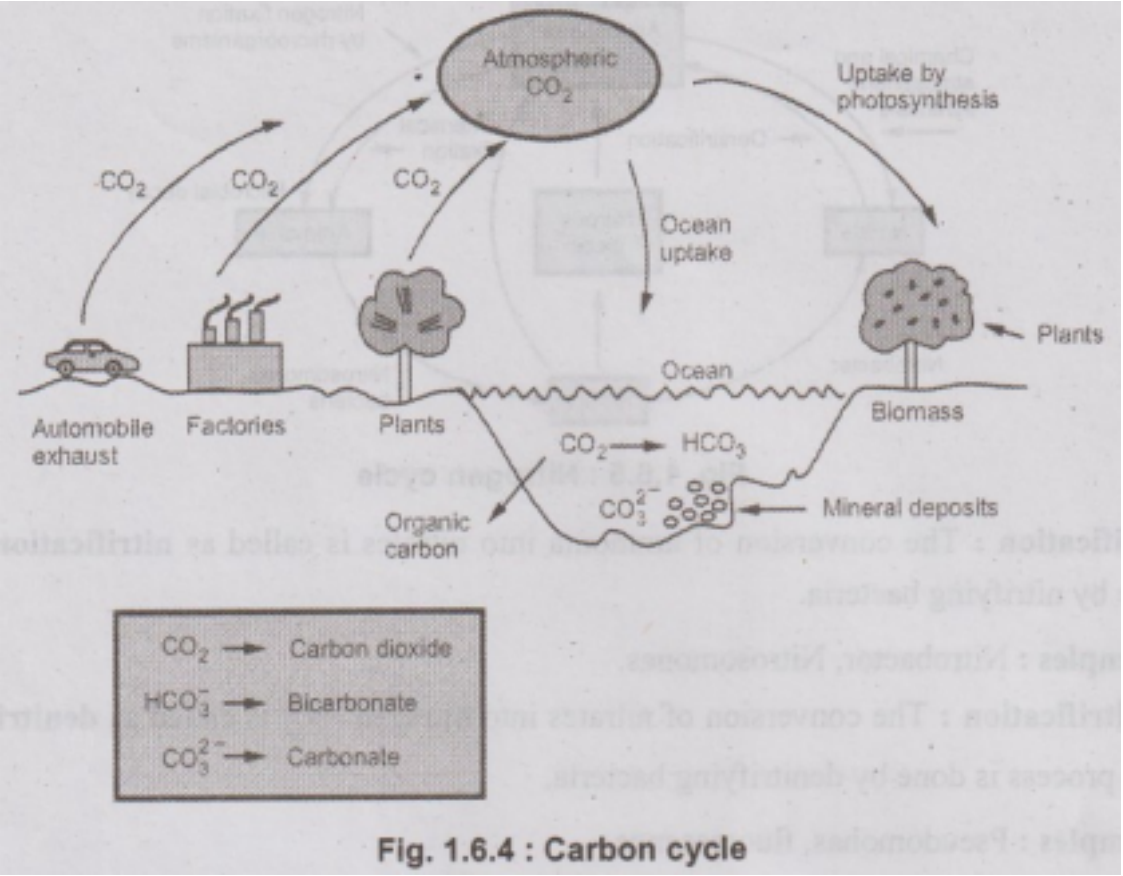


Fig. 1.6.4 : Carbon cycle

Sources of CO_2 in atmosphere

i) Respiration of plants, animals and humans librates CO_2, in

atmosphere. ii) Combustion of fuels releases CO_2

iii) Volcanic eruptions.

5. Nitrogen Cycle

• Nitrogen and its compounds are essential for its life process in the biosphere.

• Nitrogen gas (N_2) comprises about 78 % of the atmosphere, still plant growth is affected due to nitrogen, deficiency, agriculture quickly deplets soil nitrogen, therefore fertilizers

fulfills this deficiency.

• The nitrogen is present in all biotic components in different forms as

food. **Examples :** Proteins, vitarriins, aminoacids etc.

• There is continuous exchange nitrogen between atmosphere and plants which is known as nitrogen cycle.

• Fig. 1.6.5 illustrates nitrogen cycle.

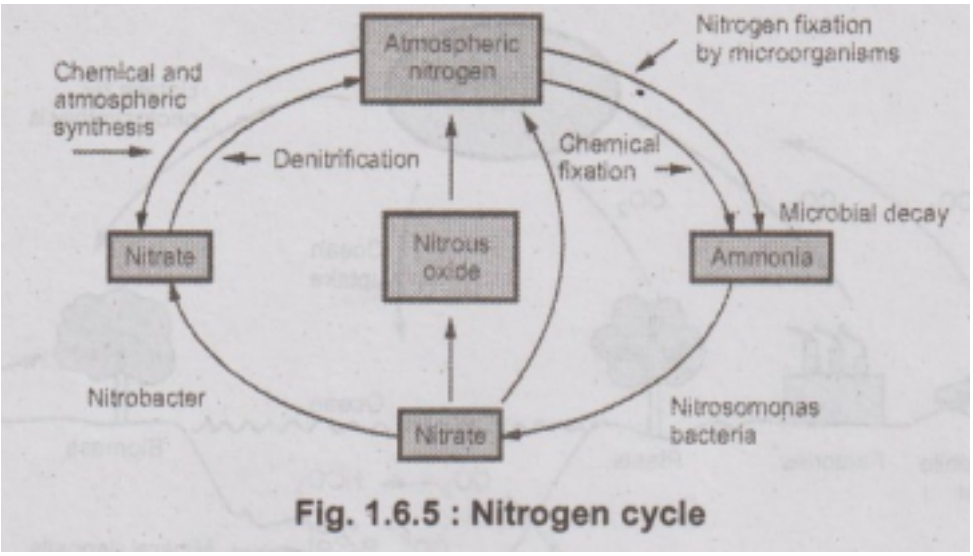


Fig. 1.6.5 : Nitrogen cycle

• **Nitrification :** The conversion of ammonia into nitrates is called as nitrification. This is done by nitrifying bacteria.

Examples : Nitrobactor, Nitrosomonas.

• **Denitrification :** The conversion of nitrates into nitragen (N2) is called as denitrification. This process is done by denitrifying bacteria.

Examples : Pseudomonas, fluorescence.

6. Phosphorous Cycle

• Phosphorus is found in rocks and fossils. It is present in all biotic components in different forms.
Examples : Bones, teeths, guano deposits.

• Phosphorus is excavated for fertilizer manufacturing. Farmers use excessive fertilizers for crops.

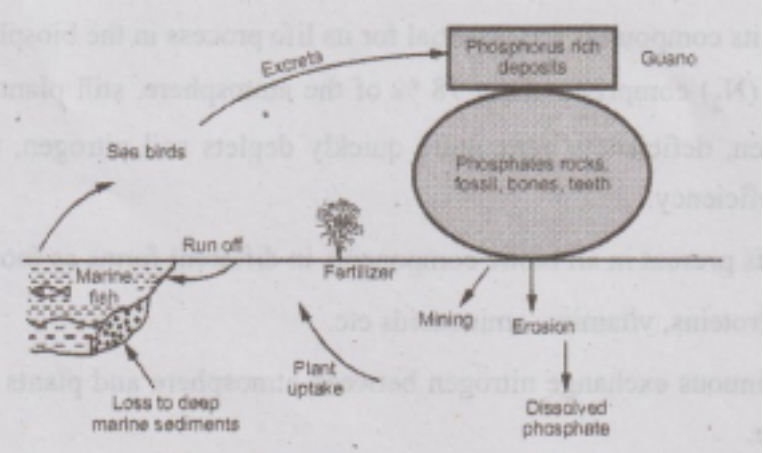


Fig. 1.6.6 : Phosphorus cycle

• This excess phosphate fertilizer move with surface runoffs to ocean and lost into sediments. Sea birds eat fishes, which are phosphorus rich and birds return phosphorus to land.

• The sea birds are playing an important role in phosphorus cycling. Animals and plants use phosphates during biosynthesis.

7. Photosynthesis

• Photosynthesis is a complex redox process by which plants, algae and certain bacteria, using the energy of sunlight, convert carbon dioxide and water into carbohydrates (sugar) and dioxygen.

• The catalysts used in plants are the chlorophyll pigments, carotenoids and the phycoblins. These pigments absorb light and help to convert it into chemical energy via the formation of new chemical bonds.

• The overall reaction can be simply represented by,

$$CO_2(g) + H_2O(1) \xrightarrow[\text{Sunlight energy}]{\text{Chlorophyll}} (CH_2O)(aq) + O_2(g)$$

• Photosynthesis is the main way what foodstuffs are produced for the higher animals, atmospheric dioxygen is replenished and energy obtained from the sun is stored. Plants that can photosynthesis are therefore referred to as the primary producers in the food chain.

• All other organisms that feed on plants in order to use their organic compounds in respiration and as an energy source are called consumers.

Review Questions

1. With a neat sketch explain carbon cycle.

2. Explain energy flow models in ecosystem.

3. With a neat sketch, describe carbon cycle.

Functions and Types of Ecosystem

• Three major functions of an ecosystem are : 1. Primary function 2. Secondary function 3. Tertiary function

Functions of Ecosystem

• Three major functions of an ecosystem are

1. Primary function : Ecosystem produces starch by interaction of biotic and abiotic components.

2. Secondary function : Ecosystem is related to processes and events that change form of energy and materials within biotic and abiotic components.

3. Tertiary function : Ecosystem allows flow of energy and cycling of materials so that system remains stable and there is continuity in life.

1. Ecosystem Conservation

• Ecosystem and its conservation are now vital environmental issues of international concern.

• There are several strategies which are adapted for conservation of ecosytem. Some of these are -

1. Legislation : Formal policies and programmes for conservation and sustainable utilisation of ecosytem resources.

2. In -situ Conservation : Conserving the animals and plants in their natural habitats is known as in situ conservation.

3. Ex-situ Conservation : Ex-situ conservation of plants and animals preserve/ or protect them away from their natural habitat.

4. Community Participation in Biodiversity Conservation.

Ecosystem Types

1. Forest Ecosystem

• A forest ecosystem is one in which considerably tall and dense trees grow that support many animal species within it.

a. Types of Forest Ecosystem

• A forest ecosystem can be classified depending upon climatic conditions. Several forest ecosystems are :

1. Tropical rain forests 2. Tropical deciduous forests

3. Temperature deciduous forests 4. Tropical scrub forests

5. Temperature rain forests.

b. Structure and Function of Forest Ecosystem

• The forest ecosystem has two parts :

1. Abiotic (non-living) components.

2. Biotic (living) components.

1. Abiotic (non-living) components

• The abiotic components are inorganic and organic substances present in soil and

atmosphere. **Examples :** Climatic factors (temperature, rainfall light), minerals.

2. Biotic (living) components

• The biotic components includes both the large (macrophytes) and the microscopic plants and animals.

Examples

a. Producers - Trees, shrubs and ground vegetation.

b. Consumers - Ants, flies, insects, mice, deer, snakes, birds, tiger and lion.

c. Decomposers - Bacteria and fungi.

c. Characteristics of Forest Ecosystem

1. Forest have warm climate with adequate rainfall.
2. Forests have well defined seasons of about equal length.

3. Forest protects biodiversity.

4. Forests have tall and dense trees with many wild animals within

ecosystem. 5. The soil of forest is rich in organic matter and nutrients.

6. Forests grow very slowly.

7. Forests provide various resources for human life.

2. Grassland Ecosystem

• A grassland has variety of grasses, herbs, insects depending on climatic conditions and temperature. The grass is major producers of biomass.

• The grassland may be either temperature or tropical. The grasslands are degraded because of overgrazing.

a. Types of Grassland Ecosystem

• Grassland ecosystem can be classified depending upon climatic conditions. Different grassland ecosystems are

1. Tropical grassland 2. Temperature grassland 3. Polar grassland.

b. Structure and Function of Grassland Ecosystem

• The grassland ecosystem has two parts :

1. Abiotic (Non-living) components

2. Biotic (Living) components.

1. Abiotic (Non-living) components '

• The abiotic components are sourced by CO_2, H_2O, nitrate, phosphates and

sulphates. **Examples :** Nutrients, C, H, O, N, P, S.

2. Biotic (Living) components

• Three biotic components are : producers, consumers and

decomposers **I] Producers :** Producers produce food.

Examples : Grasses, forbs and shrubs.

II] Primary consumers : They depend on grass for their food.

Examples : Cows, buffaloes, deer, sheep.

Secondary consumer : They feed on herbivores (primary

consumers). **Examples :** Snakes, lizards, birds etc.

Tertiary consumers : They feed on secondary consumers.

Examples : Hawks, eagles etc.

III] Decomposers - They decompose the dead organic matter.

Examples : Fungi and bacteria.

c. Characteristics of Grassland Ecosystem

1. Grassland ecosystem exists where rainfall is low and uneven.

2. The soil of grassland ecosystem is rich in nutrients and organic matters. 3.

Grassland ecosystem provides largest biomass and is used for grazing animals.

4. The grassland ecosystem exists in moderate climates.

5. Grassland ecosystem is characterized by seasonal flowering plants and savannas (scattered trees).

3. Desert Ecosystem

• The ecological succession of grassland is deserts. Deserts are characterized by high temperature, less moisture, warm, dry, less vegetation, special habitats.

• Four major types of deserts are

1. Hot and dry desert. 2. Semiarid desert.

3. Coastal desert. 4. Cold desert.

a. Types of Desert Ecosystems

• Desert ecosystems can be categerized depending on climatic

conditions: 1. Tropical desert

2. Temperature desert

3. Cold desert

b. Characteristics of Desert Ecosystem

1. Desert are subjected to strong winds.

2. There is low annual rainfall. .

3. The desert air is dry and climate is hot.

4. Temperature variation is large (days are hot and nights are cold).

5. Without or rare vegetation.

6. No soil is present.

c. Structure and Function of Desert Ecosystems

• Desert ecosystem consists of two components

1. Abiotic components 2. Biotic components

1. Abiotic components

Examples : Temperature, rainfall, sunlight, water etc.

2. Biotic components

a) Producers : Mostly found plant in deserts are succulent (cacti). They have water content inside which keeps them alive. The waxy outer layer protects them from sun.

Examples : Shrubs, bushes etc.

b) Consumers : Animals dig holes in ground to live in. They come out at night to find food. They can extract water from the seeds they eat.

Examples : Mice, rabbits, reptiles, squirrles etc.

c) Decomposers : Desert has poor vegetation with a very low amount of dead organic

matter. **Examples :** Fungi and bacteria.

4. Aquatic Ecosystem

• The ecosystems exists in the medium of water is called as aquatic ecosystem. In aquatic ecosystems, plants and animals live in water.

• The organisms found in aquatic environment are determined by quality of water such as clarity, salinity, oxygen content and rate of flow.

a. Types of Aquatic Ecosystem

• The aquatic ecosystems may be classified as -

1. Fresh water ecosystems :

Examples : Rivers, pond, lake, streams, wetland.

