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SCHOOL OF MANAGEMENT STUDIES

UNITI - ENVIRONMENTAL STUDIES - SBAA1204

SYLLABUS - UNIT 1 - INTRODUCTION AND ECO SYSTEMS

Multidisciplinary Nature of Environmental Studies - Scope and Importance - Concept of sustainability and Sustainable Development. Eco systems- Meaning - Structure and function of ecosystem - Energy flow in an ecosystem - food chains, food webs and ecological succession - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

ENVIRONMENT

The word environment is derived from the French word _environner 'which means to encircle or surround'. Thus our environment can be defined as –the Social, Cultural and Physical conditions that surround, affect and influence the survival, growth and development of people, animals and plants| This broad definition includes the natural world and the technological environment as well as the cultural and social contexts that shape human lives. It includes all factors (living and nonliving) that affect an individual organism or population at any point in the life cycle; set of circumstances surrounding a particular occurrence and all the things that surrounds us.

Environment consists of four segments.

- Atmosphere- Blanket of gases surrounding the earth.
- Hydrosphere- Various water bodies present on the earth.
- Lithosphere- Contains various types of soils and rocks on the earth.
- Biosphere- Composed of all living organisms and their interactions with the environment.

Multidisciplinary nature of environmental studies

- The Environment studies is a multi-disciplinary science because it comprises various branches of studies like chemistry, physics, medical science, life science, agriculture, public health, sanitary engineering etc.
- It is the science of physical phenomena in the environment. It studies about the sources, reactions, transport, effect and fate of physical and biological species in the air, water, soil and the effect of from human activity upon these.
- As the environment is complex and actually made up of many different environments like natural, constructed

- Multidisciplinary Nature of Environmental Studies and cultural environments, environmental studies is inter disciplinary in nature including the study of biology, geology, politics, policy studies, law, religion engineering, chemistry and economics to understand the humanity‘s effects on the natural world.

- Multidisciplinary Nature of Environmental Studies educates the students to Appreciate the complexity of environmental issues and citizens and experts in many fields.

- By studying environmental science, students may develop a breadth of the interdisciplinary and methodological knowledge in the environmental fields that enables them to facilitate the definition and solution of environmental problems.

Meaning of Environmental Studies:

Environmental studies are the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Objectives and Guiding Principles of Environmental Studies:

According to UNESCO (1971), the objectives of environmental studies are:

- Creating the awareness about environmental problems among people.
- Imparting basic knowledge about the environment and its allied problems.
- Developing an attitude of concern for the environment.
- Motivating public to participate in environment protection and environmentimprovement.
- Acquiring skills to help the concerned individuals in identifying and solving environmental problems.
- Striving to attain harmony with Nature.

Need of Public Awareness about Environment:

The environment studies enlighten us, about the importance of protection and conservation of our natural resources, indiscriminate release of pollution into the environment etc.

- In today‘s world because of industrialization and increasing population, the natural resources has been rapidly utilized and our environment is being

increasingly degraded by human activities, so we need to protect the environment.

- It is not only the duty of government but also the people to take active role for protecting the environment, so protecting our environment is economically more viable than cleaning it up once, it is damaged. The role of mass media such as newspapers, radio, television, etc to make people aware regarding environment.

- There are various institutions, which are playing positive role towards environment to make people aware regarding environment like BSI (Botanical Survey of India, 1890), ZSI (Zoological Survey of India, 1916), WII (Wild Life Institute of India, 1982) etc.

Significance of Environment studies

Environment Issues being of International Importance: It has been well recognized that environment issues like global warming, ozone depletion, acid rain, marine pollution and loss of biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

Problems due to urbanization and development in all sectors: Development, in its wake gave birth to Urbanization, Industrial Growh, Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed world. The North, to cleanse their own environment has, fact fully, managed to move dirty‘factories to South. When the West developed, it did so perhaps in ignorance of the environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.

Increase in Pollution: World census reflects that one in every seven persons in this plant lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

Need for An Alternative Solution: It is essential, especially for developing countries to find alternative paths to an alternative goal. We need a goal asunder:

- A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.
- A goal common to all citizens of our earth.
- A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the –developed world.

Need to save humanity from extinction: It is incumbent upon us to save the humanity from extinction. Consequences to our activities cause destructing the environment and

Depleting the biosphere, in the name of development.

Need for wise planning of development: Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to be synchronized with the ecological cycles in any plan of development. Our action should be planned ecologically for the sustenance of the environment and development.

SCOPE OF ENVIRONMENTAL STUDIES

Environmental studies as a subject has a wide scope. It includes a large number of areas and aspects, which may be summarized as follows:

- **Natural resources- their conservation and management**
- **Ecology and Biodiversity**
- **Environmental pollution and control**
- **Human population and environment**
- **Social issues in relation to development andenvironment**

These are the basic aspects of environmental studies which have a direct relevance to every section of society. Several career options have emerged in these fields that are broadly categorized as:

- **Research and development in environment:** Skilled environmental scientists have an important role to play in examining various environmental problems in a scientific manner and carry out R&D activities for developing cleaner technologies and promoting sustainable development.
- **Green advocacy:** With increasing emphasis on implementing various Acts and Laws related to environment, need for environmental lawyers has emerged, who should be able to plead the cases related to water, air, forest, wildlife, pollution and control etc.
- **Green marketing:** While ensuring the quality of products with ISO mark, now there is an increasing emphasis on marketing goods that are environment friendly. Such products have Eco mark or ISO 14000 certification. Environmental auditors and environmental managers would be in great demand in the coming years.
- **Green media:** Environmental awareness can be spread amongst masses through mass media like television, radio, newspaper, magazine, hoardings, advertisements etc., for which environmentally educated persons are required.

- **Environmental consultancy:** Many non-government organizations, industries and Government bodies are engaging environmental consultants for systematically studying and tackling environment related problems.

IMPORTANCE OF ENVIRONMENTAL STUDIES

- At present a great number of environmental issues, have grown in size and complexity day by day, threatening the survival of mankind on earth. These issues are studiedbesides giving effective suggestions in the environment studies.
- The environment studies enlighten us, about the importance of protection and conservation of our natural resources, indiscriminate release of pollution into the environmentetc.
- The importance of environmental studies is that, the current trend of environmental degradation can be reversed if people of educated communities are organized, empowered and experts are involved in sustainable development.
- Environmental factors greatly influence every organism and their activities.

Environment studies have become significant for the following reasons:

- **Environment Issues being of International Importance**: : It has been well recognized that environment issues like global warming, ozone depletion, acid rain, marine pollution and loss of biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.
- **Problems Cropped in The Wake of Development**: Development, in its wake gave birth to Urbanization, Industrial Growth, Transportation Systems, Agriculture and Housing etc. However, it has become phased out in the developed world. The North, to cleanse their own environment has, fact fully, managed to move _dirty ‘factories to South. When the West developed, it did so perhaps in ignorance of the environmental impact of its activities. Evidently such a path is neither practicable nor desirable, even if developing world follows that.
- **Explosively Increase in Pollution:** World census reflects that one in every seven

persons in this plant lives in India. Evidently with 16 per cent of the world's population and only 2.4 per cent of its land area, there is a heavy pressure on the natural resources including land. Agricultural experts have recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

- **Need for An Alternative Solution:** It is essential, especially for developing countries to find alternative paths to an alternative goal. We need a goal as under:
    - A goal, which ultimately is the true goal of development an environmentally sound and sustainable development.
    - A goal common to all citizens of our earth.
    - A goal distant from the developing world in the manner it is from the over-consuming wasteful societies of the ―developed world.
- **Need to Save Humanity From Extinction**: It is incumbent upon us to save the humanity from extinction. Consequences to our activities cause destructing the environment and depleting the biosphere, in the name of development.
- **Need for Wise Planning of Development:** Our survival and sustenance depend. Resources withdraw, processing and use of the product have all to be synchronized with the ecological cycles in any plan of development. Our actions should be planned ecologically for the sustenance of the environment and development.

SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT

Sustainability focuses on balancing that fine line between competing needs - our need to move forward technologically and economically, and the needs to protect the environments in which we and others live.

Concept of Sustainability

The term –sustainable development first came to prominence in the world Conservation Strategy (WCS) in 1980.

Sustainability is not just about the environment. it's also about our health as a society in ensuring that no people or areas of life suffer as a result of environmental legislation, and it's also about examining the longer term effect s of the actions humanity takes and asking questions about how it may be improved.

The definition of –sustainability is the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance.

NEED FOR SUSTAINABILITY

- It also acknowledges that human civilization takes resources to sustain our modern way of life. Sustainability takes into account how we might live in harmony with the natural world around us, protecting it from damage and destruction
- The present modern living style has changed and major of the consumerist are based on urban existence throughout the developed world and we consume a lot of natural resources every day.
- In our urban centres, we consume more power than those who live in rural settings and urban centres use a lot more power than average, keeping our streets and civic buildings lit, to power our appliances, our heating and other public and household power requirements.
- That's not to say that sustainable living should only focus on people who live in urban centres though, there are improvements to be made everywhere - it is estimated that we use about 40% more resources every year than we can put back and that needs to change .

The principles of a sustainable society are

- Respect and care for the community of life.
- Improve the quality of human life.
- Conserve the Earth's vitality and diversity.
- Minimize the depletion of non-renewable resources.
- Keep within the Earth's carrying capacity.
- Change attitudes and practices.
- Enable communities to care for their own environments.
- Provide a national framework for integrating development and conservation.
- Create a global alliance.

Sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Gro Harlem

Brundtland first introduced the concept of sustainable development in 1987. He was then the Prime Minister of Norway and chairman of the World Commission on Environment and Development. In the year 1987, the World Commission on Environment and Development (WCED) is introduced the term sustainable development in its report common future (the Brundtland Commission).

According to WCED, sustainable development may be defined as a process of changes in which the exploitation of resources, direction of investments, the orientation of technological development and the institutional changes are in harmony and enhance both current and future potential to meet human need as aspiration.

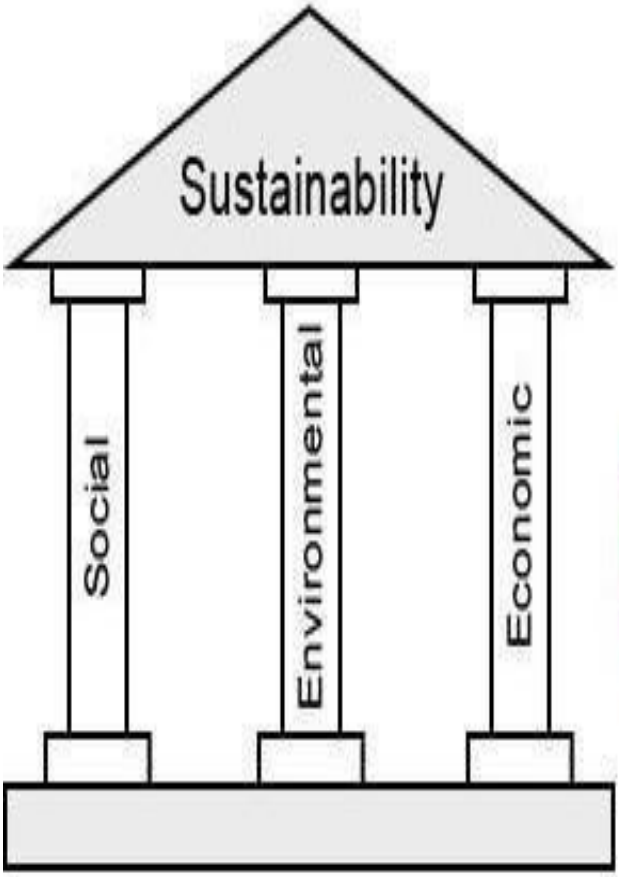
CONCEPTS OF SUSTAINABLE DEVELOPMENT

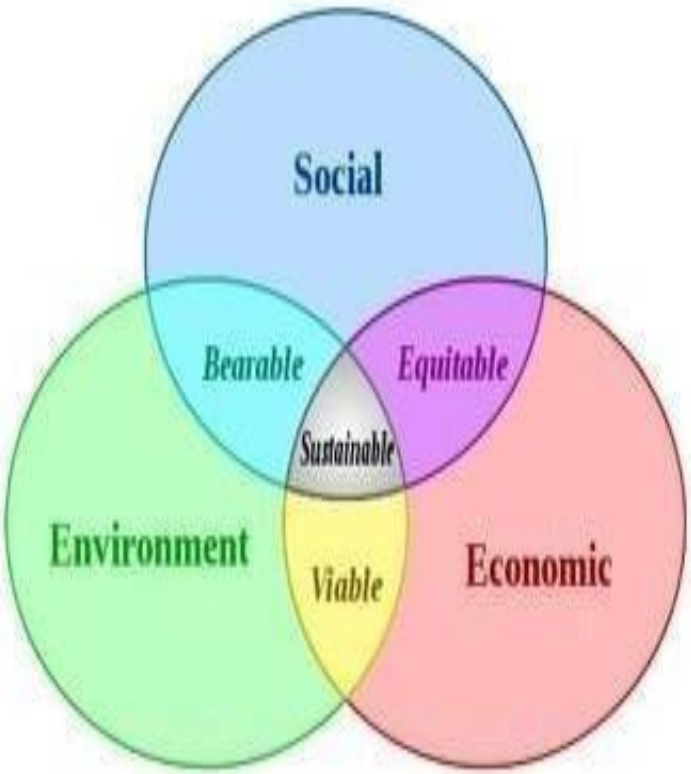
The first concept considers earth‘s carrying capacity and stresses on natural resources like forest, soil fertility, healthy wetlands, ozone layer etc. which provide basic requirements of human being.

The second concept focuses on balancing of economical, social and ecological goals which include the basic needs like health, literacy, democratic values etc. However, both the concepts are concerned with quality of life and conservation of environment.

Three Pillars of Sustainability

The three pillars of sustainability are a powerful tool for defining the Sustainable Development problem. This consists of three parameters: Economic, Social, and Environmental pillars. If anyone pillar is weak then the system as a whole is unsustainable. Two popular ways to visualize the three pillars are shown in the figure below:


Sustainability
Social
Environmental
Economic


Social
Bearable
Equitable
Sustainable
Environment
Viable
Economic

Social Sustainability

Social Sustainability is the ability of a social system, such as a country, family, or organization, to function at a defined level of social well-being and harmony indefinitely. Problems like war, endemic poverty, widespread injustice, and low education rate are symptoms of a system that is socially unsustainable.

Environmental Sustainability

Environmental Sustainability is the ability of the environment to support a defined level of environmental quality and natural resource extraction rates indefinitely. This is the world's biggest actual problem, though, since the consequences of not solving the problem now are delayed, the problem receives too low a priority to be solved.

The sustainability in environmental restoration programme considers the following key issues:

- Stabilization of population growth
- Conservation and rational exploitation of forest resources.
- Afforestation in waste lands and deforested areas.
- Control of pollution (Air, water, land etc.)
- Maintenance of sustainability in agriculture
- Recycling of waste and residue
- Conservation of biodiversity
- Development of non-polluting renewable energy stems.
- Updating environmental laws and its strict imposition.
- Assessment of ecological security.

Economic Sustainability

Economic Sustainability is the ability of an economy to support a defined level of economic production indefinitely. Since the Great Recession of 2008 this is the world's biggest apparent problem which endangers progress due to environmental sustainability problem. Since development activities are always associated with environmental

degradation, sustainability in development has to enter in all our planning processes as important parameter.

Measures to improve sustainable development

- The input of matter and energy should be reduced up to their limiting values.
- The exhaustible and polluting fossil fuels should be replaced by less harmful renewable energy.
- Technology should be developed which provides essential goods with minimum waste in a non-polluted manner.
- The population growth should be slow down which will reduce stress on global life support.
- There should be strict implementation of environmental laws.
- Steps should be taken for the conservation of forest, conservation of biodiversity, recycling a of wastes, control of pollution etc.
- There should be integrated land use planning.
- Environmental education should be made compulsory to create awareness about the basic environmental issues.

ECOSYSTEMS

Ecology

The term _ecology 'was first coined by Hons Reiter and Haekel in 1869.. Ecology is the study of interactions among organisms (or) group of organisms with their environment.

A group of organisms interacting among themselves and with environment is known as ecosystem. A system of interaction of organisms with their surroundings (i.e., environment) is called as –ecosystem‖. "**Ecosystem is a complex in which habitat, plants and animals are considered as one interesting unit, the materials and energy of one passing in and out of the others" – Woodbury Characteristics of Ecosystem**

- Eco system is the basic functional unit of ecology.
- It contains both biotic and abiotic components.
- The function of ecosystem is related to the cycling of matter (materials) and flow of energy.
- The amount of energy needed to maintain an ecosystem depends on itsstructure.
- Ecosystem passes from a less complex state to more complex state, which is called as—ecological succession‖.

Structure of Ecosystem: The structure of an ecosystem is basically a description of the

Organisms and physical features of environment including the amount and distribution of nutrients in a particular habitat. It also provides information regarding the range of climatic conditions prevailing in the area.

From the structure point of view, all ecosystems consist of two basic components:

1. Abiotic components
2. Biotic components

1. Abiotic Components:

Ecological relationships are manifested in physicochemical environment. Abiotic component of ecosystem includes basic inorganic elements and compounds, such as soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds (by-products of organic activities or death).It also includes such physical factors and ingredients as moisture, wind currents and solar radiation. Radiant energy of sun is the only significant energy source for any ecosystem. The amount of non-living components, such as carbon, phosphorus, nitrogen, etc. that are present at any given time is known as standing state or standing quantity.

2. Biotic Components:

The biotic components include all living organisms present in the environmental system.

From nutrition point of view, the biotic components can be grouped into two basic components:

(i) Autotrophic components, and
(ii) Heterotrophic components

The autotrophic components include all green plants which fix the radiant energy of sun and manufacture food from inorganic substances. The heterotrophic components include non-green plants and all animals which take food from autotrophs.

Components of eco-systems:

Producers (Autotrophic elements):

The producers are the autotrophic elements—chiefly green plants. They use radiant energy of sun in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy. The chemical energy is actually locked up in the energy

rich carbon compounds. Oxygen is evolved as by-product in the photosynthesis.

This is used in respiration by all living things. Algae and other hydrophytes of a pond, grasses of the field, and trees of the forests are examples of producers. Chemosynthetic bacteria and carotenoid bearing purple bacteria that also assimilate CO_2 with the energy of sunlight but only in the presence of organic compounds also belong to this category.

Consumers:

Those living members of ecosystem which consume the food synthesized by producers are called consumers. Under this category are included all kinds of animals that are found in an ecosystem.

There are different classes or categories of consumers, such as:

(a) Consumers of the first order or primary consumers,

(b) Consumers of the second order or secondary consumers,

(c) Consumers of the third order or tertiary consumers, and

(d) Parasites, scavengers and saprobes.

(a) Primary consumers:

These are purely herbivorous animals that are dependent for their food on producers or green plants. Insects, rodents, rabbit, deer, cow, buffalo, goat are some of the common herbivores in the terrestrial ecosystem, and small crustaceans, mollusks, etc. in the aquatic habitat. Elton (1939) named herbivores of ecosystem as –key industry animals|. The herbivores serve as the chief food source for carnivores. **(c) Tertiary consumers:** These are the top carnivores which prey upon other carnivores, omnivores and herbivores. Lions, tigers, hawk, vulture, etc. are considered as tertiary or top consumers.

(d) Besides different classes of consumers, the parasites, scavengers and saprobes are also included in the consumers. The parasitic plants and animals utilize the living tissues of different plants and animals. The scavengers and saprobes utilize dead remains of animals and plants as their food.

Decomposers and transformers:

Decomposers and transformers are the living components of the ecosystem and they are

matters are then attacked by another kind of bacteria, the transformers which change these organic compounds into the inorganic forms that are suitable for reuse by producers or green plants. The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems. fungi and bacteria. Decomposers attack the dead remains of producers and consumers and degrade the complex organic substances into simpler compounds. The simple organic

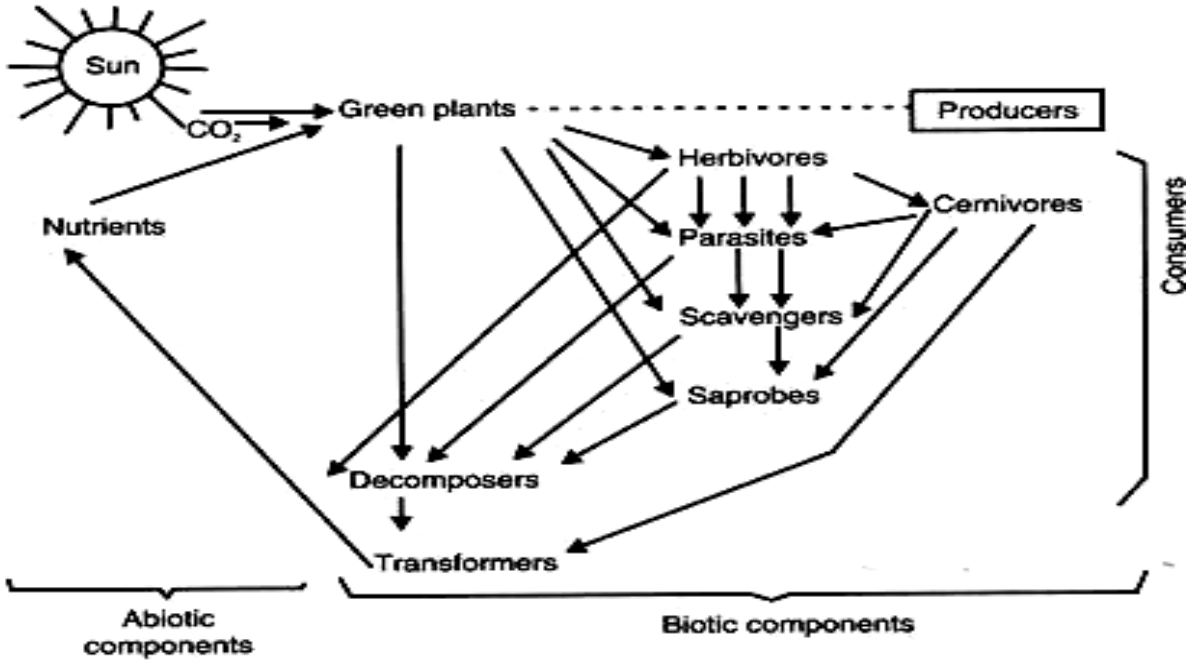


Fig. 3.1. Different components of ecosystem.