2. Marine ecosystems :

Examples : Marine or ocean, estuary.

b. Pond Ecosystem

• A pond is a freshwater aquatic ecosystem, where water remain in the same area for a longer period.

• As the pond fills in the monsoon season, a large number of food chains are formed. It contains several types of algae, aquatic plants, insects, fishes and birds.

Characteristic features of pond ecosystem

1. Most pond are temporary that has water only in monsoon season.

2. It is a stagnant (standing) water body.

3. The medium contains less nutrients.

4. Most pond become dry after the rains are over and are covered by terrestrial plants for the rest of year.

5. Pond get polluted easily due to limited amount of water.

Structure and functions of pond ecosystem

• The two components of pond ecosystems are :

1. Abiotic components 2. Biotic components.

1. Abiotic components
Examples : Light, temperature, chemical environment such as dissolved and particulate matter, oxygen, pH, phosphorous.

2. Biotic components

a. Producers : These are green photosynthetic organisms. They are of two types :

I] Phytoplankton : These are microscopic aquatic plants, which freely float on surface of water.

Examples : Algae, volvox, pandorina, cosmarium.

II] Microphytes : These are large floating plants and submerged

plants. **Examples :** Hydrilla, jussiaea, wolfia, demma.

b. Consumers :

I] Primary consumers (Zooplanktons) : Microscopic animals which can freely float on the surface of water.

Examples : Protozoa, very small fish, ciliates, flagellates.

II] Secondary consumers (Carnivores): They feed on zooplanktons.

Examples : Insects like water beetles and small fish.

III] Tertiary consumers : They feed on smaller fish.

Examples : Large fish like game fish.

c. Decomposers : They decompose-the dead plant and animal matter and their nutrients are released and reused by green plants.

Examples : Fungi, bacteria and flagellates.

c. Lake Ecosystem

• A lake is a giant permanent pond. A large amount of its plant material is the algae, which derives energy from the sun.

Types of lake

• Important types of lakes are

1. Oligotrophic lakes: Low nutrient concentrations.
2. Eutrophic lakes : Ovemourished nutrients.

3. Dystrophic lakes : Low pH, brown water, acidic.

4. Volcanic lakes : Receive water from magma after volcanic eruptions.

5. Meromictic lakes : Salt rich.

Characteristic features of lake ecosystem

1. Lake is a shallow fresh water body.

2. Lake is a permanent water body.

3. Food chains are inter linked with terrestrial food chains.

Structure and function of lake ecosystem

1. Abiotic components

Examples : Temperature, proteins and lipids, light, CO_2, O_2.

2. Biotic components

a. Producers : They can be green plants submerged, free floating and amphibious

plants. **Examples :** Phytoplanktons, algae and flagellates

b. Consumers : I] Primary consumers (Zooplanktons): Ciliates.

II] Secondary consumers : Insects, small fishes.

III] Tertiary consumers : Large fish.

c. Decomposers : They decompose the dead plant and animals.

Examples : Bacteria, fungi and actinomy cetes.

d. River or Stream Ecosystem

• The river or stream has running water. The river water contains more oxygen. There exists less species in rivers.

• The nutrient content in the water is largely determined by the terrian and vegetation surrounding the river.
• Overhanging vegetation adds a substantial amount of organic material from fallen leaves. The erosion of the streambed adds inorganic nutrients to the running water.

Characteristics of river/stream ecosystem

1. Rivers are fresh water system.

2. Dissolved oxygen content is more in streams.

3. Moving down stream, numerous tributaries join to form a river.

4. It carries sediments (from the erosion of soil) and nutrients.

Structure and function of river ecosystem

1. Abiotic components

Examples : Temperature, light, pH, nutrients, organic and inorganic compounds.

2. Biotic components

a. Producers : Phytoplankton, algae, water grasses, aquatic masses and amphibious

plants. **b. Consumers :**

i) Primary consumers : Water insects, snails, fishes.

ii) Secondary consumers : Birds, mammals.

c. Decomposers : Bacteria and fungi.

e. Ocean (Marine) Ecosystem

• The ocean or marine is a saltwater aquatic ecosystem. The ocean environment is characterized by its high concentration of salts and minearls.

• The marine or ocean ecosystem is largest of all ecosystems. It supplies huge variety of sea products, minerals, natural gas etc. ocean contains the richest diversity of species.

Characteristics of ocean ecosystem

1. It covers large surface area with saline water.

2. Marine or oceans are rich in biodiversity.

3. The evaporation of sea water provides rain water for the land.
4. Algae are abundant in ocean and provide much of the world's oxygen supply by absorbing huge amounts of atmospheric carbon dioxide.

Structure and function of marine ecosystem

1. Abiotic components

Examples : Temperature, light, Nacl, K, Ca and Mg salts, alkalinity.

2. Biotic components

a. Producers : Phytoplanktons (diatoms, unicellular algae), marine plants (seaweeds, chlorophyceal, phaeophyceae).

b. Consumer : These are heterotrophic macroconsumers. They depend on producers for their nutrition.

i) Primary consumers / herbivores : They feed on producers.

Examples : Crustaceans, moiluscs, fish.

ii) Secondary consumers/carnivores : They feed on herbivores.

Examples : Herring sahd, mackerel etc.

iii) Tertiary consumers : They are top consumers. They feed on small fishes.

Examples: Cod, haddock.

c. Decomposers : They decompose the dead organic matter.

Examples : Bacteria and some fungi.

Review Question

1. Explain pond ecosystem.

Biodiversity

Biodiversity (Biological diversity) is defined as variety and variability of living organisms in a given assemblage. Biodiversity covers whole life on earth.

Biodiversity

• Varieties of life on the earth exists over thousands of years to fulfill the needs of mankind. For understanding the life cycle of plants and animals they must be classified and categorized properly.
Biodiversity (Biological diversity) is defined as variety and variability of living organisms in a given assemblage. Biodiversity covers whole life on earth.

• Biodiversity may be described in terms of genes, species and ecosystems, corresponding to three fundamental and hierarchically related levels of biological organization.

• All life depends on uninterrupted functioning of natural systems that ensure the supply of energy and nutrients, so ecological responsibility among all people is necessary for survival, security, equality and dignity of the world's communities.

1. Importance of Biodiversity

1. Increase ecosystem productivity; each species in an ecosystem has a specific role to

play. 2. Support a larger number of plant species and, therefore, a greater variety of crops.

3. Protect freshwater resources.

4. Promote soils formation and protection.

5. Provide for nutrient storage and recycling.

6. Aid in breaking down pollutants.

7. Contribute to climate stability.

8. Speed recovery from natural disasters.

9. Provide more food resources.

10. Provide more medicinal resources and pharmaceutical drugs.

11. Offer environments for recreation and tourism.

2. Types of Biodiversity

• There are three basic types of biodiversity -

1. Genetic diversity

2. Species diversity

3. Ecosystem diversity or community diversity.

3. Genetic Diversity

• Genetic diversity is a measure of variety available for the same genes within individual species.

• Genetic diversity is based on variation between genes i.e. functional units of hereditary information. The genetic variability is essential for a healthy breeding population of a species.

Example : Each human being is different from all other, thousands of rice varieties are available.

4. Species Diversity

• Species diversity is the number of different species of living things within an area.

• Species are regarded as populations within which gene flow occurs under natural conditions. Members of one species, do not breed freely with members of other species.

Examples : Tiger, lion, teakwood, human being etc.

5. Ecosystem Diversity

• Ecosystem diversity relates to the variety of habitats, biotic communities and ecological processes in the biosphere as well as the diversity within ecosystems.

• Diversity can be described at a number of different levels and scales : * Functional

diversity is the relative abundance of functionally different kinds of organisms

* Community diversity is the number sizes and spatial distribution of communities, and is sometimes referred to as patchiness (uneven quality)

* Landscape diversity is the diversity of scales of patchiness.

• No simple relationship exists between the diversity of an ecosystem and ecological processes such as productivity, hydrology and soil generation.

• Neither does diversity correlate neatly with ecosystem stability, nor its resistance to disturbance and its speed of recovery.

• There is no simple relationship within any ecosystem between a change in its diversity and the resulting change in the system's processes.

• For example, the loss of a species from a particular area or region (local extinction or extripation) may have little or no effect on net primary productivity of competitors take its . place in the community.
• The converse may be true in other cases. For example, if herbivorous such as zebra and wild beasts are removed from the African savanna, net primary productivity of the ecosystem decreases.

Review Questions

1. Define the term biodiversity. What are its values ?

2. What is meant by genetic diversity ? Species diversity and ecosystem diversity.

Values and Hot-spots of Biodiversity

A rich biodiversity is the wealth of any nation. Biodiversity provides variety of environmental survives and ecosystem essential for human life. Each organism has its own significance in the biosphere.

Values of Biodiversity

• A rich biodiversity is the wealth of any nation. Biodiversity provides variety of environmental survives and ecosystem essential for human life. Each organism has its own significance in the biosphere.

• The value of biodiversity is classified into various categories depending on its use, such

as i) Consumptive use

iii) Social use

ii) Productive use

iv) Ethical use

v) Aesthetic

vi) Option value.

1. Consumptive Use

• Consumptive use is direct utilization of various species by the modem society. The major sources are - Food, medicinal plants, fuel etc. These products are directly supplied by biodiversity.

Examples

a) Food - Seasonal fruits, vegetable, food grains, sea food, chicken,

duck. **b) Medicinal plants** - Bamboo, eucaliptas, neep, honey comb,

herbs.

c) Fuel - Fuel wood, timber, fodder, coal, petroleum, natural gas,

biomass. **2. Productive Use**

• Most commercial products are synthesized from natural products of biodiversity. The product may be derived from plants, animals and by products.

Examples : Silk, wool, leather, tusk - from animals and wood, cotton, oil seed, crop - from plants.

3. Social Values

• Social values of biodiversity counts for use of biodiversity for social aspect. The consumptive and productive values of biodiversity is closely related to the social concern.

• Many communities are finding that local bioversity can bring cash through ecotourism. Many people value biodiversity as a part of livelihood through cultural and religious sentiments.

Examples

Holy plants - Banyan, peepal, lotus etc.

Holy animals - Cow, peacock, snake etc.

4. Ethical Values

• Ethical value of biodiversity is related to conservation of life. Plants and animals have equal right to live and exist on our planet. No one has right to destroy other's life. The ethical value tells that any species may or may not be used but its presence is must in ecology.

• India's rich heritage and culture tells us to worship animals. Plants, rivers and mountains. Some communities have mission of preserving animals life.

5. Aesthetic Values

• Biodiversity is a beautiful and wonderful aspect of nature. Wild plants and animals are source of beauty wonder, joy and recreational pleasure for many people. Wild life tourism (ecotourism) is a good source of earning currency.

Examples

i) Neem and mango leaves are used during festivals and fair

aesthetics. ii) Ornamental plants, flowers are used for decoration.

iii) Elephants, horses and camels are used for ceremonial purposes.

6. Option Values

• The potential use of biodiversity is proseutly not known to us, this future possible use is termed as option value. Any specific species of biodiversity may be found very useful for any particular purpose ; if it is preserved and exists.

Example : Rarely found medicinal plant may be used for medicinal purpose for any chronic disease.

Review Questions

1. Define the term biodiversity. What are its values ?

2. What are the values of biodiversity ?

3. What are the values of biodiversity ? Describe.

Hot-spots of Biodiversity

• There is no uniform distribution of bio-diversity along the geographical regions of the world. Some habitats are found to be highly rich in abundant number in some specific regions.

• Hot-spots are the specific areas which contain the richest and the most threatened reservoirs of plant and animal species.

• The number of endemic species and degree of threats which are measured in terms of habitat loss, are certain criteria to determine a hot-spot. If these species lost, they can never be replaced.

1. Criteria to Qualify as Hot-spots

• To qualify as a hot-spot a region must satisfy following criteria.

1. The richness of endemic species.

2. Significant percentage of specified species should be present.

3. The site must have lost more than 70 % of its original habitat.

4. The site must be under threat.

2. Reason for Rich Biodiversity in Tropics

• The reasons for rich biodiversity in tropics are as following :
1. The tropics have more stable climate.

2. Tropical areas have warm temperature and high humidity, which provide favourable condition.

3. No single species can dominate hence there is an opportunity for many species to

coexist. 4. The rate of outcrossing among plants is higher in tropics.

3. Area of Hot-spot

• Twenty five numbers of hot-spots are identified and selected for the conservation of biodiversity.

• The total area of the hot spots cover about 1.4 % of the total land surface on the earth.

Sr. No.	Hotspots	Plant species	Endemic plants
1.	Tropical Andes	45,000	20,000
2.	Mesoamerican forests	24,000	5,000
3.	Caribbean	12,000	7,000
4.	Brazil's Atlantic forest	20,000	8,000
5.	Panama Western Ecuador	9,000	2,250
6.	Brazil's Cerrado	10,000	4,400
7.	Central Chile	3,429	1,605
8.	California Floristic	4,426	2,125
9.	Madagascar	12,000	9,704
10.	Eastern Arc and Coastal forest of Kenya	4,000	1,500
11.	Western African forests	9,000	2,250
12.	Cape Floristic Province	8,200	5,682
13.	Succulent Karoo	4,849	1,940
14.	Mediterranean basin	25,000	13,000
15.	Caucasus	6,300	1,600
16.	Sundaland	25,000	15,000
17.	Wallacea	10,000	1,500
18.	Philippines	7,620	5,832
19.	Indo-Burma Eastern Himalayas	13,500	7,000
20.	South-Central China	12,000	3,500
21.	Western-Ghats Sri Lanka	4,780	2,180
22.	South-Western Australia	5,469	4,331
23.	New Caledonia	3,332	2,551
24.	New Zealand	2,300	1,865
25.	Polynesia / Micronesia	6,557	3,334
Total		–	**1,33,149**

4. Hot-spots of Biodiversity in India

• Out of 25 hot-spots in the world, two hot-spots are found in

India. 1. Eastern Himalayas 2. Western Ghats.

• These areas are rich in floral wealth and also in reptiles, amphibians butterflies and some mammals.

a. Eastern Himalayas

• These area comprises Nepal, Bhutan and neighbouring states of northern India along with Yunnan province in southwest China.

• The eastern Himalayas form a distinct floral region. There are around 35000 plant species in Himalayas of which 30 % are endemic.

Features of Himalayan Regions

1. Eastern Himalayas shows an ultra varied topography, which has species diversity and endemism.

2. In Sikkim, in semi-isolated area of 7298 km of 4250 plant species, 2550 (60 %) are

endemic. 3. In India's sector, there are 5800 plant species of which 2000 (36 %) are endemic.

4. In Nepal, there are 7000 plant species of which 500 (8 %) are endemic. 5. In Bhutan, there

are 5000 plant species of which 750 (15 %) are endemic. **b. Western Ghats**

• Western ghats extend along the western coastal region for about 1600 km in Tamilnadu, Maharashtra, Karnataka and Kerala.

• The Agasthimalai Hills and silent valley / New Amambalam Reserve basin are the two important places of biodiversity in western ghat region.

• Out of India's 49219 plant species, 1600 endemics (40 %) are found in this region. Only 6.8 % of the originial extent of vegetation existing today while the rest has been deforested or degraded.

Common plants : Temstroemia Japonica, Rhododendron and

Hypericum. **Common animals :** Blue bird, Lizard hawk.

Threats to Biodiversity

There is loss or threat to biodiversity because of several reasons. These include primary changes in abiotic and biotic factors of an ecosystem which causes harmful effects on biodiversity.

Threats to Biodiversity

• There is loss or threat to biodiversity because of several reasons. These include primary changes in abiotic and biotic factors of an ecosystem which causes harmful effects on biodiversity.

• Major threats to the biodiversity are -

1. Habitat loss

2. Poaching of wild life

3. Man - wild life conflicts

4. Destruction of coastal areas

5. Filing up of wetlands

6. Commercial exploitation.

1. Habitat Loss

• The loss of wild habitats, due to rapid human population growth contributes to the rapid global destruction of biodiversity.

• Other important factors of loss of habitat are :

⊕ Deforestation

⊕ Destruction of wetlands

⊕ Over grazing

⊕ Urban development

⊕ Building of dams

⊕ Mining

⊕ Land slides

⊕ Poor agricultural practices

⊕ Industrial wastes.

2. Poaching of Wild Life

• Poaching of wildlife for sport, making profit and for human consumption. Wild species are hunted for their fur, tusks, meat, thorns. Various animals and their purpose of producing article / use are summarized here.

Sr. No	Species	Use
1.	Elephant	Ivory, ashtray
2.	Alligators	Boots for urban needs
3.	Blubber	Lubricating oils
4.	Baleen	Combs and other articles
5.	Tiger	Skin and bones
6.	Rhinos	Horns
7.	Deer	Musk, perfume

• Habitat loss also occur when man introduces species from one area into other, disturbing the balance of existing community. Species are lost due to destruction of natural ecosystem.

3. Man-Wild Conflicts

• Man is continuously interacting with different ecosystems for food, fuel, recreation, sports, urban development, waste disposal etc.

• Every activity is responsible directly or indirectly responsible for disturbing species.

• Natural forests are being deforested for timber and single species trees like teak, sal. This monoculture plantation creates imbalance ecosystem.

• Natural size of forests are reducing because of human encroachment, therefore animals often attacks on human society and creates violence.

Review Questions

1. What are the threats to biodiversity?

2. Mention the threats to biodiversity.

Conservation of Biodiversity

Biodiversity is an important tool for sustaining development in any country. Multiple utility of biodiversity in commercial, medical, genetic, aesthetic and ecological field makes it necessary to preserve biodiversity. There is need to educate people to adopt environment friendly practices

Conservation of Biodiversity

• Biodiversity is an important tool for sustaining development in any country. Multiple utility

of biodiversity in commercial, medical, genetic, aesthetic and ecological field makes it necessary to preserve biodiversity. There is need to educate people to adopt environment friendly practices.

1. Advantages of Conservation of Biodiversity

1. Biodiversity (ecotourism) is a good source of income.

2. Biodiversity provides various medicinal plants.

3. It provides life support system on earth.

4. Biodiversity maintain environmental balance on earth.

5. Various commercial aspects are related to biodiversity.

2. Factors affecting Biodiversity

1. Over-exploitation of natural resources.

2. Degradation of habitat.

3. Discharge of industrial waste.

4. Global warming.

5. Urbanization.

6. Use of insecticides.

7. Construction of dam.

8. Poaching and trade in wildlife species

9. Extension of agriculture and associated irrigation systems.

10. Filling up of wetlands
11. Population explosion

3. Approaches of Biodiversity Conservation

• The two basic approaches of biodiversity conservation are :

1. In-situ conservation (on site method)

2. Ex-situ conservation (off site method)

4. In-situ Conservation

• The in-situ conservation of biodiversity involves protection of species, where they naturally exists. It includes identifying and protecting reserved areas for biodiversity. These specific areas are national parks, sanctuaries, forests, lakes, botanical gardens, biosphere reserves where vast number of species of living organism, exist.

• The natural habitat maintained under in-situ conservation is called protected areas.

• Protecting the areas helps not only in conserving individual species but preserves ecosystem also. In these protected areas - tourism, explosive activities, poaching, shooting, grazing of domestic animals, cutting of trees are strictly prohibited.

• Inspite of these protections, these habitats are facing problem of encroachment, maintenance and monitoring land management. Also, various activities which are illegal but profitable for humans are earned out.

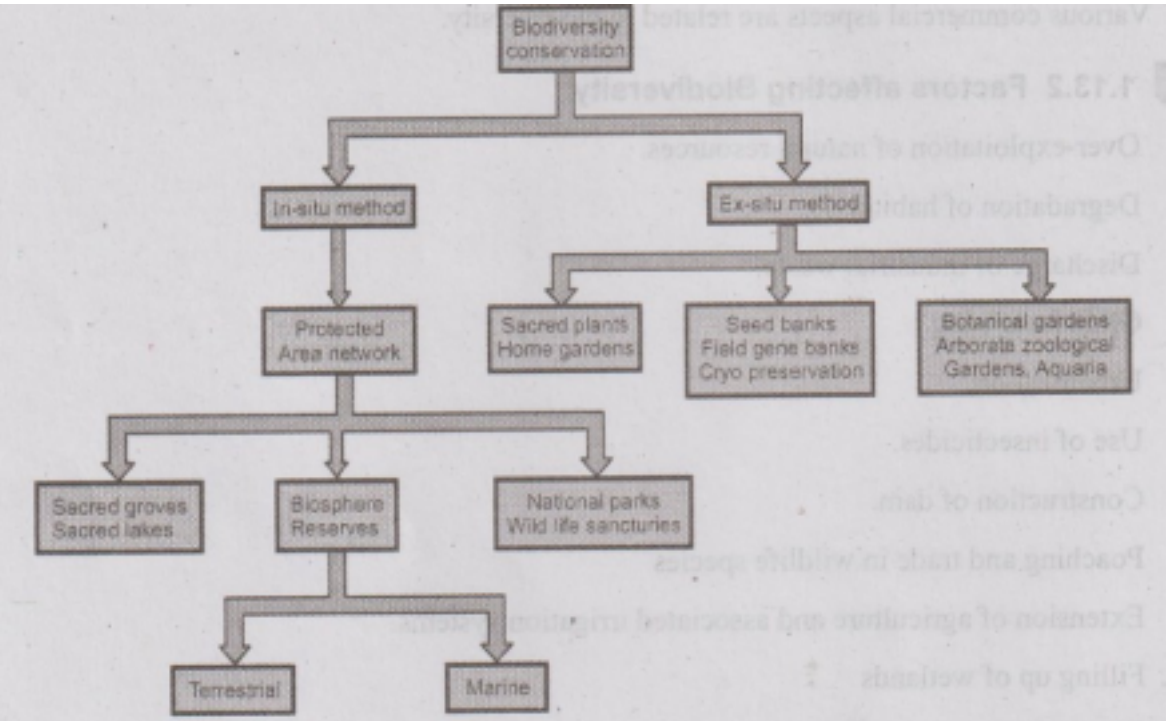


Fig. 1.13.1 : In-situ and ex-situ approaches of biodiversity conservation

Methods of In-situ Conservation

• Following methods are used for In-situ conservation are used.

Sr. No.	In-situ conservation	Available numbers
1.	Biosphere Reserves	7
2.	National Parks	80
3.	Wild-life Sancturies	420
4.	Botanical gardens	120

1. Biosphere reserves :

• The special category of protected areas in which human population constitutes an important component are called biosphere reserves.

• There are about 408 biosphere reserves in 94 countries by the end of 2000 year. In India following biosphere reserves are identified.

Sr. No.	Name of the site	Date of notification	Location and state
1.	Nilgiri	1.8.86	Part of Wynad, Nagarhole, Bandipur and Madumalai, Nilambur, Silent valley and Siruvani hills **(Tamil Nadu, Kerala and Karnataka).**
2.	Nanda Devi	18.1.88	Part of Chamoli, Pithoragrah and Almora districts **(Uttar Pradesh).**
3.	Nokerek	1.9.88	Part of Garo hills **(Meghalaya)**
4.	Manas	14.3.89	Part of Kokrajhar, Bongaigaon, Barpeta **(Assam).**
5.	Sunderbans	29.3.89	Part of delta of Gangas and Brahmaputra river system **(West Bangal).**
6.	Gulf of Mannar	18.2.89	Indian part of Gulf of Mannar between India and Srilanka **(Tamil Nadu).**
7.	Great Nicobar	6.1.89	Southern most islands of **Andaman and Nicobar (A&N islands).**
8.	Similipal	21.6.94	Part of Mayurbhanj district **(Orissa).**
9.	Dibru-Saikh owa	28.7.97	Part of Dibrugarh and Tinsukia districts **(Assam).**
10.	Dehang Debang	2.9.98	Part of Siang and Debang valley in **Arunachal Pradesh.**
11.	Pachmarhi	3.3.99	Part of Betul, Hoshangabad and Chindwara districts of **Madhya Pradesh.**
12.	Kanchanjunga	7.2.2000	Part of Kanchanjanga hills **(Sikkim).**

Table 1.13.1 : Biosphere reserves in India

Role of Biosphere Reserves

1. Biosphere gives long-term survival of ecosystem.

2. Biosphere protects endangered species.

3. Biosphere protects maximum number of species and communities.

4. Biosphere serves as site of recreation and tourism.

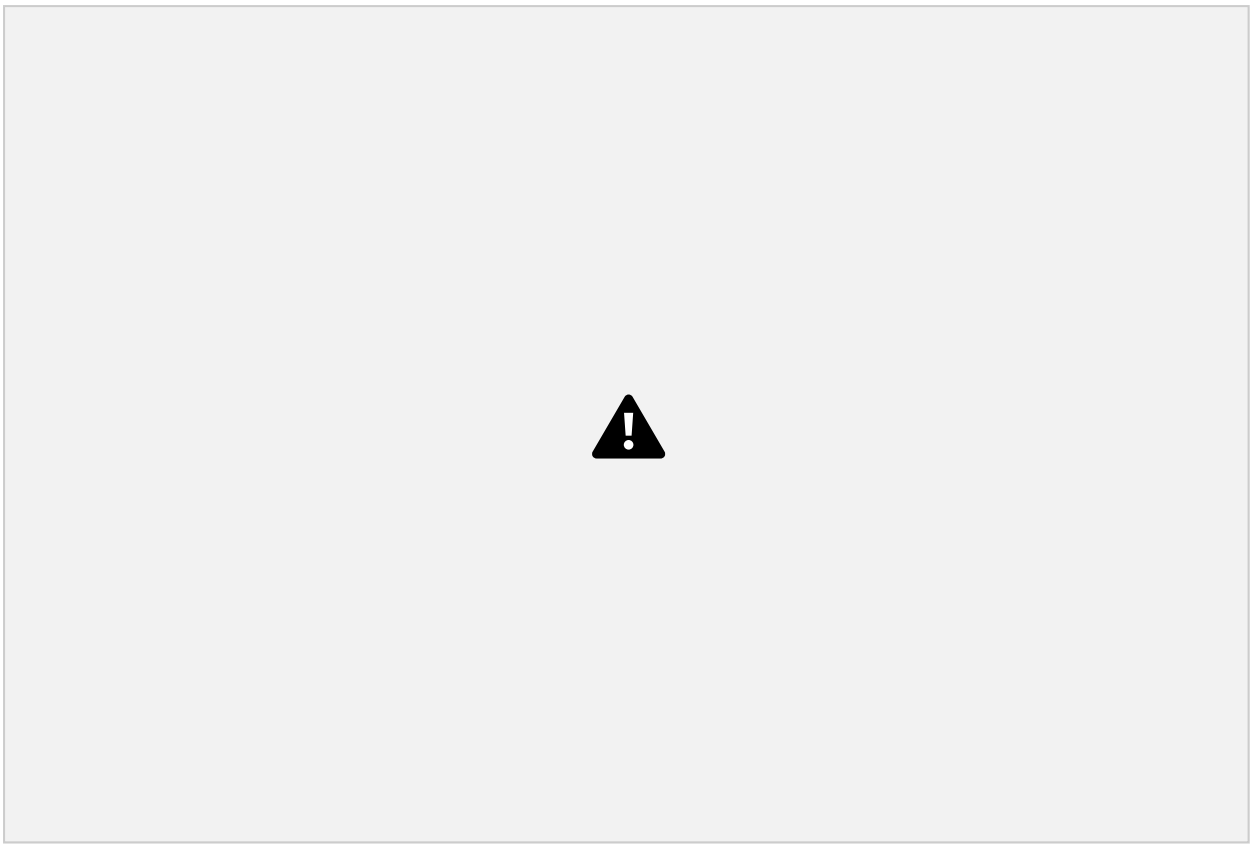
5. Biospheres can be used for educational and research purpose.

Restriction

• Explosive activities are not permitted in biosphere..

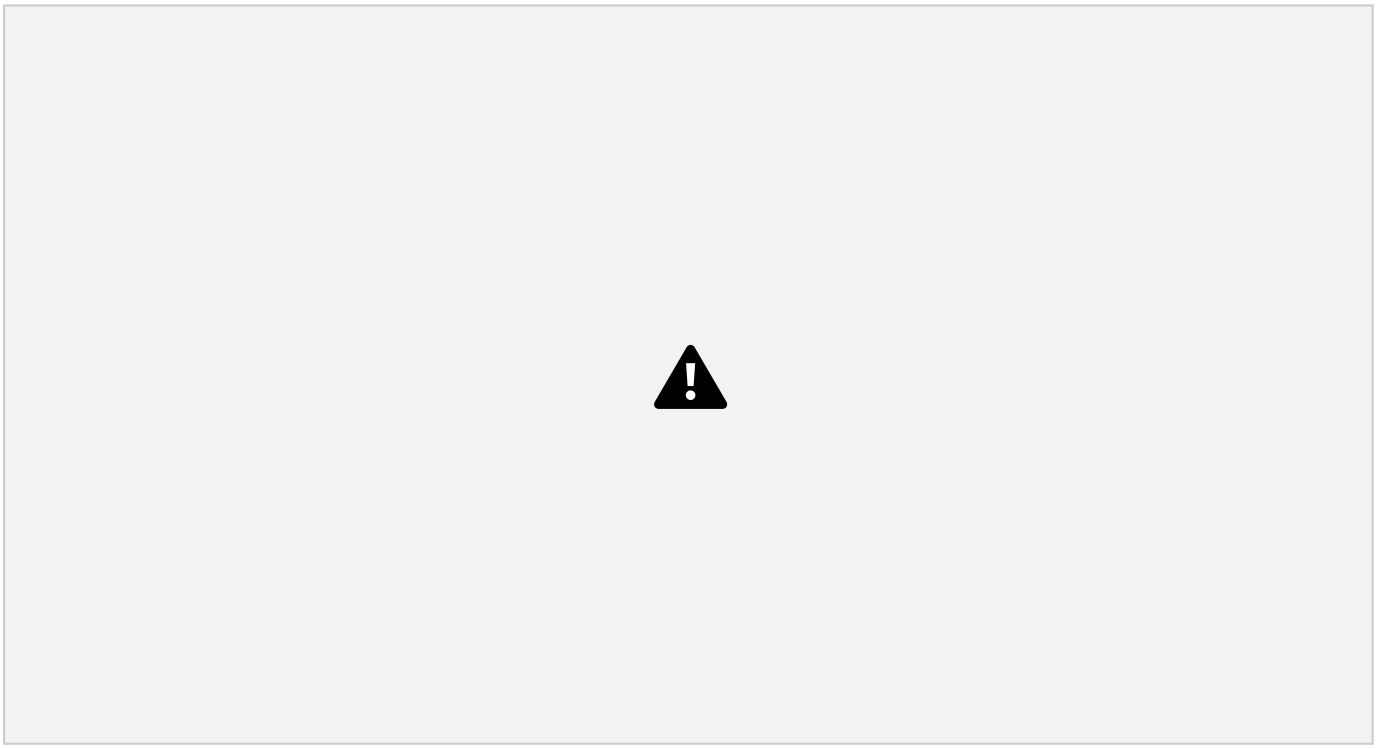
2. National park :

• A national park is an area dedicated for conservation of wildlife along with its environment. • Some important national park in India are listed below.