FOOD CHAIN

Food Chain in Ecosystem

For an ecosystem to work there has to be a flow of energy within it. The organisms of the ecosystem need energy in the form of food. The ultimate source of this energy is the sun. Producers like green plants trap solar energy and convert it into the chemical energy of food. When a primary consumer eats the producer, a part of this energy is passed on to it.

Some common food chains are mentioned below:

Plants → Deer → Lion

Plants → Worm→ Bird → Cat

Algae→ Small→ animal → Small fish → Big fish —> Bird

Plants→ Grasshopper→ Frog→ Snake→ Hawk

Types of consumers in a food chain:

Herbivores (or) Primary Consumers (Plant Eaters): Animals that eat only plants are called Herbivores. They directly depend on the plants for their food. So they are called Plant eaters.

Examples: Insects, goat, deer, cow, horse, etc.

Carnivores (or) Secondary Consumers (Meat Eaters): Animals that eat other animals are called carnivores. They directly depend on the herbivores for their food. Examples: Frog, cat, snake & foxes,etc.

Omnivores: Animals that eat both plants and animals are called omnivores. They depend on both herbivores and carnivores for their food. Examples: humans, tigers, lions, rats and fox etc.

Detritivores: (Detritifeeder): Animals that eat dead organisms and waste of living are called detritivores. Examples: beetles, termites, ants, crabs, earthworms, etc.

Decomposers (or) Saptrotrophs: Decomposers attack the dead bodies of producers and consumers and decompose them into simple compounds. During the decomposition inorganic nutrients are released. The organisms which break down the complex compounds into simple products are called decomposers (or) reducers.Examples: micro-organisms such as bacteria and fungi, etc.

Abiotic Components: The non-living component of an ecosystem is called –abiotic component These non- living components enter the body of living organism, take part in metabolic activities and then return to the environment.

The abiotic component of the ecosystems divided into three portions.

1. Climate factors : Solar radiation, temperature, wind, water current, rainfall,etc.
2. Physical factors : light, fire, soil, air,etc.
3. Chemical factors: Organic and Inorganicsubstances.

Examples of various types of food chain

The primary consumer is then eaten by a secondary consumer. And the secondary consumer may be eaten by a tertiary consumer, and so on. In this way energy gets transferred from one consumer to the next higher level of consumer. In a forest ecosystem, grass is eaten by a deer, which in turn is eatenby a tiger. The grass, deer and tiger forma food chain.

A food chain always begins with producers. Herbivores (plant-eaters) come next in the chain. They are consumed by carnivores (flesh-eaters). A few food chains can be long and may extend to the fourth, fifth or even sixth order of consumers.

In this food chain, energy flows from the grass (producer) to the deer (primary consumer) to the tiger (secondary consumer).

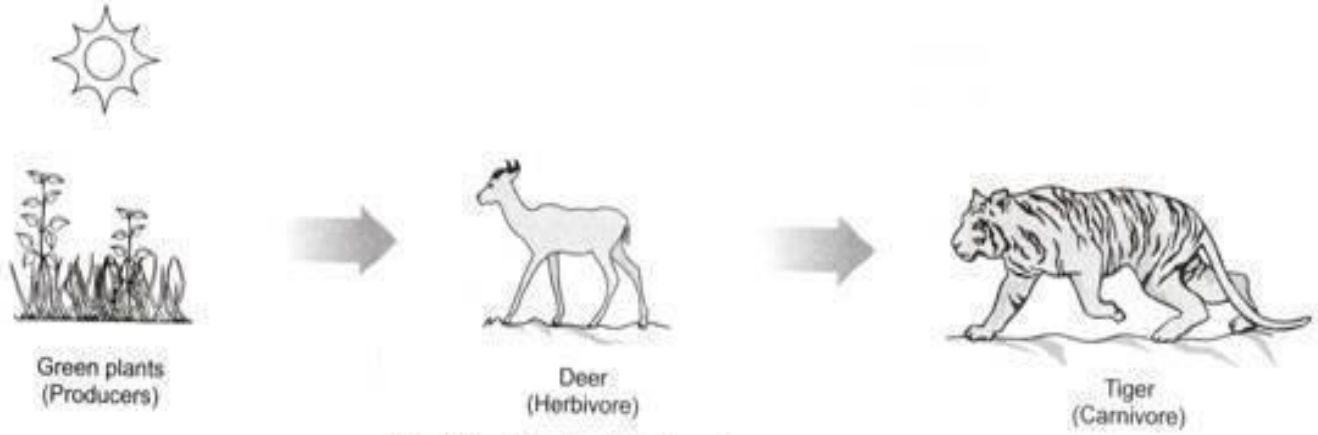


Fig. 8.2 A food chain in a forest ecosystem

A food chain in a grassland ecosystem may consist of grasses and other plants, grasshoppers, frogs, snakes and hawks

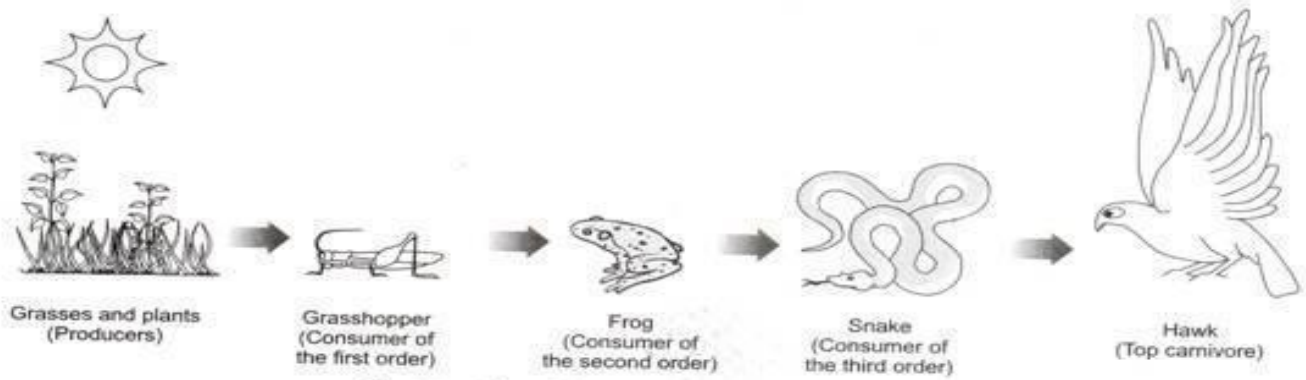


Fig. 8.3 A food chain in a grassland ecosystem

In a freshwater aquatic ecosystem like a pond, the organisms in the food chain include algae, small animals, insects and their larvae, small fish, big fish and a fish-eating bird or animal (Figure 8.4).

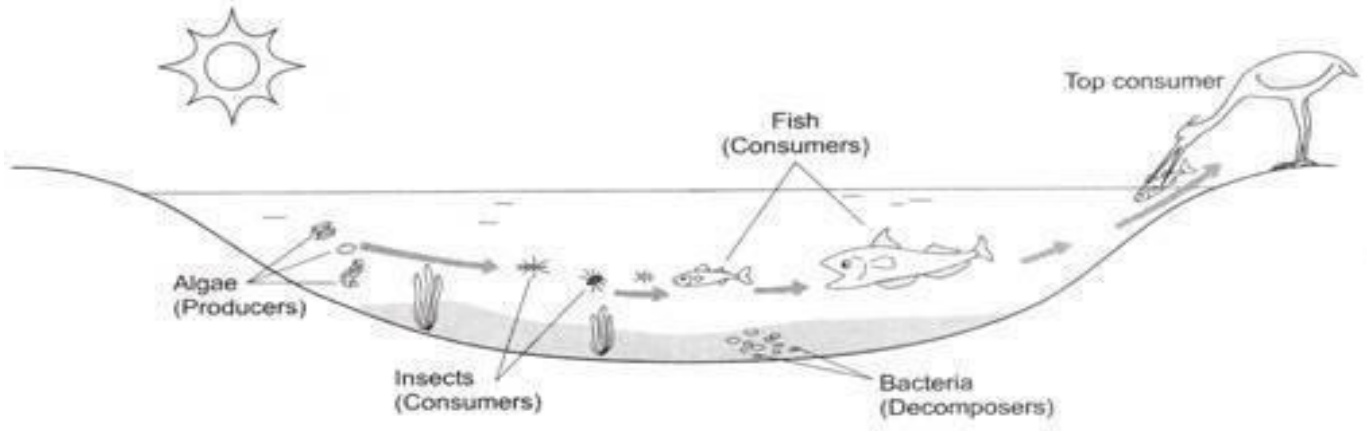


Fig. 8.4 A food chain in a freshwater pond

In a freshwater aquatic ecosystem like a pond, the organisms in the food chain include above

Food web and ecological succession

Food chains in natural conditions never operate as isolated sequences, but are interconnected with each other forming interlocking pattern, which is referred to as a food web. Food webs are basic units of ecosystem ecology. Under natural conditions, the linear arrangement of food chains hardly occurs and these remain indeed interconnected with each other through different types of organisms at different trophic levels.

For example, in grazing food chain of grassland, in the absence of rabbit, grass may also be eaten by mouse. The mouse in turn may be eaten directly by hawk or by snake first which is then eaten by hawk. Thus, in nature there are found alternatives which all together constitute some sort of interlocking pattern and are called the food web.

The following diagram shows five possible food chains interlocked together making the food web.