3. Wild life sanctuaries :

• A wild life sanctuary is an area which is reserved for the conservation of animals only. • Some important wild life sanctuaries in India are listed below.



5. Ex-situ Conservation

• The ex-situ conservations of biodiversity involves conservation of biodiversity under the control of human and outside the natural habitats.

• The endangered species of plants, and animals are collected in botanical gardens, zoos, aquariums and their maintenance and breeding is done under controlled conditions.

• The biodiversity management in captivity (human control) has certain advantages and disadvantages.

Advantages of Ex-situ conservation

1. The organisms will have longer life span because of assured food, water, shelter and security.

2. Because of special care the species endangered may survive longer.

3. Modem facilities can provide better process of breeding.

Disadvantages

1. Maintenance and cost of breeding plants and animals are expensive.

2. Species are habitual to favourable environmental conditions, they can not adapt to ever changing natural condition.

3. Freedom of wildlife is lost.

6. Steps of Conservation of Biodiversity

• Important steps for conservation of biodiversity are as follows -

1. Biodiversity inventories and assessments - population surveys and

assessment. 2. Identifying and expanding protected areas.

3. Conserving biodiversity in seed banks and gene banks.

4. Controlling wild life trade.

5. Providing environmental education to the people.

6. Reviewing agricultural practices.

7. Controlling urbanization.

8. Geographical information system for planning and monitoring.

9. Restoration of biodiversity.

10. Population control.

11. Implementing Environmental Protection Act (EPA).

12. Involving more Non-govemment organizations (NGOs).

7. National Biodiversity Act

• India is party to the Convention on Biological Diversity (CBD) 1992 which recognizes the sovereign rights of states to use their own biological resources. In order to help in realizing the objectives of CBD, India has enacted an umbrella legislation called the biological Diversity Act 2002.

• The central government has established a body called the National Biodiversity Authority, on and from the 1st day of October, 2003.

• The Act aims at the conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process for purposes of implementing the objects of the Act it establishes the National Biodiversity Authority in Chennai.

• The main functions of the authority are :
a) To lay down procedures and guidelines to govern the activities provided under section 3, 4, and 6. (Permission to foreigners/NRI's foreign companies)

i) For obtaining any biological resource (Section -3).

ii) For transferring the results of any research (Section -4).

iii) Certain collaborative research projects exempted (Section 5).

b) To advice the government of India. Specific areas mentioned as per the Act are the following:

i) Notifications of threatened species (Section - 38).

ii) Designate institutions as repositories for different categories of biological resources (Section - 39).

iii) Exempt certain biological resources, normally traded as commodities (Section -

40) c) To encourage setting up state biodiversity boards

d) To build up database and documentation system

e) To create awareness through mass media

i) Training of personnel

ii) Necessary measures in the areas of intellectual propriety rights.

Review Questions

1. Explain biodiversity conservation measures.

2. Explain the measures of conservation of bio-diversity.

3. Explain in -situ measures of conversation of biodiversity.

Environmental Pollution

Environmental Pollution

Syllabus

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

Contents

2.1 Environmental Pollution

2.2 Water Pollution

2.3 Noise Pollution

2.4 Soil Pollution

2.5 Air Pollution

2.6 Biomedical Waste : Management and Handling Rules

2.7 Solid Waste Management

2.8 Occupational Health and Safety (OH&S)

2.9 Environmental Protection Act

2.10 Two Marks Questions with Answers

Environmental Pollution

• Pollution is defined as any substance introduced into the environment that adversely affects the usefulness of a resource.

• Pollution can be in the form of solid, liquid or gaseous substance. Pollution causes damage to human, plant and animal life. The nature and concentration of pollutant determine the severity of effect of pollution.

Pollution is defined as the excess discharge of any substance into the environment which affects adversely quality of environment and causing damage to humans, plants and animals.

• Terms used to describe pollution concentration are as under -
Examples : Industry pollution, automobile pollution, agriculture pollution, thermal pollution etc.

1. Definition of Pollution

• Ecologically, pollutants can be divided into three types :

1. Bio-degradable or non-persistent pollutants

2. Slowly degradable or persistent pollutants

3. Non-degradable pollutants.

1. Bio-degradable pollutants:

• The pollutants that can be rapidly decomposed by natural processes is called bio-degradable or non-persistent pollutants.

Examples : Domestic sewage, discarded vegetables etc.

2. Slowly degradable pollutants :

• Some pollutants remain in environment for longer time because they decompose very slowly by the natural processes.

Examples : Plastics, pesticides, etc.

3. Non-degradable pollutants :

• Some pollutants can not be decomposed by natural processes are called non-degradable pollutants.

Example : Lead, mercury, nuclear wastes etc.

2. Classification of Pollution

• The pollutants that pollute the environment is divided into following

types. 1. Air pollution

2. Water pollution

3. Soil pollution

4. Marine pollution
5. Noise pollution

6. Thermal pollution

7. Nuclear hazards

Water Pollution

Any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for certain uses is referred as water pollution.

Water Pollution

• Any physical, biological or chemical change in water quality that adversely affects living organisms or makes water unsuitable for certain uses is referred as water pollution.

• When the quality or composition of water changes by any means it becomes unsuitable for any purpose and is said to be polluted.

1. Types, Effects and Causes of Water Pollution

• Various types of water pollution their effects and causes are summarized

here. **1. Infectious agents**

• Micro-organisms are naturally found in water and can cause infections to human

being. **Examples :** Bacteria, virus, protozoa and parasitic worms.

Human sources I causes

• Human and animal wastes

Effects

• Infectious agents may cause amoebic dysentery, skin problems, maleria

etc. **2. Oxygen demanding wastes / Dissolved oxygen**

• This waste when discharged in water body are degraded by oxygen demanding micro organisms. The amount of oxygen consumed by microbes is Biochemical Oxygen Demand (BOD).

• High levels of BOD can deplete the oxygen in water.

Examples : Organic waste such as animal manure and plant debris that can be decomposed by aerobic bacteria which requires oxygen.
Human sources / causes

• Sewage, animal feed lots, paper mills, food processing

units. **Effects**

• Depleted oxygen level in water may kill animals of aquatic

life. **3. Inorganic chemicals**

• Water soluble inorganic chemicals can pollute water.

Examples

• Acids, lead (pb), arsenic (As), selenium (Se), fluorides

(F). **Human sources / causes**

• Surface run-off, industrial effluents and household

cleanser. **Effects**

• Water cannot'be used for drinking and irrigation

purpose. • Causes skin cancers.

• Damage the nervous system, liver.

• Crop yield may reduce.

• Metals exposed to water may corrode.

4. Organic chemicals

• Water soluble organic chemicals pollute water.

Examples

• Oil, gasoline, plastic, pesticides, detergents, solvents.

Human sources / causes

• Industrial effluents, household cleansers, surface run-off from

farms. **Effects**

• Water cannot be used for drinking.

• Can cause several disease - cancer, damage of liver, nervous system.

• Can harm aquatic life.

5. Plant nutrients

• Water soluble compounds of plant nutrient or synthetic fertilizers pollute water.

Examples

• Nitrate, phosphate and ammonium.

Human sources I causes

• Sewage, manure, run-off of agricultural and urban.

Effects

• Causes excessive growth of algae killing aquatic life.

• Excessive nitrate can lower the oxygen carrying capacity of blood.

6. Sediment

• These are suspended solids or physical pollutants. They are always naturally present in the water.

Examples

• Soil, silt.

Human sources I causes

• Land erosion.

Effects

• It reduces photosynthesis.

• Aquatic food web is disrupted.

• Carry pesticides, bacteria and other harmful substances.

7. Radioactive materials
Examples

• Radioactive isotopes of uranium, thorium and cesium.

Human sources / causes

• Nuclear power plants.

• Nuclear weapons.

• Processing of uranium.

Effects

• Genetic mutations.

• Birth defects.

• Cancer.

8. Thermal pollution I Heat

• Thermal pollution is caused by increase in rise in temperature of

water. **Examples**

• Excessive heat, chemical reaction.

Human sources / causes

• Water cooling in industrial process.

Effects

• Aquatic organisms become more vulnerable to diseases.

9. Point and non-point sources water pollution

• Water pollutants are categorized as point source pollution and non-point source

pollution. **I Point source of pollution**

• Point source pollution is defined as any single identifiable source of pollution from which pollutants are discharged.

Examples
• Industrial discharge, factory smoke stack, municipal sewage etc.

• Point source pollution sources are discrete and identifiable and hence easy to monitor and regulate.

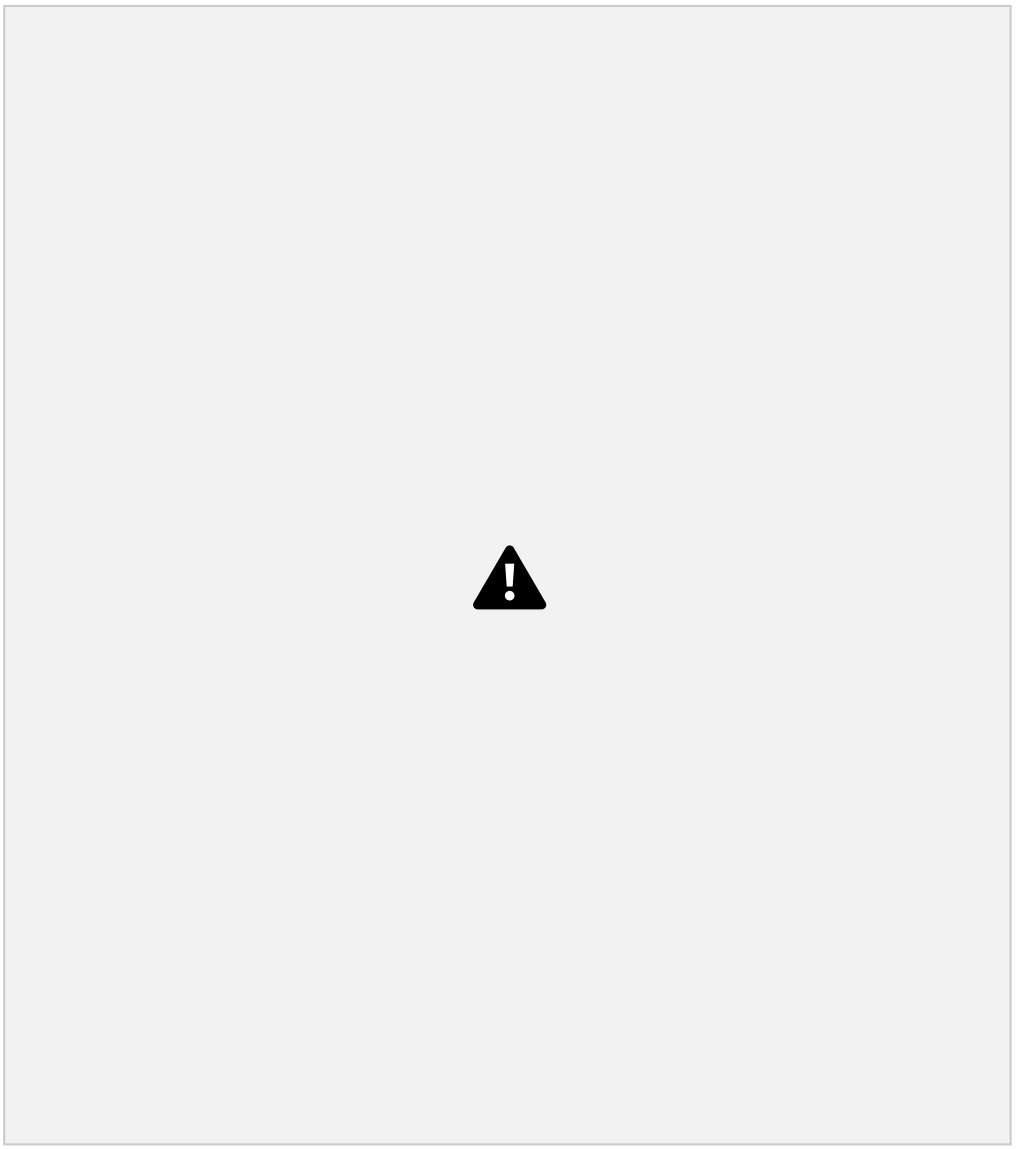
II Non-point source of pollution

• When a source of pollution cannot be readily, identified i.e. sources are scattered or diffuse they are called as non-point source of pollution.

Examples

• Run-off from farm lands, construction sites, parking lots, agriculture logging, animal

waste. • Table 2.2.1 lists some types of pollutants and their main sources.



2. Effects of Water Pollution

On human beings

• On consuming polluted water following effects are observed on human beings

: 1. Amoebic dysentery

2. Skin cancers

3. Cholera

4. Typhoid fever

5 . Damage of nervous system

6. Genetic mutations / Birth defects

7. Hepatitis

8. Malaria.

On plants and animals

1. Lower crop yields.

2. Harmful to aquatic life and wild life.

3. Excess growth of algae can kill aquatic life.

4. Reduce photosynthesis.

5. Disrupts food chain and food web.

3. Control Measures for Preventing Water Pollution

1. Setting up effluent treatment plants to treat waste.

2. Recycling of water must be encouraged.

3. Industrial wastes must be treated before discharge.

4. Educate public for preventing water pollution and the consequences of water

pollution. 5. Strict enforcement of water pollution control act.

6. Continuous monitoring of water pollution at different places.

7. Developing economical method of water treatment.

8. River, streams, lakes and other water reservoirs must be well protected from being polluted.

4. Drinking Water Standards

• Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water (treated or untreated) supplied by any means for human consumption.

• Drinking water shall comply with the following requirements.