1. Grass- Grass hoper – hawk
2. Grass - Grass hoper- lizard-hawk
3. Grass- Rabbit-hawk
4. Grass- Mouse-hawk
5. Grass - Mouse - snake- hawk

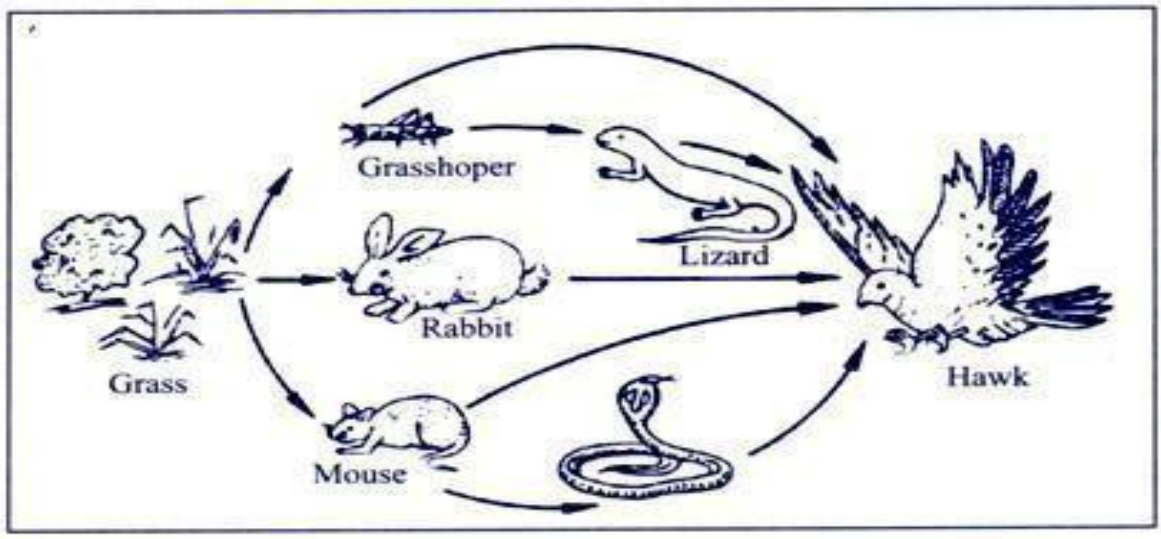


Fig. 1.1 Diagrammatic sketch showing a food web in a grassland ecosystem.

A balanced ecosystem is essential for the survival of all living organisms of the system. For instance, had primary consumers (herbivores) not been in nature producers would have perished due to overcrowding and competition.

Similarly, the survival of primary consumers is linked with the consumers (carnivores) and so on. Thus, each species of any ecosystem is indeed kept under some sort of a natural check so that the system may remain balanced.

Factors affecting the complexity of any food web

(i) Length of the food chain. Diversity in the organisms based upon their food habits would determine the length of food chain. More diverse the organisms in food habits, longer would be food chain.

(ii) Alternatives at different points of consumers in the chain. More the alternatives more would be the interlocking pattern. In deep oceans, seas, where we find a variety of organisms, the food webs are much complex.

Ecological Succession

Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing.

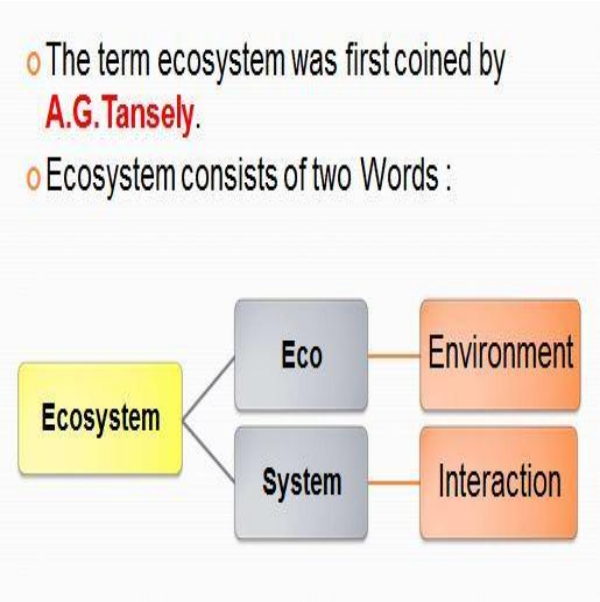
There are two main types of succession, primary and secondary

1. Primary succession is the series of community changes which occur on an entirely new habitat which has never b e e n colonized before. For example, a newly quarried rock face or sand dunes. Secondary succession is the series of community changes which take place on a previously colonized, but disturbed or damaged habitat. For example, after felling trees in a woodland, land clearance or a fire.

2. Primary succession is the series of community changes which occur on an entirely new habitat which has never been colonized before. Examples of such habitats would include newly exposed or deposited surfaces, such as landslips, volcanic lava and debris, elevated sand banks and dunes, quarried rock faces. A number of serial stages will take place in which an initial or 'pioneer' community will gradually develop through a number of different communities into a 'climax' community, which is the final stage.

ECO SYSTEM

An ecosystem consists of all the living and non-living things in a specific natural setting. Plants, animals, insects, microorganisms, rocks, soil, water and sunlight are major components of many ecosystems.



Tundra Ecosystems

As with deserts, a harsh environment characterizes ecosystems in the tundra. In the snow- covered, windswept, treeless tundra, the soil may be frozen year-round, a condition known as permafrost. During the brief spring and summer, snows melt,

producing shallow ponds which attract migrating waterfowl. Lichens and small flowers may become visible during this time of year. The term –tundra| most commonly denotes polar areas, but at lower latitudes, tundra-like communities known as alpine tundra may be found at high elevations.

Freshwater Ecosystems

Freshwater ecosystems can be found in streams, rivers, springs, ponds, lakes, bogs and freshwater swamps. They are subdivided into two classes: those in which the water is nearly stationary, such as ponds, and those in which the water flows, such as creeks. Freshwater ecosystems are home to more than just fish: algae, plankton, insects, amphibians and underwater plants also inhabit them.

Marine Ecosystems: Marine ecosystems differ from freshwater ecosystems in that they contain saltwater, which usually supports different types of species than does freshwater. Marine ecosystems are the most abundant types of ecosystems in the word. They encompass not only the ocean floor and surface but also tidal zones, estuaries, salt marshes and saltwater swamps, mangroves and coral reefs.

Types of Ecosystems

1. Forest Ecosystems

Forest ecosystems are classified according to their climate type as tropical, temperate or boreal. In the tropics, rainforest ecosystems contain more diverse flora and fauna than ecosystems in any other region on earth. In these warm, moisture-laden environments, trees grow tall and foliage is lush and dense, with species inhabiting the forest floor all the way up to the canopy. In temperate zones, forest ecosystems may be deciduous, coniferous or oftentimes a mixture of both, in which some trees shed their leaves each fall, while others remain evergreen year-round. In the far north, just south of the Arctic, boreal forests – also known as taiga – feature abundant coniferous trees. It is a natural ecosystem consisting of dense growth of trees and wild animals

(a) Temperate Forest Ecosystem:

The temperate forest ecosystem is very important on Earth. Temperate forests are in regions where the climate changes a lot from summer to winter. Tropical rain forests are in regions where the climate stays constant all year long. Temperate forests are almost

always made of two types of trees, deciduous and evergreen. Deciduous trees are trees that lose their leaves in the winter.

(b) The Tropical Rain Forest Ecosystem:

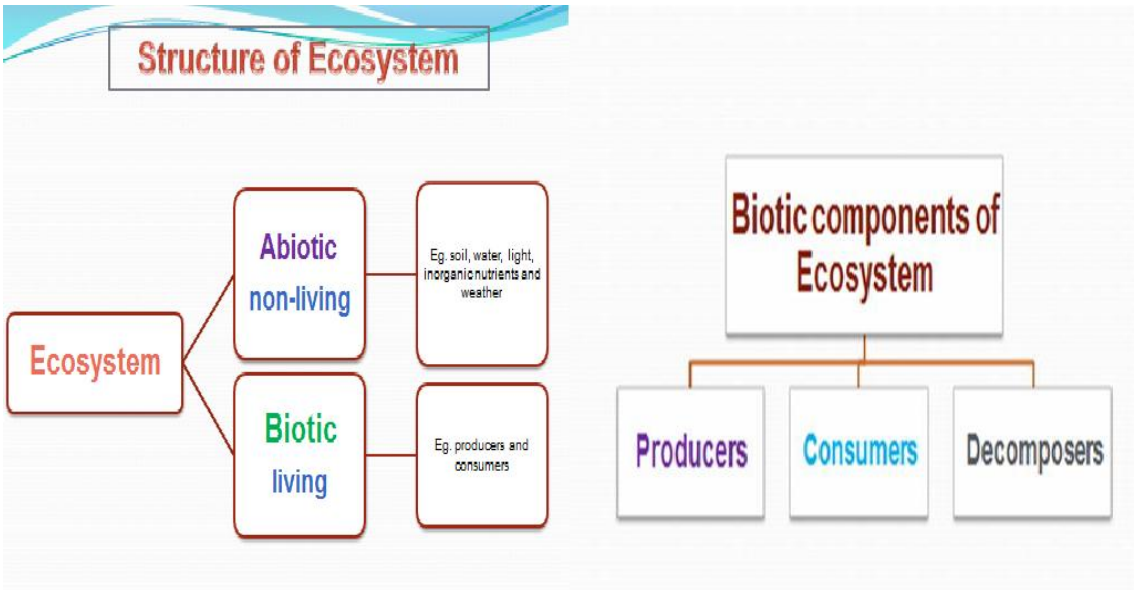
Tropical rain forests are one of the most important areas on Earth. These special ecosystems are homes to thousands of species animals and plants. Contrary to popular belief, rain forests are not only densely packed plants, but are also full of tall trees that form a ceiling from the Sun above. This ceiling keeps smaller plants from growing. Areas where sunlight can reach the surface are full of interesting plants.

(c) Boreal or Taiga Forests:

The boreal forest ecosystem is the contiguous green belt of conifer and deciduous trees that encircles a large portion of the Northern Hemisphere. In North America, the boreal forest stretches across most of northern Canada and into Alaska. It has long been identified as one of the world‘s great forest ecosystems.

Structure of Ecosystems:

Different organisms exist within the forest layers. These organisms interact with each other and their surroundings. Each organism has a role or niche in sustaining the ecosystem. Some provide food for other organisms; others provide shelter or control populations through predation:



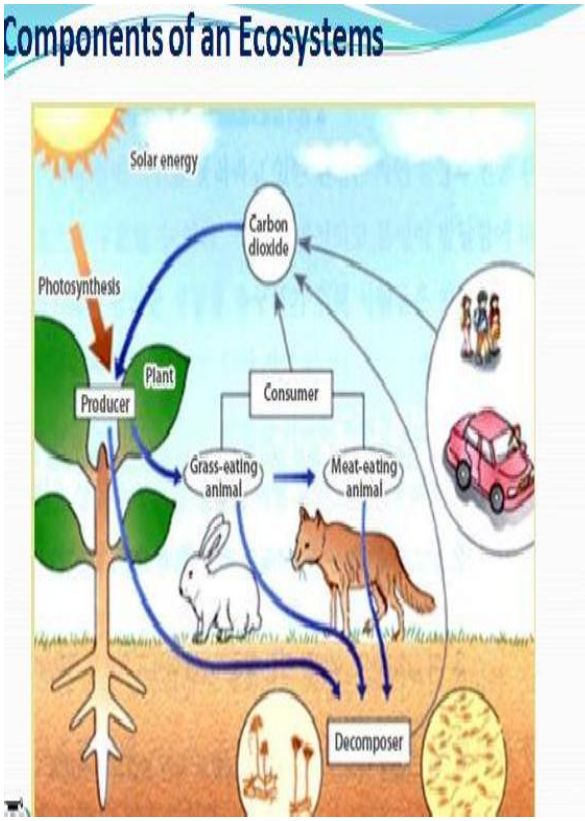
1. **Abiotic Components:** Abiotic component of ecosystem includes basic inorganic elements and compounds, such as soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds. It also includes such physical factors and ingredients as moisture, wind current sand solar radiation. Radiant energy of sun is the only significant energy source for any ecosystem.
2. **Biotic Components:** The biotic components include all living organisms present in the environmental system. From nutrition point of view, the biotic components can be grouped into two basic components:

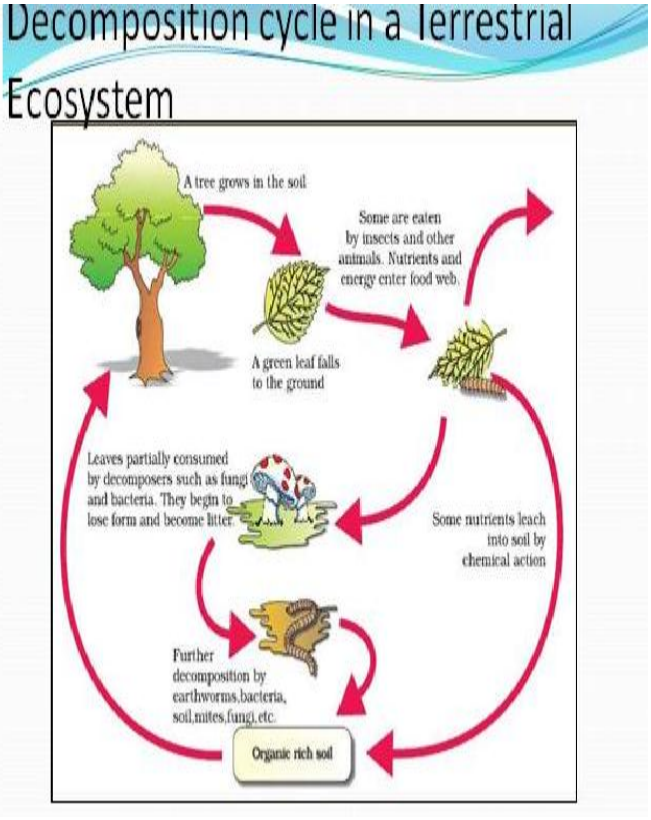
   Autotrophic components: The autotrophic components include all green plants which fix the radiant energy of sun and manufacture food from inorganic substances. Heterotrophic components: The heterotrophic components include non-green plants and all animals which take food from autotrophs.

Components of an Ecosystem

1. **Producers (Autotrophic elements):**
   - The producers are the autotrophic elements—chiefly green plants.
   - They use radiant energy of sun in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy.
   - The chemical energy is actually locked up in the energy rich carbon compounds. Oxygen is evolved as by-product in the photosynthesis.
   - This is used in respiration by all living things. Algae and other hydrophytes of a pond, grasses of the field, and trees of the forests are examples of producers
2. **Consumers:**
   - Those living members of ecosystem which consume the food synthesized by producers are called consumers.
   - Under this category are included all kinds of animals that are found in an ecosystem.

   There are different classes or categories of consumers, such as:
   - Consumers of the first order or primary consumers,
   - Consumers of the second order or secondary consumers,
   - Consumers of the third order or tertiary consumers, and
   - Parasites, scavengers and saprobes.
3. **Decomposers and transformers:**
   - Decomposers and transformers are the living components of the ecosystem and they are fungi and bacteria.
   - The breakdown of complex organic matter into inorganic substances like carbon dioxide, water and nutrients and the process is called decomposition.
   - Decomposers attack the dead remains of producers and consumers and degrade the complex organic substances into simpler compounds.
   - The simple organic matters are then attacked by another kind of bacteria, the transformers which change these organic compounds into the inorganic forms that are suitable for reuse by producers or green plants.
   - The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.



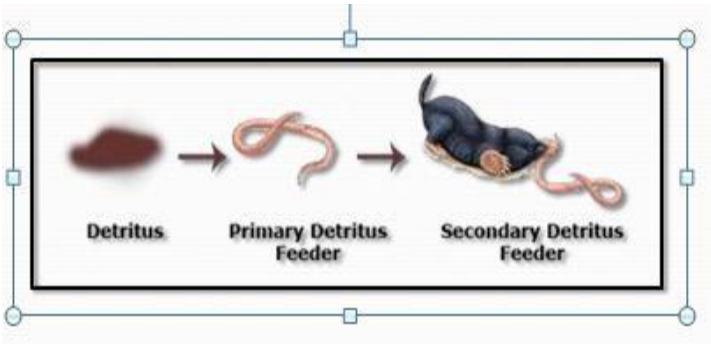


Energy Flow in an Ecosystem:

- The flow of energy is one way direction from producer to consumers, and ends in decomposition process.
- However, a part of the energy is lost as heat

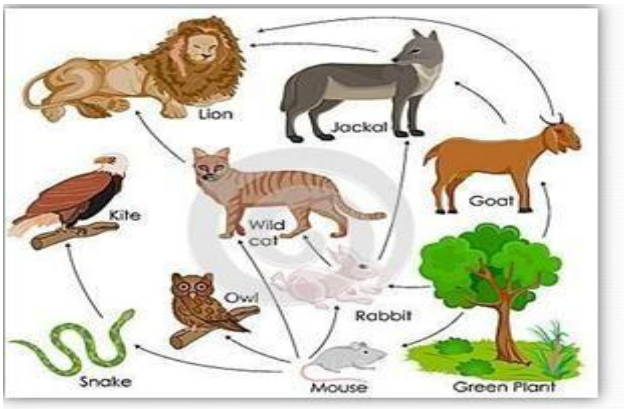
Detritus Food Chain:

- Detritus is non-living particulate organic material includes the bodies or fragments of dead organisms as well as fecal material.
- Decomposers are heterotrophic organisms also called Saptrotrophs. Eg. Fungi and Bacteria.



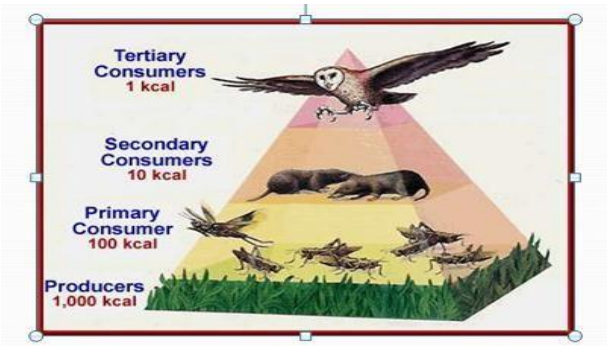
Food Web

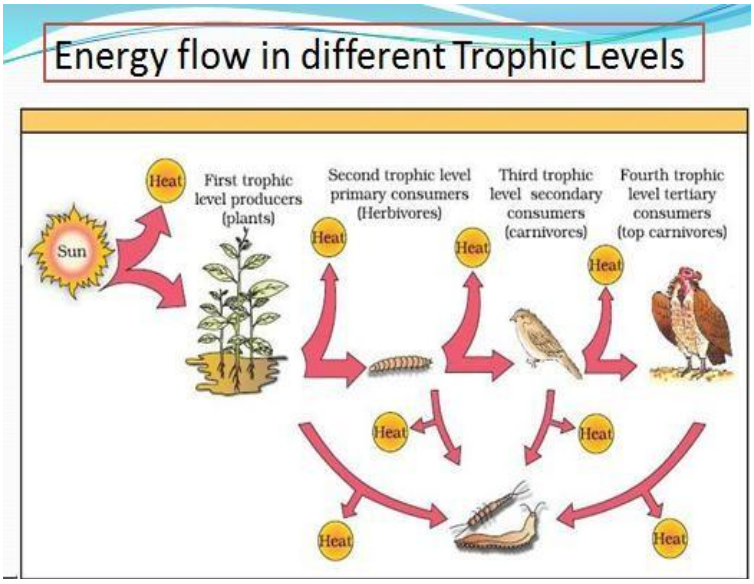
- A food web depicts various feeding connections in an ecological community.
- Natural interconnected food chains make a food web.



Trophic Level

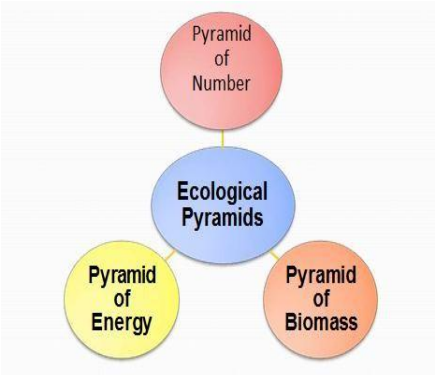
- The trophic level is the position of an organism it occupies in the community or a food chain.





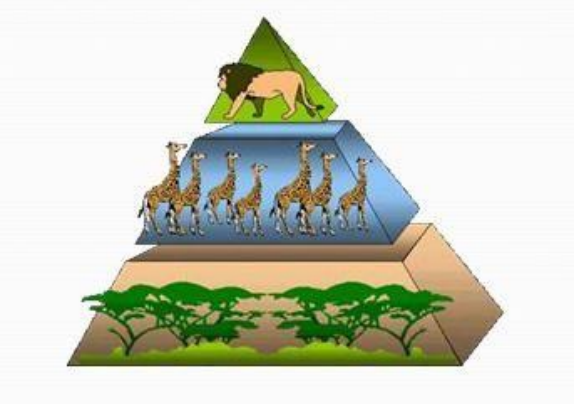
Ecological Pyramid

- An ecological pyramid is a graphical representation of trophic levels in a given ecosystem.