1. Organoleptic and Physical parameters

2. General parameters concerning substances undesirable in excessive

amounts 3. Parameters concerning toxic substances

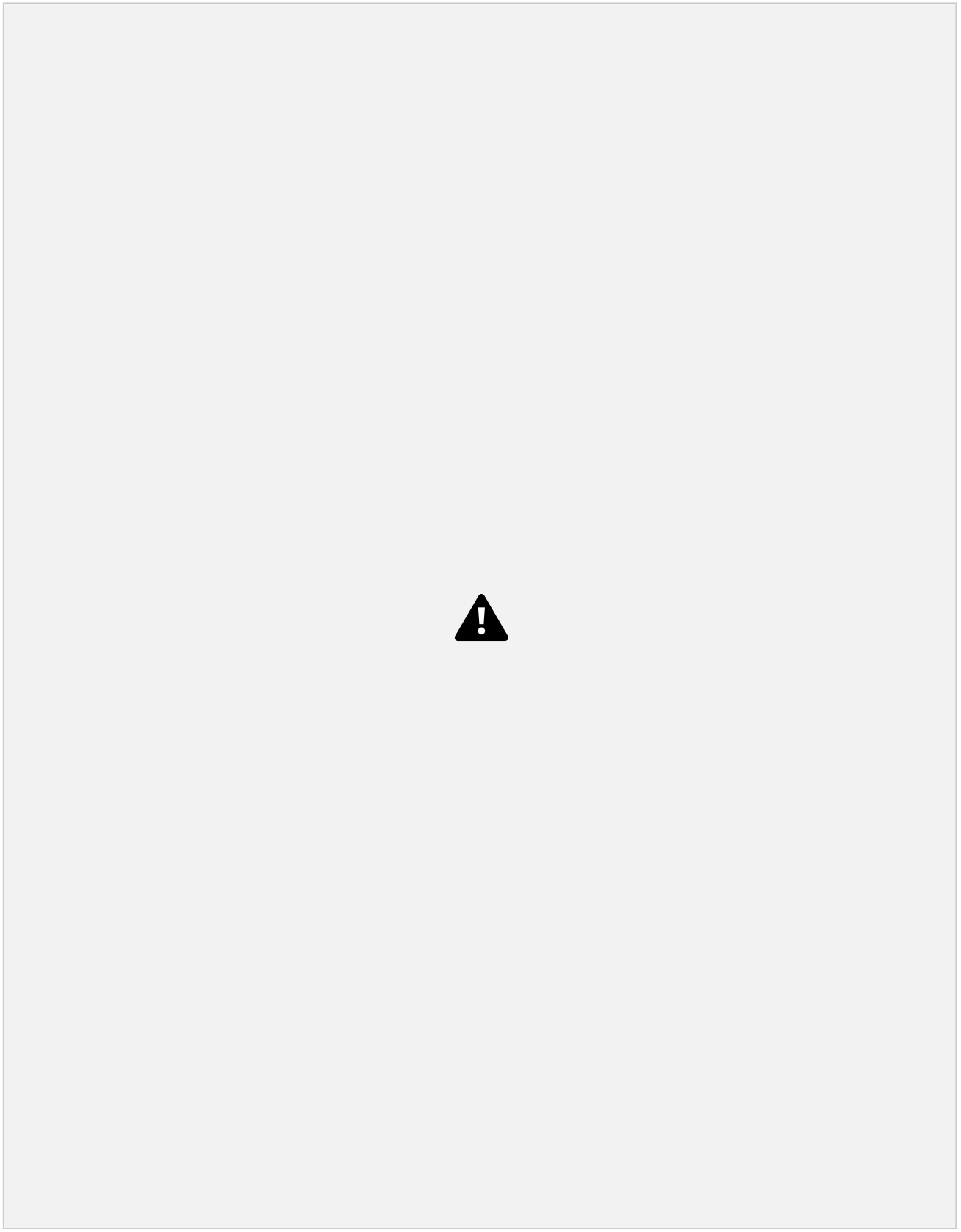
4. Parameters concerning radioactive substances

5. Bacteriological requirements

6. Virological requirements

7. Biological requirements

Bureau of Indian Standards for Drinking Water – Specification (BIS 10500 :1991



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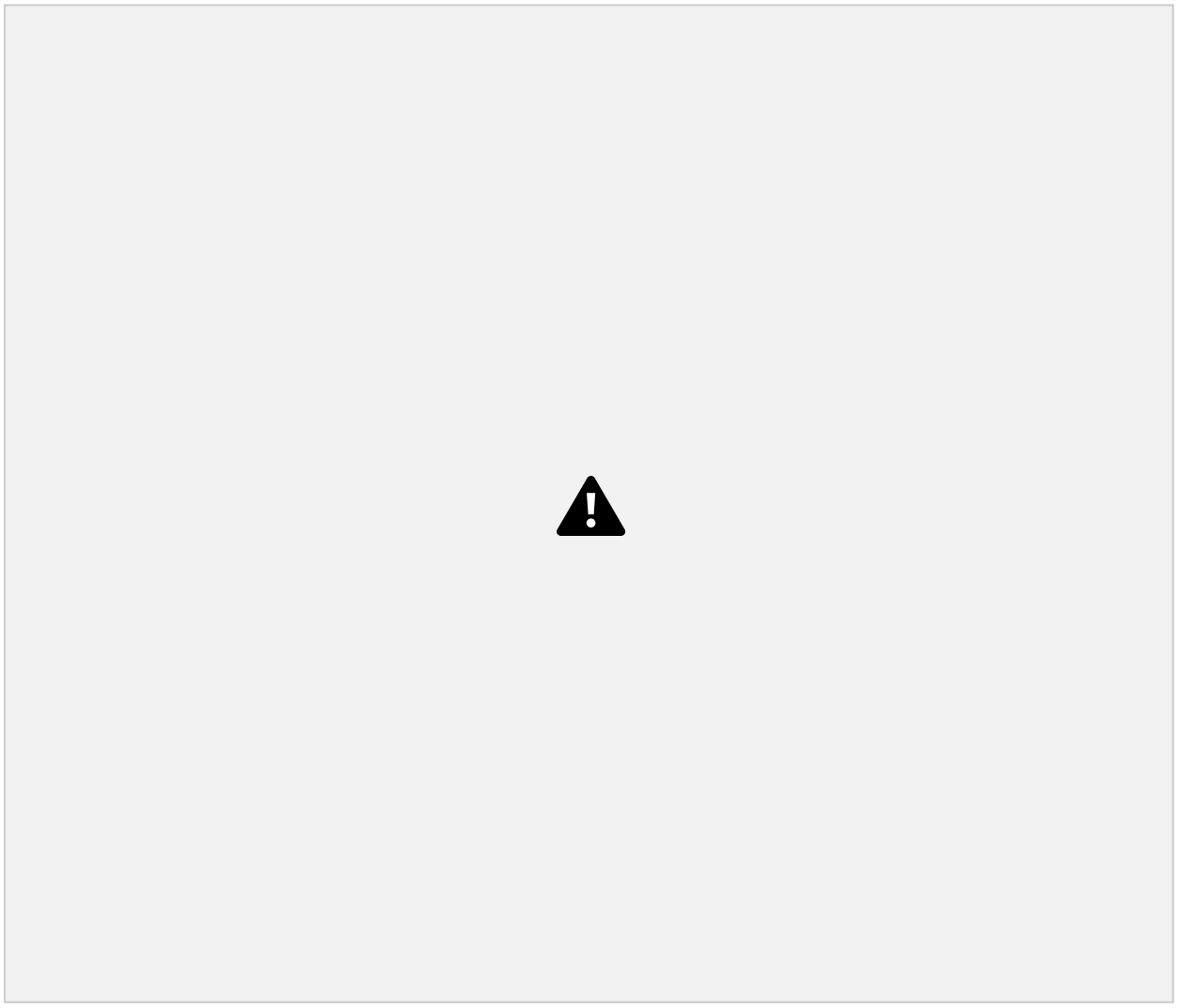
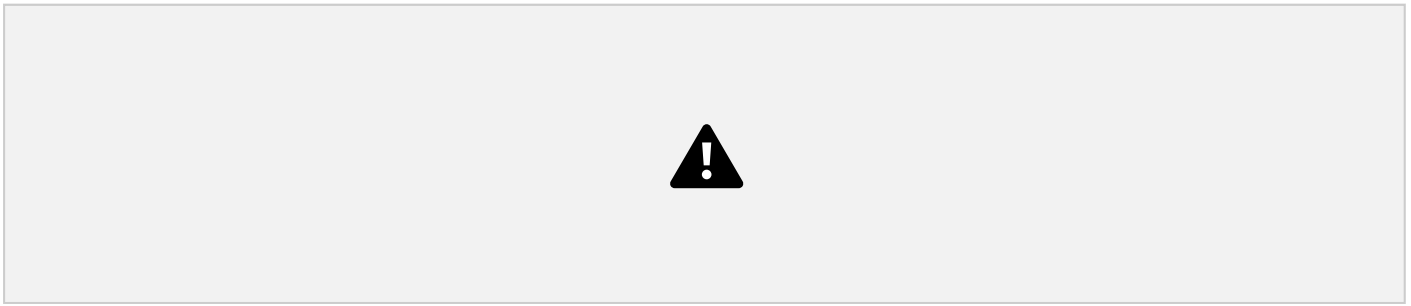


Parameters and Risks or Effects



5. Water Recycling

• Water recycling is reusing treated wastewater for beneficial purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing and replenishing a ground water basin (referred to as ground water recharge).

• Water recycling offers resource and financial savings. Wastewater treatment can be tailored to meet the water quality requirements of a planned reuse.
• Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use.

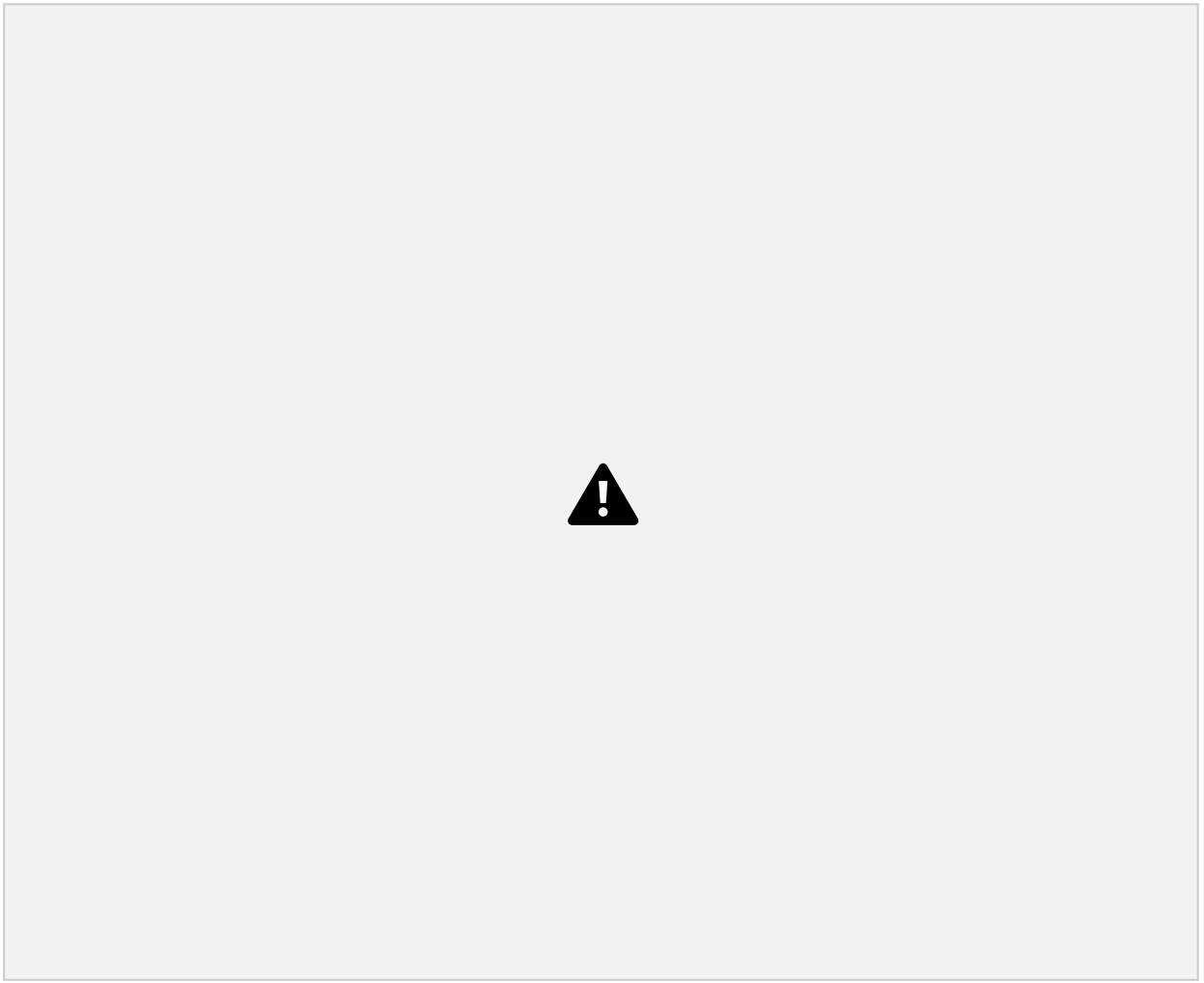
• Recycled water is most commonly used for nonpotable (not for drinking) purposes, such as agriculture, landscape, public parks and golf course irrigation.

• Other non-potable applications include cooling water for power plants and oil refineries, industrial process water for such facilities as paper mills and carpet dyers, toilet flushing, dust control, construction activities, concrete mixing and artificial lakes.

• In addition to providing a dependable, locally-controlle.d water supply, water recycling provides tremendous environmental benefits. By providing an additional source of water, water recycling can help us find ways to decrease the diversion of water from sensitive ecosystems.

• Other benefits include decreasing wastewater discharges and reducing and preventing pollution. Recycled water can also be used to create or enhance wetlands and riparian habitats.

Suggested Water Recycling Treatment and Uses



Review Questions

1. Mention the reasons for water pollution and explain the control measures.

2. What are the drinking water standards for nitrates and fluorides ? What are the health impacts of nitrates and fluorides.

Noise Pollution

In homes, especially in developed countries, but also in big cities of developing countries more and more power gadgets constitute additional sources of noise. The effect of these multiple causes of noise can be cumulative.

Noise Pollution

• No one can escape the unwanted sound that is called noise-a disturbance to our environment escalating so rapidly that it is becoming one of the major threats to the quality of human life.

• Noise pollution is defined as - unwanted, unpleasant sound that causes discomfort of human beings. Noise or sound is measured in decibal (dB).

• In homes, especially in developed countries, but also in big cities of developing countries more and more power gadgets constitute additional sources of noise. The effect of these multiple causes of noise can be cumulative.

• Noise exposure at work is added at home during leisure activities. Slowly, insensibly, man seems to accept noise-and the physiological and psychological deterioration that accompanies it-as an inevitable part of his life.

• Because noise does not pose as obvious and immediate a danger to health as polluted water or air, public wareness of noise and public commitment to noise reduction have been modest.