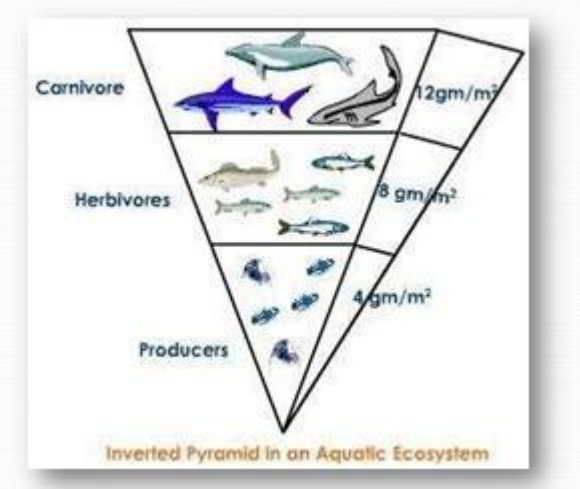
PYRAMID OF NUMBERS

- The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.



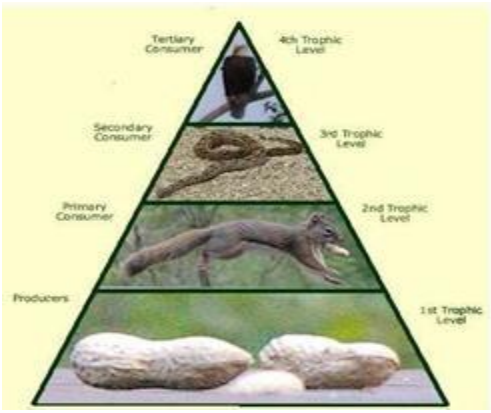
PYRAMID OF BIOMASS

- The pyramid of biomass in sea is also generally inverted because the biomass of fishes far exceeds that of phytoplankton.



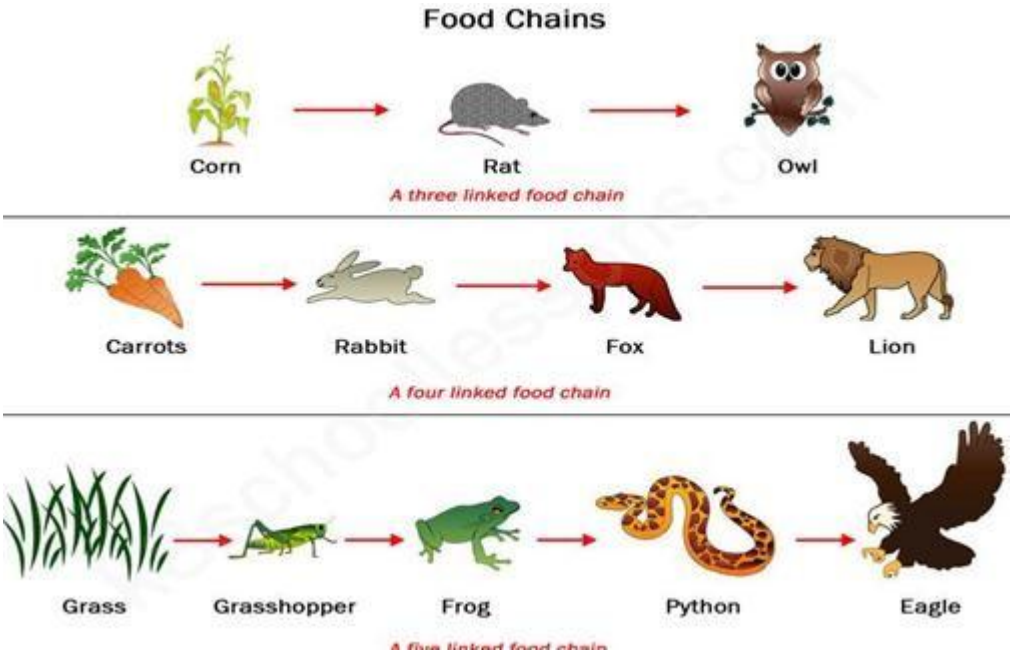
PYRAMID OF ENERGY

- Pyramid of energy is always upright.
- It can never be inverted.



Food Chain in Ecosystem

- For an ecosystem to work there has to be a flow of energy within it.
- The organisms of the ecosystem need energy in the form of food.
- The ultimate source of this energy is the sun.
- Producers like green plants trap solar energy and convert it into the chemical energy of food.
- When a primary consumer eats the producer, a part of this energy is passed on to it.



Types of consumers in a food chain

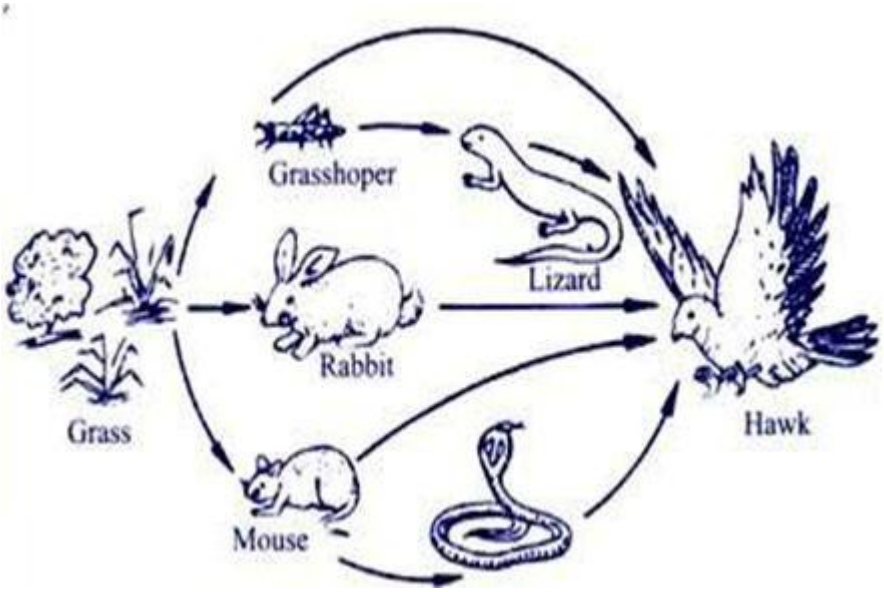
- **Herbivores (or) Primary Consumers (Plant Eaters):** Animals that eat only plants are called Herbivores. They directly depend on the plants for their food. So they are called Plant eaters. Examples: Insects, goat, deer, cow, horse, etc.
- **Carnivores (or) Secondary Consumers (Meat Eaters):** Animals that eat other animals are called carnivores. They directly depend on the herbivores for their food. Examples: Frog, cat, snake & foxes, etc.
- **Omnivores:** Animals that eat both plants and animals are called omnivores. They depend on both herbivores and carnivores for their food. Examples: humans, tigers, lions, rats and fox etc.

- **Detritivores: (Detritifeeder):** Animals that eat dead organisms and waste of living are called detritivores. Examples: beetles, termites, ants, crabs, earthworms, etc.
- **Decomposers (or) Saptrotrophs:** Decomposers attack the dead bodies of producers and consumers and decompose them into simple compounds. During the decomposition, inorganic nutrients are released. The organisms which break down the complex compounds into simple products are called decomposers (or) reducers. Examples: micro-organisms such as bacteria and fungi, etc.

Food web and ecological succession

- Food chains in natural conditions never operate as isolated sequences, but are interconnected with each other forming interlocking pattern, which is referred to as a food web.
- Food webs are basic units of ecosystem ecology.
- Under natural conditions, the linear arrangement of food chains hardly occurs and these remain indeed interconnected with each other through different types of organisms at different trophic levels.

  For example, in grazing food chain of grassland, in the absence of rabbit, grass may also be eaten by mouse. The mouse in turn may be eaten directly by hawk or by snake first which is then eaten by hawk. Thus, in nature there are found alternatives which all together constitute some sort of interlocking pattern and are called the food web



Ecological Succession

- Ecological succession is the gradual process by which ecosystems change and develop over time. Nothing remains the same and habitats are constantly changing.
- There are two main types of succession, primary and secondary
- Primary succession is the series of community changes which occur on an entirely new habitat which has never been colonized before. For example, a newly quarried rock face or sand dunes.
- Secondary succession is the series of community changes which take place on a previously colonized, but disturbed or damaged habitat. For example, after felling trees in a woodland, land clearance or a fire.

Types of Ecosystems

1. Forest Ecosystem

- **Producers**: All living organisms 'intake energy in order to survive. In a forest ecosystem, trees and other plants get their energy from sunlight. Plants produce their own food, in the form of carbohydrates. Plants are, therefore, called the primary producers, since they produce the basic foodstuffs for other organisms within food chains and food webs. Photosynthesis is the chemical reaction that allows plants to produce their own food.
- **Consumers:** Animals cannot produce their own food. They must consume food sources for die energy they need to survive. All animals, including mammals, insects, and birds, are called consumers. Consumers rely on plants and other animals as a food source. Primary consumers only eat plants and are referred to as herbivores. Secondary consumers are referred to as carnivores and feed on herbivores. Tertiary consumers are carnivores that feed on other carnivores. Omnivores eat both plant and animal matter.
- **Decomposers***:* Leaves, needles, and old branches fall to the forest floor as trees grow. Eventually all plants and animals die. In due course of time these materials are decomposed by worms, microbes, fungi, ants, and other bugs .Decomposers break these items down into their smallest primary elements to be used again. Decomposers are important in that they sustain the nutrient cycle of ecosystems.

2. Grassland Ecosystems

Grassland ecosystems are typically found in tropical or temperate regions, although they can exist in colder areas as well .Grasslands share the common climactic characteristic of semi-aridity. Trees are sparse or nonexistent, but flowers may Animals interspersed with the grasses. Grasslands provide an ideal environment for grazing Dominated by grass – few shrubs and trees are also found – rainfall average but erratic– overgrazing leads to desertification.

Three types – depending on the climate

1. **Tropical grass lands** – found near the boarders of tropical rain forests. Eg. Savannas in Africa. Animals – Zebra, giraffes etc. – fires are common in dry seasons – termite mounds produce methane – leads to fire – high in photosynthesis – deliberate burning leads to release of high CO2 – globalwarming.

2. **Temperate grasslands** – flat and gentle slopes of hills. Very cold winter and very hot summer - dry summer fires do not allow shrubs and trees to grow – soil is quite fertile
   – cleaned for agriculture.

3. **Polar grasslands** – found in arctic polar region – organism – arctic wolf, fox, etc. –
   A thick layer of ice remains frozen under the soil surface throughout the year – known as permafrost – summer insects and birds appear.

3. Desert Ecosystems:

The deserts are territories that are characterized by an arid and dry environment, caused by the scarcity of rain.. The common defining feature among desert ecosystems is low precipitation, generally less than 25 centimeters, or 10 inches, per year. Not all deserts are hot – desert ecosystems can exist from the tropics to the arctic, but regardless of latitude, deserts are often windy. Some deserts contain sand dunes, while others feature mostly rock. Vegetation is sparse or nonexistent, and any animal species, such as insects, reptiles and birds, must be highly adapted to the dry conditions. Deserts receive less than 25 centimeters of rain per year and this value is often variable, so it can sometimes be even lower. For example, there are areas of the Sahara desert that spend years without receiving a single drop of rain.

- In the desert areas there are wide ranges of temperature throughout the day and night. The absence of vegetation and water makes it difficult for the earth to absorb solar radiation.
- For this reason, it is difficult for the earth to conserve heat at night; this causes strong decreases in temperature during night hours.
- The soil is very dry, usually composed of sand; therefore, it is low in organic nutrients needed for most plants. This makes vegetation development difficult and only a few species can grow in it.
- The animals and plants that inhabit the deserts usually have special characteristics that allow their survival. These characteristics include the ability to store water and reproduce rapidly during brief periods of humidity.

The three types of desert ecosystems

- **Hot Deserts:** The hot deserts are located near the line of the Ecuador and its altitude is usually near the level of the sea. The Sahara is the best-known example of this kind of deserts. This type of ecosystem has very hot soil, little water and little shade. Therefore, they offer conditions in which few plant species can survive.
- **Cold deserts:** Cold deserts occur in places of high altitude, especially in the rocky

peaks of the highest mountains. The soil of cold deserts is usually sandy or rocky, a hostile environment for the development of any plant and animal species. However, it is also possible to see how living things have adapted to survive.

- **Frozen desserts:** Icy deserts are another type of cold desert that occur mainly in the north and south poles of the planet, as well as in the perpetual snows of the mountain peaks. In these cases, the soil is not sand or rock, but is composed entirely of ice.

4. Aquatic ecosystem

Deals with water bodies and biotic communities present in them-Classified as fresh water and marine ecosystems. Fresh water systems are classified as lentic and lotic ecosystems.

Types of Aquatic ecosystem

- **Pond ecosystem**: Small fresh water ecosystem – seasonal in nature – organisms: algae, aquatic plants, insects, fishes etc. Ponds are very often exposed to anthropogenic pressure like cloth washing, bathing, cattle bathing, swimming etc.

- **Lake ecosystem:** Big fresh water ecosystem – Zonation or stratification, especially during summer is a common one.Top layer – shallow, warm, prone to anthropogenic activities – Littoral zone Second layer – enough sunlight, high primary productivity – **Limnetic zone**

Third layer – very poor or no sunlight – Profundal zone. Eg. Dal lake in Srinagar, Naini lake in Nainital

Organisms:

1. Planktons – phytoplankton eg. Algae – zooplankton eg. Rotifers
2. Nektons – that swims in water eg. Fishes
3. Neustons – that float on the surface of water Benthos – that attached to sediments eg. Snails

Types of lakes: Many types

1. Oligotrophic lakes – with less nutrient content
2. Eutrophic lakes – with very high nutrient content due to fertilizer contamination
3. Desert salt lakes–that contains high saline water due to over evaporation
4. Volcanic lakes – formed by water emitted from magma due to volcanic eruptions
5. Dystrophic lakes – that contains highly acidic water (low pH)

6. Endemic lakes – lakes that contain many endemic species, etc.

- **Streams:** fresh water ecosystem where water current plays a major role. Oxygen and nutrient content are uniform. Stream organisms have to face extreme difference in climatic conditions but they do not suffer from oxygen deficiency as pond and lake organisms. This is because large surface area of running water provides more oxygen supply. The animals have very narrow range of tolerance towards oxygen deficiency. Thus stream are worst victims of industrial pollution.
- **River ecosystem:** large streams flowing from mountain highlands are rivers Mountain highlands – rushing down water fall of water – large quantity of dissolved oxygen – plants attached to rocks and fishes that require more oxygen are found. Gentle slopes of hills – warmer – supports the growth of plants and fishes that require less oxygen are seen. River shapes the land – lots of silts, nutrients are brought – deposited in plains and delta – very rich in biodiversity.

Oceans: Gigantic reservoirs of water covering >70% of earth surface – 2,50,000 species huge variety of sea products, drugs etc. – provide Fe, Mg, oils, natural gas, sand etc. – major sinks of carbon di oxide – regulate biochemical cycles.

1. Coastal zone – warm, nutrient rich, shallow – high sunlight – high primary productivity. Open sea

– away from continental shelf – vertically divided in to 3 zones.

2. Euphotic zone – abundant sunlight
3. Bathyal zone – dim sunlight
4. Abyssal zone – dark zone – world‘s largest ecological unit.

Estuary: coastal area where river meet ocean – strongly affected by tidal actions – very rich in nutrients – very rich in biodiversity also – organisms are highly tolerant – many species are endemic – high food productivity – however to be protected from pollution

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QUESTION BANK

	PART – A
1	Define the term ecosystem
2	Distinguish between a food chain and a food web
3	Recognize any two scope of learning environmental studies
4	List any two objectives of environmental studies
5	Write any two importance of learning environmental studies
6	Infer sustainability and sustainable development
7	Define term environment
8	Write any two measures to improve sustainable development
9	What is biotic and abiotic components
10	Write any two principles of a sustainable society

	PART-B
1	Explain the three pillars of sustainability
2	Distinguish forest ecosystem and grassland ecosystem
3	Explain the components of an ecosystem with examples
4	Explain the types of consumers
5	Describe the structure and functions of an ecosystem
6	List and explain the different types of ecosystem

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SCHOOL OF MANAGEMENT STUDIES

UNITII - ENVIRONMENTAL STUDIES -SBAA1204

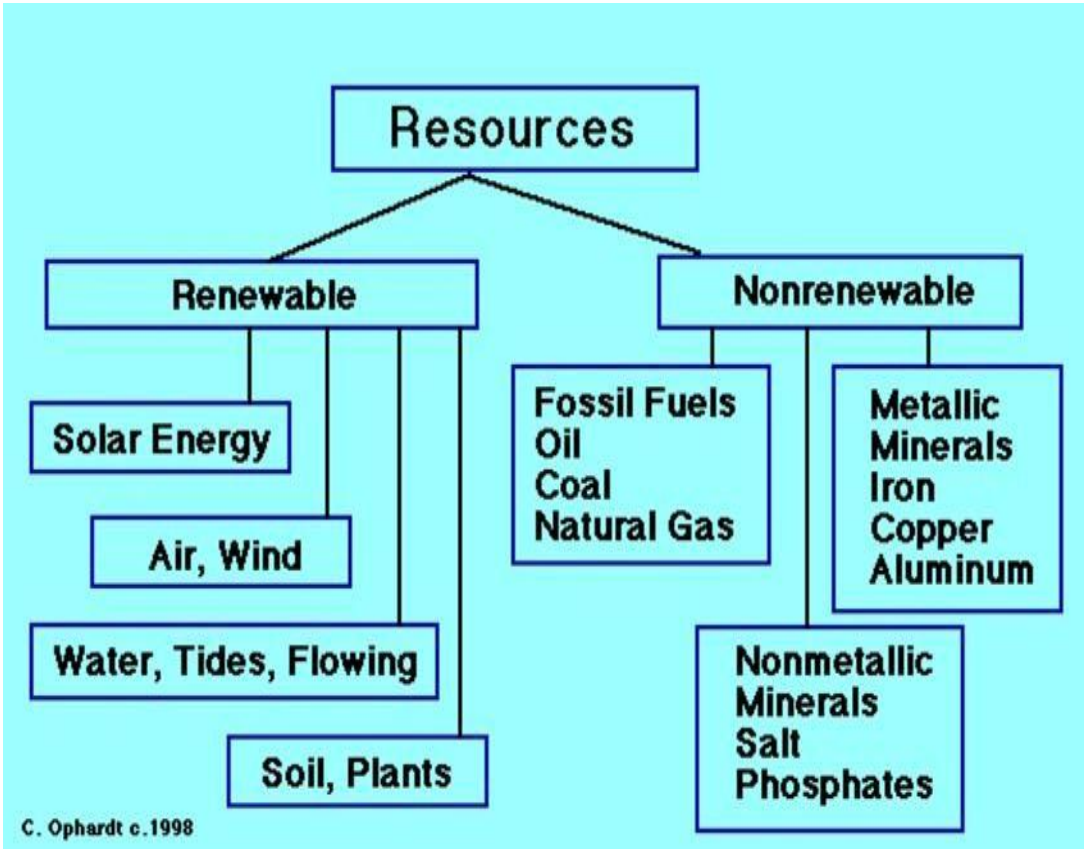
SYLLABUS - UNIT 2 NATURAL RESOURCES

Renewable and Non-renewable Resources - Land resources and land use change; Land degradation, soil erosion and desertification - Deforestation: Causes and impacts due to mining, dam building on environment, forests - biodiversity and tribal populations - Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over Water (inter-state).-Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs.

Natural Resources

- Natural resources can be defined as _variety of goods and services provided by nature which are necessary for our day-to-day lives‘.

  Eg: plants, animals and microbes (living or biotic part), air, water, soil, minerals, climate and solar energy (non- living or abiotic part).
- They are essential for the fulfillment of physiological, social, economic and cultural needs at the individual and community levels.



Types of natural resources

Renewable resources	Nonrenewable resources
The resources that can be replenished through rapid natural cycles are known as renewable resource. These resources are able to increase thei abundance through reproduction and utilization of simple substances	The resources that cannot be replenished through natural processes are known as non- renewable resources. These are available in limited amounts, which cannot be increased. These resources include fossil fuels (petrol, coal etc.), metals (iron, copper, gold, silver, lead, zinc etc.), minerals and salts (Carbonates, phosphates, nitrates etc.).

Classification of resources

Natural resources are valuable to us. The broadest classification of resources is done on the basis of their replenishing ability. Let us take a look, at these two classifications.

Renewable resources Non-renewable resources

Renewable resources

Renewable resources are those resources that can be replenished or renewed naturally over time. Air, water, wind, solar energy etc. are all renewable resources. Renewable resources can be easily renewed by nature.

1. **Solar energy:** Sun is a big source of energy. The energy that we get from the *sun* is called solar energy. All the natural phenomenon like the flowing of wind, water cycle, photosynthesis etc. is possible only due to solar energy. Now a day, solar energy is being used to cook food with the help of solar cookers, heat water, light streets, pump water for irrigating fields etc.
2. **Hydro-energy:** Water is important natural resources. All living organisms need water to live. Humans need water for many purposes such as drinking, cleaning, and cooking and for growing crops. Water flowing into the river or water stored in a dam is sources of hydro energy. The simple method to use hydro energy is to convert it into electrical energy.
3. **Wind energy: Winds** are constantly being created in nature. The windmill is a source of electrical energy. These windmills are generally established only at places where most of the days in a year experience strong winds. The energy from this wind is used for grinding grain, pumping water and to produce electricity. In india, many windmills have been set up in different places such as Tamil nadu, Maharashtra, Rajasthan, Kerala, West Bengal and Gujarat.
4. **Biogas:** Biogas is a type of fuel which is a mixture of gases such as methane, carbon

dioxide, hydrogen etc. which is obtained by decomposition of animal and plant wastes like animal dung, with the help of micro-organisms in the presence of water. It is used as fuel in gas stove especially in ruralareas.