• Major differences between noise and other forms of pollution are as follows : 1. Noise is

everywhere; it is not as easy to control as the sources of water and air pollution.

2. Although certain effects of noise, like those of many other pollutants, accumulate in the organism, if noise pollution were to cease there would be no noise residual in the environment, as there would be in the case of water and air pollutants.

3. Unlike air and water pollution, the effects of noise are felt only close to the source.

4. An essential awareness of noise and motivation to reduce the problem are not present ; people are more likely to complain and demand political action about air or water pollution than about noise.
5. Finally, noise is not likely to have genetic effects, while some form of air and water pollution, such as radioactive pollution, can cause genetic effects.

1. Sources / Causes of Noise Pollution

• All the noise sources can be categorized into three types

1. Industrial noise 2. Transport noise 3. Domestic noise

1. Industrial noise : Industrial noise sources are - steel industry, textile industry, power generation, oil refineries generate huge amount of noise.

2. Transport noise : Traffic is considered to generate most annoying kind of noise. Road traffic, rail traffic and air traffic, all contribute to transport noise.

3. Domestic noise : Domestic noise sources are - household gadgets such as mixer, washing machine, refrigerator, air conditioners, vacuum cleaners and recreational noise (TV, radio) etc.

2. Effects of Noise Pollution

• Noise pollution severely affects human health. Various health problems are being reported because of noise pollution, such as -

i) Neurological disorder

ii) Anxiety

iii) Mental distress

iv) Heartattacks

v) Pathological disorder

vi) Deafiness/Impairment of hearing

vii) Sleeplessness.

• Ultrasonic sound affects digestive, respiratory cardio vascular systems and semicircular canals of the internal ear. The heart-beat rate is also affected.

• Because of loud and sudden noise brain also get adversely affected. People are subject to psychiatric illness.

3. Control Measures of Noise Pollution

1. Source control

Source control involves source modification such as :

Acoustic treatment to machine surface.

Change in machine design.

Controlling vibration of machines.

Applying proper lubrication of machine.

2. Transmission path intervention

Keeping noise source in insulating enclosure.

Constructing sound proof rooms.

3. Receptor control

This includes protection of receiver by altering the work

schedule. Using earplugs where abnormal noise is produced.

Dissipation and deflection of noise.

4. Banning noise polluting vehicles.

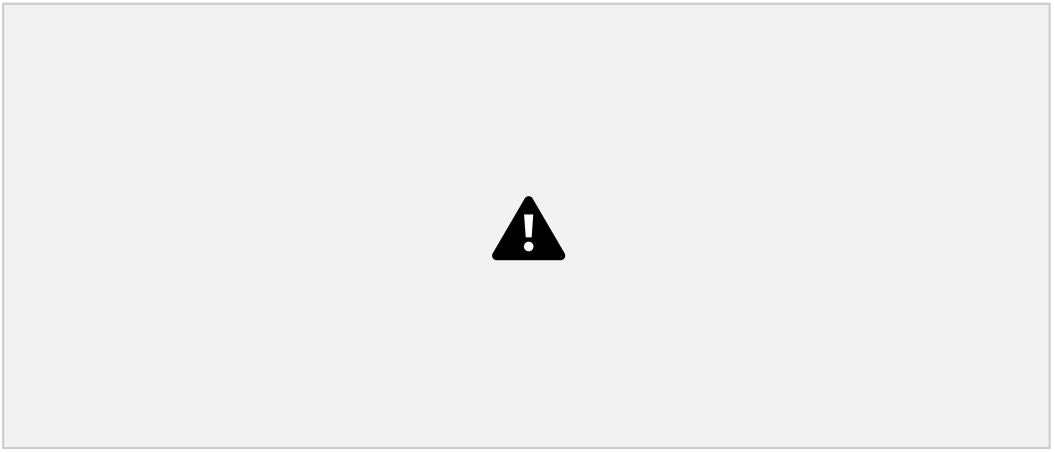
5. Plantation of trees on road side and near building can absorb

noise. 6. Enforcing noise pollution control act.

7. Educating people about noise pollution and its

consequences. **4. Ambient Noise Level**

• Ambient noise levels at different zones are listed here



Soil Pollution

Soil pollution is defined as the contamination of soil causing adverse effects on living organisms in it.

Soil Pollution

• Soil pollution is defined as the contamination of soil causing adverse effects on living organisms in it.

1. Causes of Soil Pollution

1. Soil erosion : Soil erosion can be defined as the movement of topsoil from one place to another. Soil erosion is a natural process due to wind, flood and due to human activities like - construction, overgrazing, farming and deforestation.

2. Industrial wastes : Various pollutants exists in environment from industrial wastes. Discharge from chemical industries, fertilizer company, pharmaceutical companies are highly polluting.

3. Urban wastes : Because of modem life style and eating habits the urban wastes are becoming very dangerous to the human beings. Urban wastes include both domestic and commercial wastes. Plastic is used in almost all packed foods, which is a non-degradable material and harmful to the society in long run.

4. Agricultural practice : Use of strong fertilizer, pesticides and inorganic chemicals for increasing yields causes soil pollution. Their effects can be seen even after the crop.

5. Biological agents : Human and animal excreta wastes enter the soil pores and decompose pathogenic bacteria present in those wastes spread infection.

2. Effects of Soil Pollution

1. Toxic compounds affects plant growth and human life also.
2. Water logging and salinity makes soil infertile.

3. Hazardous chemicals enter into food chain from soil disturbing the biochemical process.

4. Nervous disorders, gastrointestinal disorder, joint pain, respiratory problems are the effects seen on human beings.

3. Control Measures for Preventing Soil Pollution

1. Soil erosion must be prevented or controlled by proper tree plantation. 2. All the

wastes from industry, domestic, must be dumped with proper treatment. 3. Use of

synthetic fertilizers must be avoided instead natural fertilizers must be preferred 4.

Educate people regarding consequences of soil pollution and to prevent soil pollution. 5.

Strict enforcement of environment protection law'.

6. Toxic and non-degradable materials must be totally banned.

7. Recycling and reuse of industrial and domestic wastes can minimize soil pollution considerably.

4. Impacts of Modern Agriculture

a. Fertilizers

1. Micronutrient imbalance

• The fertilizer contents are nitrogen, phosphorous and potassium, which are macronutrients. The excess use of fertilizer causes imbalance of micronutrients, which affects the productivity of soil.

2. Blue baby syndrome (Nitrate pollution)

• Nitrate is highly soluble, they leach deep into the soil and can elevate concentrations in groundwater. This results in unacceptable quality for drinking water and may cause serious health problem called Blue Baby Syndrome which leads even to death.

3. Eutrophication

• Phosphorous does not leach but more tightly bound to soil particles. Large amount of phosphorous used in fertilizers carried with soils by runoff water and reaches water bodies causing excessive growth of aquatic plants. This process is called Eutrophication.
• If this process continues, lakes and reserviors becomes choked with algal species. These algae have offensive oders and can kill fish.

• The life of algal species are less they die quickly and pollute the water, which affect the aquatic life.

b. Pesticides

• Pesticides are used to improve the crop yield. Pesticides kill the pets.

First Generation Pesticides

Examples : Sulpher, arsenic, lead and mercury.

Second Generation Pesticides

Example : Dichlorodiphenyl Trichloromethane (DDT).

• Pesticides protect crop from losses due to pests. Pesticides kill not only the pest of concern but also a wide range of other organisms including beneficial insects. They produce number of side effects.

1. Death of non-target organisms

• Pesticides kill several non-target species which are useful to us.

2. Producing new pests (Superpests)

• Some species survice even after applying pesticides. These species generate highly resistant generation which are immune to pesticides and are called superpests.

3. Bio-magnification

• Most pesticides are note bio-degradable and keep on concentrating in food chain. This process is called bio-magnification. Pesticides in bio-magnified form is harmful to human beings.

4. Risk of cancer

• Pesticides may cause cancer as it directly acts as carcinogens and indirectly suppresses immune system.

5. Contamination of ground water

• New pesticides are soluble in water. The surface runoff carries pesticides into streams, lakes and reserviors causing unacceptable level of nutrients and organic compounds (dissolved chemicals). This results in contamination of groundwater supplies.

c. Waterlogging and its Effects

• Waterlogging is the land where water stays for most of the period.

• Waterlogging occurs where clay soil is present excessively. During waterlogging the soil gets filled with water and soil-air gets depleted. Therefore, roots of plants don't get adequate air for respiration. The soil strength decreases and crop-yield falls.

• The soil is then no longer suitable for cultivation.

Causes of waterlogging

1. When soils are over irrigated.

2. Heavy rain.

3. Inadequate drain of water.

Remedy

• Following remedy is suggested to avoid waterlogging.

1. Avoid excessive irrigation.

2. Provide adequate drainage.

3. Bio-drainage trees to avoid waterlogging e.g. Eucalyptus.

Salinity

• The unabsorbed water undergo evaporation leaving behind thin layer of dissolved salts on the top soil. The process of accumulating salts on soil is called salinity.

• The saline soils are characterized by deposition of soluble salts such as sodium chloride, calcium chloride, magnesium chloride, sodium sulphate, sodium bicarbonates and sodium carbonates.

Effects of salinity

1. Because of salinity the soil becomes alkaline and crop yield decreases

severely. 2. Salinization of land leads to stunt growth.

3. The land becomes impotent and no crop can be cultivated.

Remedy for salinity

1. The salt layer can be removed by flushing more fresh water.

2. Switch to salt tolerant crops like cotton, suger beet etc.

3. Recharge soil with fertile ones.

4. Providing underground drainage system.

Review Questions

1. What are the impacts of modern agriculture ?

2. Write the impact as of modern agriculture.

Air Pollution

Air pollution is defined as the undesirable contamination of gas. smoke, dust, fume, mist, odour or chemical particulates in the atmosphere which are injurious to human beings, plants and animals.

Air Pollution

Definition :

• Air pollution is defined as the undesirable contamination of gas. smoke, dust, fume, mist, odour or chemical particulates in the atmosphere which are injurious to human beings, plants and animals.

Causes of air pollution

1. Industrialization

2. Urbanization

3. Vehicles emission

4. Deforestation

5. Population

1. Classification of Air Pollutants

• Air pollutants can be broadly classified into two types -
1. Primary pollutants

2. Secondary pollutants

1. Primary pollutants

i) Pollutants that are emitted directly from either natural events or from human activities are called primary pollutants.

ii) The natural events are dust storms, volcano etc and human activities can be. emission from vehicles, industrial wastes.

iii) About 90 % of global air pollution is constituted by five primary

pollutants. **Examples**

i) Carbon oxides (CO and CO_2)

ii) Nitrogen oxides

iii) Sulphur oxides

iv) Hydrocarbons

v) Particulate matter.

2. Secondary pollutants

• Primary pollutants when reacting with each other or from basic components of air forms a

new pollutant called secondary pollutant.

Examples : Sulphuric acid, nitric acid, carbonic acid. etc.

2. Difference between Primary and Secondary Air Pollutants

3. Common Air Pollutants

1. Carbon monoxide (CO)

• Carbon monoxide (CO) is a colourless odourless, flammable gas, which is a product of incomplete combustion. If carbon were completely oxidized during burning, complete combustion to carbon dioxide would occur and carbon monoxide would not be a problem.
• It is important not to confuse carbon monoxide with carbon dioxide. Carbon monoxide (CO) is an incomplete combustion product and can be toxic even at low concentrations, whereas carbon dioxide (CO2) is a complete oxidation product.

Sources of carbon monoxide

• Carbon monoxide is formed whenever a carbon containing material is burned.

• **For example :** Automobile exhausts, cigarettes etc. In addition to motor vehicles, sources of carbon monoxide include burning coal, natural gas or biomass.

• Biomass combustion can be a significant source of exposure in rural areas or in underdeveloped countries where it is burned for cooking, heating and even light.

• Atmospheric oxidation of methane gas and other hydrocarbons also produces carbon monoxide.

Effects of carbon monoxide

1. Health effects

• Many thousands suffer from carbon monoxide-related illness, which include headaches, dizziness and drowsiness. Reports shows that about 11 % heart failure caused by excess carbon monoxide.

• Carbon monoxide also has other adverse effects in the body. For example, it interferes with the oxygen-carrying proteins in muscles.

• If the victim continues to receive a high dosage of CO, then permanent brain damage and even death will result. Initial symptoms include dizziness, headache, nausea and faintness.

2. Environmental effects

• It increases globe temperature.

Measures to reduce carbon monoxide

• About half of the motor vehicle carbon monoxide emissions in this country are produced by only 10 % of the vehicles. Efforts are being made to find and remove these vehicles from the road.

• Car and truck owners need to maintain their vehicles so that they operate as cleanly as they were designed to operate.
• Other measures to control carbon monoxide emissions include facilities that bum fossil fuels or wood to maintain high burning efficiencies and prohibiting open burning of trash and garbage.

2. Sulphur dioxide (SO_2)

• Sulphur dioxide (SO_2) is a colourless gas with a sharp odour that accounts for about 18 % of all air pollution.

Sources of sulphur dioxide

1. Chemical industries

2. Metal smeltings

3. Pulp and paper mills

4. Oil refineries.

Effects of sulphur dioxide

i) Health effect

• Sulphur dioxide reacts with moisture in eyes, lungs and mucous membranes to form strong irritating acid. It can trigger allergic reaction and asthama.

ii) Environmental effect

• Reduced visibility; acid deposition of H_2SO_4 can damage trees, soils and aquatic life.

• The stratospheric ozone depletion, where by sulphate particles in the stratosphere provide surfaces on which ozone-destroying reactions occur. A third major effect is the antiwarming influence they exert in global climate change.

3. Nitrogen dioxide (NO_2)

• Nitrogen dioxide is a reddish brown irritating gas. They account for about 6 % of

pollution. **Sources of nitrogen dioxide**

1. Motor vehicle exhausts

2. Gasoline

3. Volcanoes

4. Lightning

Effects of nitrogen dioxide

i) Direct, exposure of NO_2 irritates eyes and causes infection, asthma.

ii) Poisonous to plant life. HNO_3 can canoed metals and eat away stones.

4. Lead (Pb)

• Lead a highly useful metal has been mined for thousands of years. And it has been known for thousands of years that lead is toxic to the nervous system. The level of lead in modem human skeletons and teeth is at least a hundred-fold greater than the level found in pre industrial age skeletons.

Source of Lead

• The combustion of alkyl lead additives in motor fuels accounts for the major part of all lead emissions into the atmosphere. An estimated 80-90 percent of lead in ambient air derives from the combustion of leaded petrol.

. • Paint and storage batteries.

Effects of Lead

• Mental retardation, digestion problems, cancer.

• Harmful to wild life.

5. Particulate Matter

• Suspended particulate matter is defined as single particle or aggregates of particles with diameters greater than 2×10^{-10} m.

• Some particulate matter is natural i.e. rain. snow. fog. hail and mist, while others are often the result of human processes, e.g. smoke, soot and fumes.

• Some natural particulates are affected by human actions such as fog and wind-blown soils.

• Smoke and soot are the products of incomplete combustions of coal, petrol and diesel fuels in furnaces, domestic heating systems and vehicle engines.

Effects of SPM

• Aerosols are mixtures of minute solid or liquid particles suspended in air that form a haze or spoil visibility.
• The main problem to humans caused by atmospheric particulate matter is how far it is able to penetrate the respiratory system.

• Particles in the size range 30×10^{-6} to 100×10^{-6} m lodge in the nasal cavity, larynre and trachea. Some examples of particles of this size are pollen, fungal spores, cement dust and coal dust.

• Particles less than 15×10^{-6} m find their way into the bronchus and bronchioles e.g. tobacco, smoke and fumes.

• Particles of 4×10^{-6} m and less can enter the alveoli where gaseous exchange take place between tile bloodstream and air e.g. asbestos dust, glass fibre and viruses.

Sources of Suspended Particulate Matter (SPM)

• Particulate matter comes from two major sources. First, those emissions that come directly from sources such as coal combustion, wind-blown dust and quarrying. These are called primary particulates.

• Other particulates can be formed from chemical reactions between pollutant gases such as sulphur dioxide, the oxides of nitrogen and ammonia such reactions lead to the formation of solid sulphate and nitrates.

• Organic aerosols may also be formed by the oxidation of volatile organic compounds. These particulates are termed as secondary particulates.

Reducing Particulate Emissions

• Emissions of particles smaller than 10 pm in diameter (PM_{10}) are controlled to meet an 3 EPA standard of 150 micrograms per cubic meter ($\mu g/m^3$) of air.

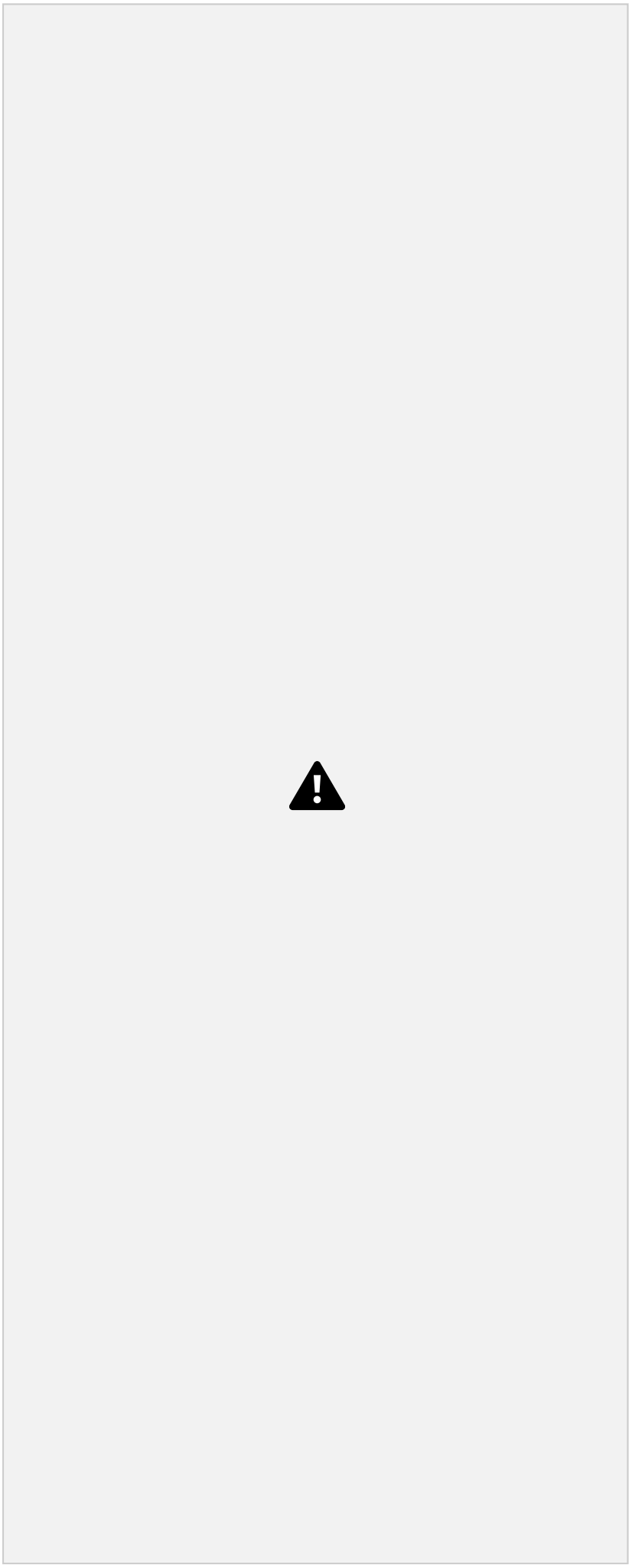
• Although many cities barely meet this standard - studies have shown Associations between very fine particulates and increased respiratory problems and premature death rates at lex els only one-third of the standard. In the near future, particulates of diameters 2.5 pm and less may be regulated.

6. Dioxins

• Dioxins are a class of chemical contaminants that are formed during combustion process

such as waste in cineration. forest fires and paper pulp bleaching.

Air Pollutants, Major Source and their Human Health Effect



4. Photochemical Smog

• Smog is a type of air pollution. The photochemical smog is a chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in atmosphere which leaves airborne particles and ground-level ozone.

• The noxious mixture of air pollutants are highly reactive and oxidizing. •

Photochemical smog is considered to be a problem of modern industrialization.

5. Control Measures for Air Pollution

• For controlling air pollution in long term, control of contaminants at their source is more desirable and effective method.

1. Source control

i) By using unleaded petrol only

ii) Use of petroleum products having low sulphur

iii) Use of public transport system rather than private vehicle

iv) Plantation of trees helps to remove particulate and carbon monoxide also they absorb

noise. v) Industries and waste disposal should be outside of city and preferably downwind of

city.

vi) Use catalytic converters to help control the emissions of carbon monoxide and hydrocarbons.

2. Control measures in industries

i) Emission rate should be restricted to permissible levels.

ii) Incorporating air pollution control equipment in design of plant layout must be made mandatory.

iii) Continuous monitoring of emission to check pollution.

Equipments used to control air pollution

i) Ensuring sufficient supply of oxygen to combustion chamber to complete the

combustion ii) Use of mechanical devices such as :

- Scrubbers
- Cyclones

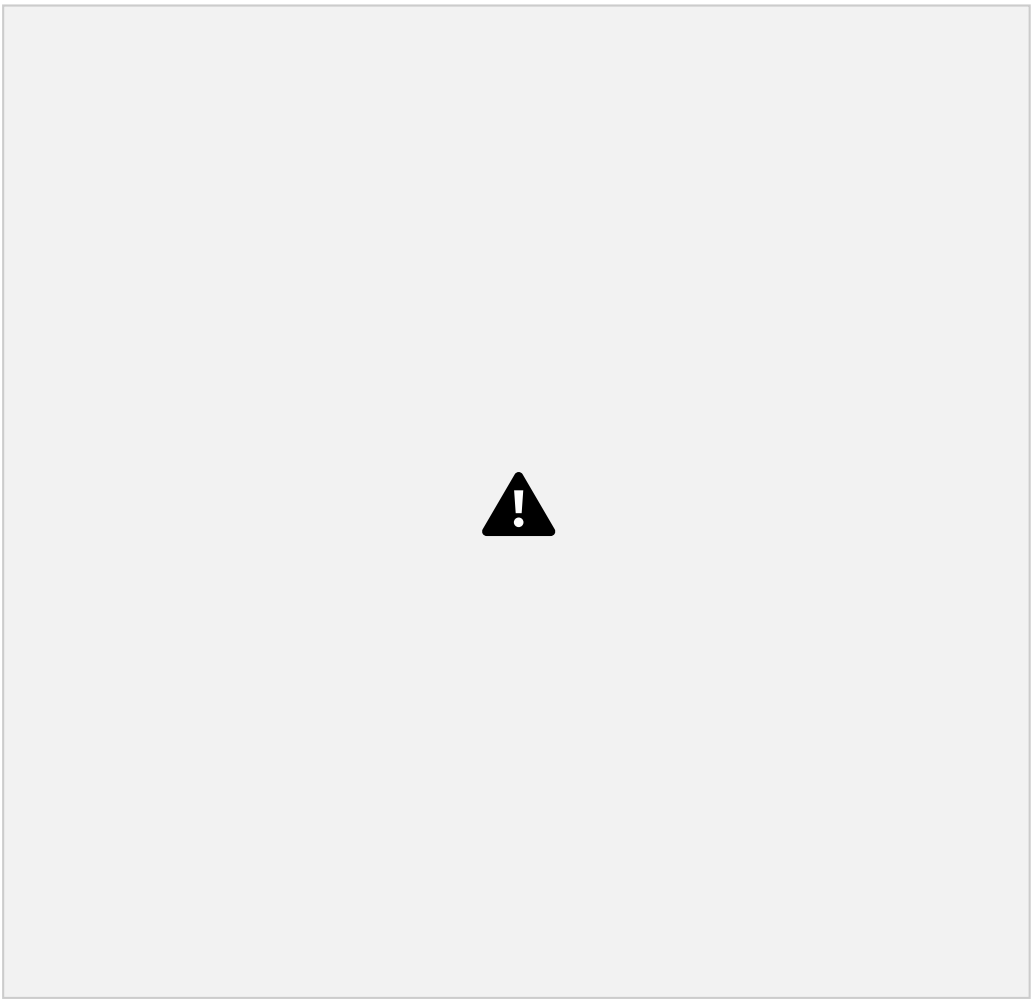
- Bag houses

- Electrostatic precipitators

• In manufacturing process, electrical power and industrial plants above devices are used for removing particulates from exhaust gases.

• All these methods retain hazardous materials of the exhaust which can be disposed of

safely. • The set scrubber can be used to remove sulphur dioxide emissions.



Review Questions

1. Define air pollution. What are the sources of air pollution ?

2. What are the global impacts of air pollution ?

Biomedical Waste : Management and Handling Rules

Bio-medical Waste (Management and Handling) Rules. 1998 were notified by the Ministry of Environment and Forests (MoEF) under the Environment (Protection) Act, 1986. These rules apply to all persons who generate, collect, receive, store, transport, treat, dispose or handle bio-medical waste in any form.

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• Thus bio medical waste should be segregated into containers/bags at the point of generation of waste. Thus colour coding and type of containers used for disposal of waste came into existence which is shown as follows :

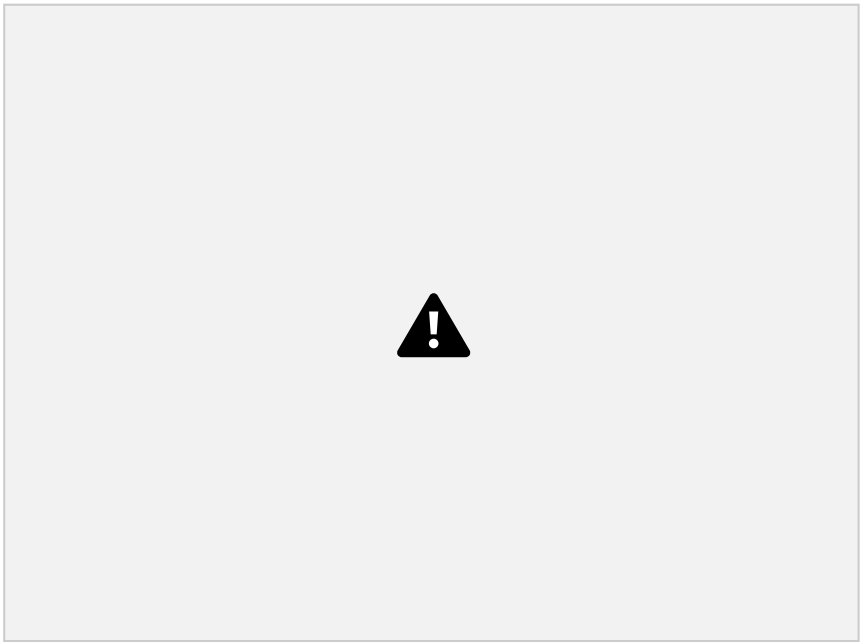
Need For BMW Management

1. Nosocomial infections in patients from poor infection control practices and poor waste management.

2. Drugs which have been disposed of, being repacked and sold off to unsuspecting buyers.

3. Risk of air, water and soil pollution directly due to waste, or due to defective incineration emissions and ash.

4. Risk of infection outside hospital for waste handlers and scavengers, other peoples. **1. Types of Biomedical Wastes**



2. Authority for Enforcement

• The authority for enforcement of the provisions of these rules in respect of all the health care facilities located in any State/Union Territory is the respective State Pollution Control Board (SPCB)/ Pollution Control Committee (PCC) and in case of health care establishments of the Armed Forces under the Ministry of Defence shall be the Director

General, Armed Forces Medical Services (DGAFMS). This rule consists of six schedules and five forms.

3. Approach for Hospital Waste Management

• Based on Bio-medical Waste (Management and Handling) Rules 1998, notified under the Environment Protection Act by the Ministiy of Environment and Forest (Government of India) following are the ways for hospital waste management.

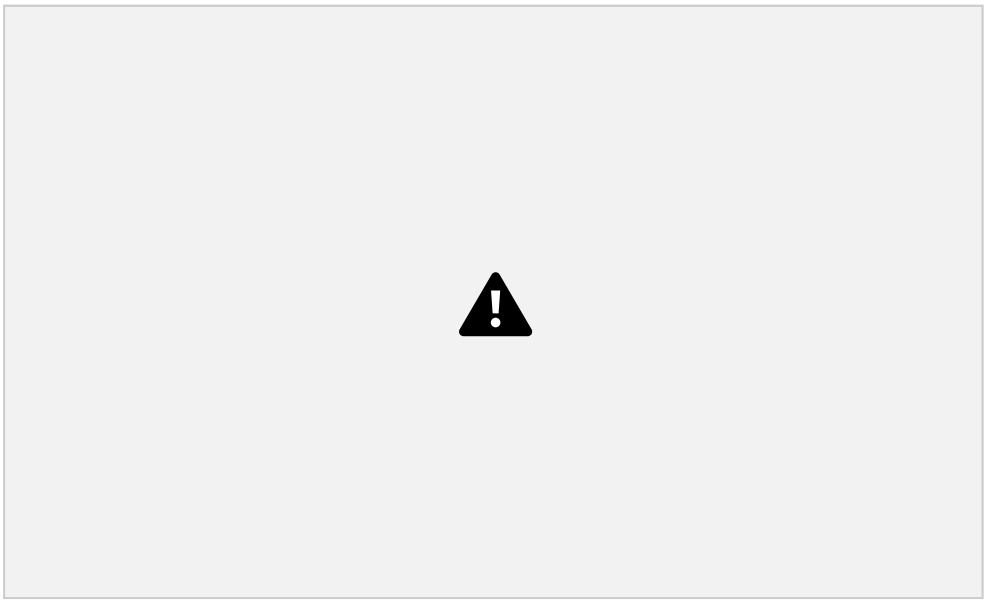
1. Segregation of waste

• Segregation, is the essence of waste management and should be done at the source of generation of Bio-medical waste e.g. all patient care activity areas, diagnostic services areas, operation theaters, labour rooms, treatment rooms etc. The responsibility of segregation should be with the generator of biomedical waste i.e. doctors, nurses, technicians etc. (medical and paramedical personnel). The biomedical waste should be segregated as per categories mentioned in the rules.

2. Collection of bio-medical waste

• Collection of bio-medical waste should be done as per Bio-medical waste (Management and Handling) Rules. At ordinary room temperature the collected waste should not be stored for more than 24 hours.

Type of container and colour code for collection of bio-medical waste



3. Transportation

• Within hospital, waste routes must be designated to avoid the passage of waste through patient care areas. Separate time should be earmarked for transportation of bio-medical waste to reduce chances of its mixing with general waste. Desiccated wheeled containers, trolleys or carts should be used to transport the waste/plastic bags to the site of storage/ treatment.

• Trolleys or carts should be thoroughly cleaned and disinfected in the event of any spillage. The wheeled containers should be so designed that the waste can be easily loaded, remains secured during transportation, do not have any sharp edges and is easy to clean and disinfect.

• Hazardous biomedical waste needing transport to a long distance should be kept in containers and should have proper labels. The transport is done through desiccated vehicles specially constructed for the purpose having fully enclosed body, lined internally with stainless steel or aluminium to provide smooth and impervious surface, which can be cleaned.

• The drivers compartment should be separated from the load compartment with a bulkhead. The load compartment should be provided with roof vents for ventilation.

4. Treatment of hospital waste

• Treatment of waste is required :

a) To disinfect the waste so that it is no longer the source of infection.

b) To reduce the volume of the waste.

c) Make waste unrecognizable for aesthetic reasons.

d) Make recycled items unusable.

5. Safety measures

• All the generators of bio-medical waste should adopt universal precautions and appropriate safety measures while doing therapeutic and diagnostic activities and also while handling the bio-medical waste.

• It should be ensured that:

a) Drivers, collectors and other handlers are aware of the nature and risk of the waste.

b) Written instructions, provided regarding the procedures to be adopted in the event of spillage/ accidents.

c) Protective gears provided and instructions regarding their use are given.
d) Workers are protected by vaccination against tetanus and hepatitis

B. **6. Measures for waste minimization**

• As far as possible, purchase of reusable items made of glass and metal should be encouraged. Select non-PVC plastic items. Adopt procedures and policies for proper management of waste generated, the mainstay of which is segregation to reduce the quantity of waste to be treated. Establish effective and sound recycling policy for plastic recycling

and get in touch with authorised manufactures.

4. Biomedical Hazardous Waste Management Rules

• Hazardous waste is defined as any waste which by reason of any of its physical, chemical, reactive, toxic, flammable, explosive or corrosive characteristics causes danger or is likely to cause danger to health or environment, whether alone or when in contact with other wastes or substances, and shall include wastes listed in Schedules I, II & III of the Rules.

• Every person who is engaged in generation, processing, treatment, package, storage, transportation, use, collection, destruction, conversion, offering for-sale, transfer or the like of the hazardous waste shall require to obtain an authorization from the State Pollution Control Board (SPCB).

• The hazardous waste shall be collected, treated, re-cycled, re-processed, stored or disposed of only in such facilities as may be authorized by the State Pollution Control Board for the purpose.

Type and Nature of HWs

1. Recyclable - Wastes having potential for recovery of useful /valuable material e.g. Metal bearing dross, ash, used oil etc.

2. Incinerable - Wastes having high calorific value, mainly organic wastes like solvents, tars, off-spec, organic products etc.

3. Land Disposable - Wastes that can neither be recycled or incinerated.

Solid Waste Management

Solid waste management is a planned process of collection, storage, transportation, processing of disposable of solid wastes in safe and economic manner.

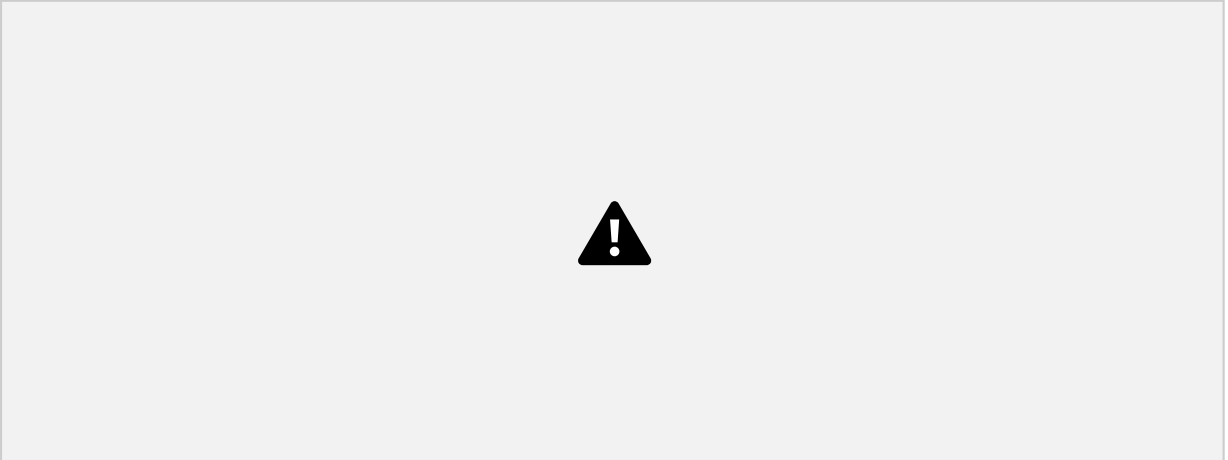
Solid Waste Management

• **Solid waste management** is a planned process of collection, storage, transportation, processing of disposable of solid wastes in safe and economic manner.
• On the basis of nature of solid wastes, it can be categorized into three

types. 1. Urban or municipal wastes.

2. Industrial wastes

3. Hazardous wastes.



1. Objective of Solid Waste Management

1. The primary objective of solid waste management is reducing and eliminating adverse impacts of waste materials on human health and environment.

2. To control, collect, process, dispose of solid wastes in an economical way consistent with the public health protection.

3. To support economic development and superior quality of life.

4. Implementation of technologically simple farm composting plants (essentially in the agricultural holdings situated near the production areas in the partners' territories), with small and adequate scales. Possibility of giving an added value to the agricultural activity through the availability of an additional source of income for managing the treatment and selling resultant compost.

5. Identification of Waste and its Minimization at the Source

6. Collection, Segregation and Storage at the Site of Collection

7. Safe transportation of Solid Waste

8. Proper treatment of Solid Waste

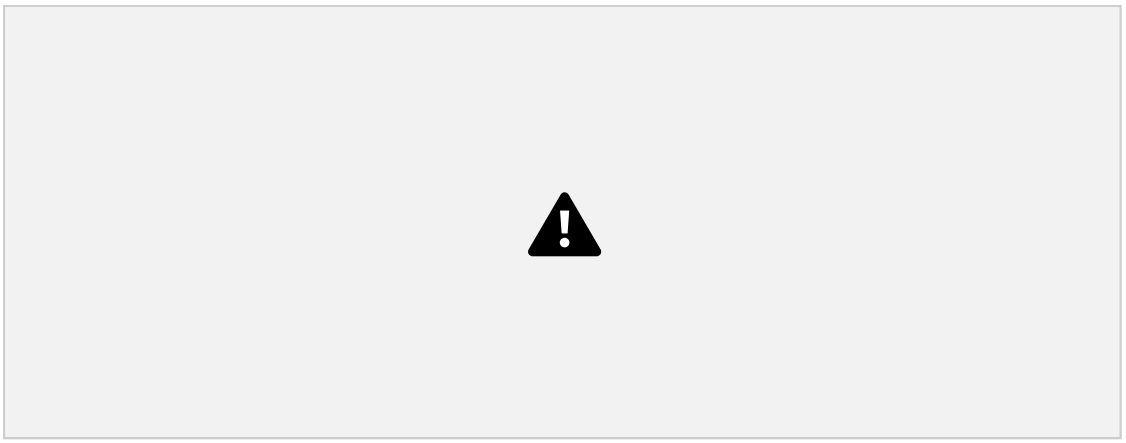
9. Energy recovery and effective disposal of solid waste.

2. Sources of Municipal / Urban Wastes

• The municipal solid waste consists of following wastes.

1. Domestic wastes 2. Commercial wastes

3. Construction wastes 4. Biomedical wastes



1. Domestic wastes

• Domestic waste includes various wastes from houses.

Examples

• Food waste, cloth, waste paper, glass, polythene, metals dust etc.

2. Commercial wastes

• Commercial wastes include waste coming out from shops, market, offices, institutions and hotels.

Examples

• Packaging material, waste papers, cans, bottles, rubber, plastic etc.

3. Construction wastes

• The construction wastes include the wastes of construction

materials. **Examples**

• Wood, concrete, debris, lime, cement, tin, Plaster of Paris (PoP) etc.

4. Biomedical wastes

• Biomedical waste includes the organic materials.

Examples

• Anatomical wastes, infectious wastes.

Types and characteristics of municipal wastes

• The municipal wastes can be categorized into two categories.

1. Bio-degradable wastes

2. Non-bio-degradable wastes

1. Bio-degradable wastes

• The urban solid waste materials, which can be degraded by micro-organisms are called bio degradable wastes.

Examples

• Food, vegetables, tea leaves, egg shells, fruits etc.

2. Non-bio-degradable

• The part of urban solid waste materials, which can not be degraded by micro-organisms are called non-bio-degradable wastes.

Examples

• Polythene bags, Plaster of Paris (PoP), scrap materials, etc.

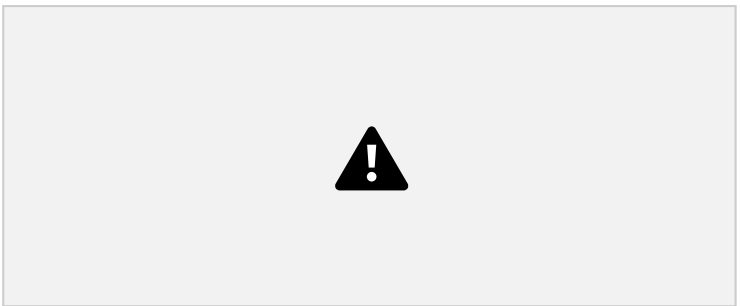
3. Sources of Industrial Wastes

• The main sources of industrial wastes are chemical industries, processing industries

etc. • The constituents of industrial waste are :

1. Nuclear power plants 2. Thermal power plants

3. Chemical industries 4. Other industries



1. Nuclear power plants

• It generates radio-active wastes

2. Thermal power plants

• Thermal power plant produces flyash, hot water, unburnt fuel.

3. Chemical Industries

• It produces large quantities of toxic-chemicals, oxides, acids.

4. Other industries

• It includes packing material, wood, scrap material, oil, paint, dyes, lime, cement, rubber, organic wastes, acids, alkalis.

4. Hazardous Wastes

• The hazardous wastes are those wastes which cause substantial danger to all living things including human, plant or animal life.

Sources of hazardous wastes

• Chemical manufacturing industries

• Petroleum refineries

• Paper mills

• Smelters

• Radio-active substances

Types arid characteristics of hazardous wastes

1. Toxic wastes

• They are poisonous even in very small amounts.

a) Acute toxicity - These wastes have immediate effect on humans or animals and causes death.

b) Chronic toxicity - It causes long term effect and slowly results in irrepairable harm.

2. Reactive wastes

• These wastes react with air. water, heat and generate toxic gases.

Examples : Gun powder, nitroglycerine.

3. Corrosive wastes

• These wastes destroy materials and living tissues by chemical

reaction. **Examples :** Acids, bases.

4. Infectious wastes

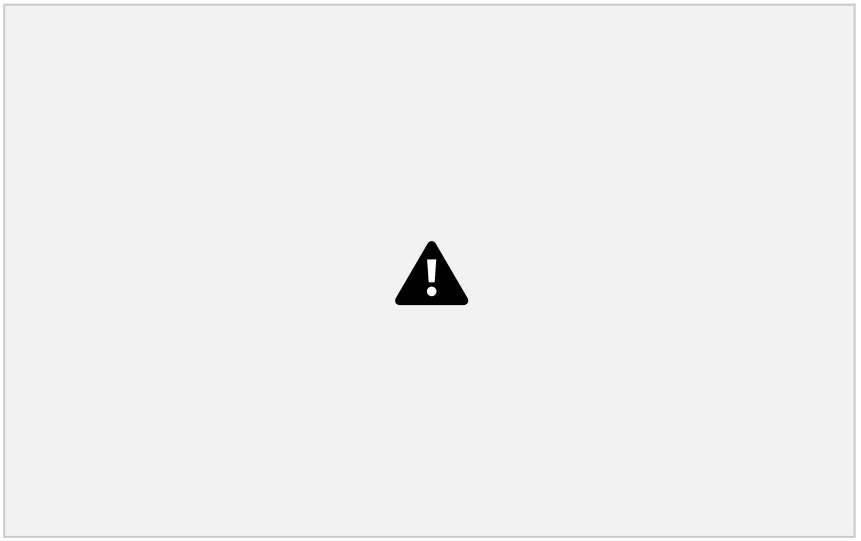
• It spreads infections to exposed persons.

Examples : Used bandages, human tissue from surgery, hypodermic needles.

5. Process in Solid Waste Management

• An integrated approach to the waste management is to be adopted. The waste management hierarchy includes following components.

1. Reduce 2. Reuse 3. Recycle 4. Recover 5. Dispose



• All above activities are arranged in a hierarchical manner. The first priority is waste avoidance, means not producing the waste. If the waste is produced then quantity should be minimized.

• The second priority is reuse i.e. maximizing recovery by reuse and recycling of suitable waste materials.

• The three components i.e. reduce, reuse and recycle together is called waste prevention.
• Once the possibilities of waste prevention are exhausted, the next priority is reduce to the volume of residual wastes being passed on for final disposal i.e. extracting resources in the form of products or energy in the process. Fig. 4.6.4 shows waste management hierarchy.

Methods of disposal of solid waste

• Disposing of municipal solid wastes can be done by any of the following methods :

1. Land fill - Spreading waste on land after few years it becomes compact which is then covered by soil.

2. Incineration - Waste is reduced by burning and then disposed.

3. Composting - Organic waste is fertilized or decomposed making it useful for growing plants and trees.

6. Green Chemistry

• Green chemistry is a philosophy of chemical research and engineering that encourages the design of products and process that minimizes the use and generation of hazardous substances. It is also called as sustainable chemistry.

• **Twelve principles of Green chemistry**

1. Prevention

2. Atom economy

3. Less hazardous chemical syntheses

4. Designing safer chemicals

5. Safer solvents and auxiliaries

6. Design of energy efficiency

7. Use of renewable feed stock

8. Reduce derivates

9. Catalysis

10. Design for degradation

11. Real time analysis for pollution prevention

12. Inherently safer chemistry for accident prevention.