5. **Wood:** Wood is an ancient and traditional source of energy. It is mainly a mixture of many carbohydrate compounds. Wood is used to cook food. It leads to deforestation and pollutes air also. In India, still in many villages, they use wood chullas to cook food every day. While having ill effects on the environment, it is also harmful to human health
6. **Hydrogen:** It is a good source of energy because it does not create pollution and produce maximum energy on burning. Hydrogen has the potential to be the answer to all our energy and fuel troubles. Technology is currently being developed to fully utilize hydrogen efficiency.

7. **Alcohol:** Alcohol has many commercial and medical purposes. It can use for producing energy. It can be obtained while making sugar from sugarcane. Thus it is a very cheap source of energy. A mixture of petrol and alcohol is being used as a fuel in automobiles. This mixture is called gasohol‘.
8. **Air:** All living things need air to breathe**.** Therefore, air is an important natural resource.
9. **Water:** All living things water in order to survive. And the water cycle means we will essentially never run out of the water. But we must be careful not to pollute water and make it unusable. Drinking and clean water are already scarce in theworld.
10. **Soil:** It is an important resource as this is the layer where plants grow. We all need food in order to survive. We get most of our food from crops grown in thesoil.

Nonrenewable resources

Non-renewable resources are those natural resources that are available in limited quantity. These resources cannot be renewed or replenished in short duration. Therefore they are also known as exhaustible resources. Examples- coal, natural gas, petroleum etc.

1. **Fossil fuel: Fossil** fuels like coal and petroleum are non-renewable resources. They are found deep inside the earth and are made by natural processes over many centuries. Their quantity is limited and they take thousands of years to get renewed. Example of fossil fuels is coal, petroleum, natural gas etc.
2. **Coal**: it is also known as black diamond. Coal is used as a fuel, to generate electricity, and in factories and steam engines.
3. **Natural gas**: natural gas is used as a fuel called compressed natural gas or cng. Some wells dug into the earth produce only natural gas. Natural gases are a good alternative to petrol and diesel and it is used as compressed natural gas. It burns easily and produces a lot of heat. It is a good source of hydrogen.
4. **Petroleum**: petroleum is also known as mineral oil or crude oil. This liquid mineral is refined to make fuels such as petrol, diesel, cooking gas and kerosene. Plastic, cosmetics, and lubricants are also products of petroleum. It is found deep inside the earth or under the sea floor. It is taken out bydrilling wells deep into the earth or under the seabed.
5. **Nuclear energy:** In the classification of resources, nuclear energy is classified as non-renewable. The fuel used for nuclear energy is generally uranium, which is in a limited supply. So we classify it as non- renewable. Production of electricity from nuclear energy does not release carbon dioxide. Thus, use of nuclear energy is safe for the environment.

6. **Fuel:** A substance which upon combustion produces a useable amount of energy is known as fuel. For example fossil fuel, biogas, nuclear energy etc. In our current times, fuel conservation is one of our biggest concerns and it is important to remain informed.

   Properties of an ideal fuel are

   - an ideal fuel is cheap
   - An ideal fuel burns easily in the air at a moderate rate.
   - It releases a large amount of energy.
   - Ideal fuel is also renewable since it will help with fuel conservation.

   Fuels can be divided into two categories. One is on the basis of its state, whether it a solid, liquid or a gas. Another way to classify fuel is on the basis of occurrence, whether it is natural or man-made.

   - **Liquid fuel–** they are derived from the remains of dead plants and animals by exposure to heat and pressure in the earth's crust. Example: petroleum, coal tar, oil, alcohols etc.
   - **Gaseous fuel**– gaseous fuels occur in nature. Most gaseous fuels are composed of hydrocarbons, carbon etc. Examples: coal gas, hydrogen gas, oil gas
   - **Solid fuel–** state at room temperature are referred to as solid fuels. Examples wood, coal,

Fuel conservation and conservation of natural resources

1. Natural resources are very important for us. That is why it is necessary to take care of our natural wealth and use it judiciously. Ways and efforts for conservation mean protection. To live comfortably in the coming year, conservation of natural resources is extremely essential. We must preserve the greatest treasure of the earth, nature.
2. Coal and petroleum which are also called fossil fuels or non- renewable energy resources. One way of fuel conservation is to avoid their wastage. Switching to alternative sources such as solar energy in the forms of solar heater, solar cookers, use of natural gas and wind energy are some ways to reduce their usage.
3. We can also reduce the use of these natural resources by using public transport and carpool.
4. Preference should be given to using renewable natural resources such as the sun and the wind. Windmills use wind energy to produce electricity. The solar energy is used to heat water, cook food and to generate electricity.
5. Water can be conserved by building reservoirs. Rainwater harvesting can be adopted to

conserve water.

6. Environmental education plays an important role in creating awareness. Through environmental education, people come to know about their rights and duties towards nature.
7. For creating environmental awareness seminar, workshops, exhibition, rallies, competition etc., play an important role.
8. Along with the government voluntary organizations to work for environment and resources conservation.
9. Conservation of soil can be done by preventing deforestation, using terrace farming and othersoil conservation methods.
10. Reducing the use and preventing wastage of electricity.
11. The ever-growing population has disturbed the balance of demand and supply. Therefore it is necessary to create mass awareness to prevent populationgrowth.
12. Conserve of soil can be done by preventing deforestation and using terracefarming.
13. Plants and trees can be conserved by planting more trees, using recycled paper products and avoiding the use of paperunnecessarily.

Forest resources

A forest can be defined as a biotic community predominant of trees, shrubs or any other woody vegetation usually in a closed canopy. It is derived from latin word *'foris'* means *'outside'*. India's forest cover is 6,76,000 sq.km (20.55% of geographic area). Scientists estimate that india should ideally have 33% of its land under forests. Today we only have about 12% thus we need not only to protect our existing forests but also to increase our forest cover.

Uses of forest Commercial uses

- Wood is used as a fuel.
- Wood is for various industries as raw materials as pulp, paper, furniture timber etc.
- Minor forest products – gum, dyes, resins
- Many plants from forest are used formedicines
- Forest also gives us the supplyvariety of animal products – honey. Ivory, horns etc.
- Forest lands are used for commercial purpose as mining, building dams and recreation as hotels, nuclear plants etc.

Ecological uses

- Photosynthesis produces large amount of oxygen which is essential forlife.

- Carbon dioxide is one of the main greenhouse gas. It is absorbed by plants for photosynthesis. Therefore the problem of global warming caused by co2 is reduced
- Roots of trees bind the soil tightly and prevent soil erosion. They also act as wind breaks.
- Watershed in forest act like giant sponges and slowly release the water for recharge ofspring
- Forest can absorb many toxic gases and noises and helpin preventing air and noise pollution
- Forest is the home of millions of wild animals and plants

Functions of forest

- It performs very important function both to human and to nature.
- They are habitats to millions of plants, animals and wildlife.
- They recycle rainwater.
- They remove pollutant fromair.
- They control water quality.
- They moderate temperature and weather.
- They influence soil condition and prevent soil erosion.

Reason for deficiency of forest:

In India the minimum area of forest required to maintain good ecological balance is about 33% of total area. But at present it is only about 12%. So over exploitation of forest material occurs.

Over exploitation of forest: due to over population, there is an increased demand for medicine, shelter, wood and fuel. Hence exploitation of forest materials is going on increasing.

Cause of over exploitation:

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

Deforestation:

It is process of removal of forest resources due to natural or manmade activities (i.e.)

Destruction of forests.

Causes of deforestation:

1. Developmental projects:

- Developmental projects causes deforestation through twoways.
- Through submergence of forest area.

- Destruction of forest area. Ex: big dams, hydroelectric projects, road construction etc.

2. **Mining operations**: it reduces forest areas. Ex: mica, coal, manganese and limestone.
3. Raw materials for industries: wood is an important raw material forvarious purposes.

   Ex: making boxes, furniture and paper etc.

4. **Fuel requirement:** wood is the important fuel for rural andtribal population.

- **Shifting cultivation:** replacement of natural forest ecosystem for mono specific tree plantation. Ex:teak

5. **Forest fires:** forest fire destructs thousands of acres of forest.
6. **Over grazing**: over grazing by cattle reduces the cultivation of land

Consequences of deforestation (or) impacts of deforestation:

i. Economic loss
ii. Loss of biodiversity
iii. Destructs the habitats of various species
iv. Reduction in stream flow
v. Increases the rate of global warming
vi. Disruption of weather patterns and global climate
vii. Degradation of soil and acceleration of the rate of soil erosion.
viii. Induces and accelerates mass movement / landslides.
ix. Increases flood frequency, magnitude /severity.
x. Breaks the water cycle
xi. Reaks the nutrient cycle

Preventive measures (or) avoid of deforestation (or) methods of conservation of forests

α. New plants of more or less of the same variety should be planted to replace the trees cut down for timber

β. Use of wood for fuel should be discouraged.

χ. Forest pests can be controlled by spraying pesticides by using aero planes

δ. Forest fire must be controlled by modern techniques.

ε. Over grazing by cattle must becontrolled.

ϕ. Steps should be taken by the government to discourage the migration of people into the islands from mainland.

γ. Education and awareness programme must beconducted.

η. Strict implementation of law of forest conservationact.

Major activities in forest

Extraction: wood used for engineering purposes like building houses, making furniture is called timber. The products derived from timber have been important to many civilizations, and thus it has acquired value within these civilizations. Timber extraction results in deforestation and in the fragmentation of the last remaining forests. It harms valuable species of trees, birds and wild animals. In spite of this, it is sometimes necessary to extract timber, so as to meet the needs of a developing country. During the extraction of timber, cutting, felling and handling should be done selectively, carefully and in a planned manner, in order to save the remaining forests and biodiversity.

Effects of timber extraction:

The major effects of timber extraction on forest and tribal people include:

i. Poor logging results in a degraded forest.

ii. Floods may be intensified by cutting of trees or upstream watersheds.

iii. Loss of biodiversity.

iv. Climatic changes such as fewer rains.

v. New logging roads permit shifting cultivators to gain access to logged areas and cut the remainingtrees.

vi. It results in forest fragmentation which promotes loss of biodiversity because some species of plants and animals require large continuous areas of similar habitat to survive.

vi. Exploitation of tribal people by the contractors.

vii. Soil erosion especially on slopes occurs extensively.

ix. Sedimentation of irrigation systems, floods may be intensified by cutting of trees on upstream.

Case study-chipko movement

The world famous **chipko movement**, pioneered by **dasohli gram swarajya mandal** in gopeshwar brought about a general awareness about conservation of forests. The first chipko movement dates back to 1731, when a village woman named amrita bai led the bishnoi women against the maharaja's men to prevent them from cutting trees. In this attempt to save the trees, she sacrificed her life along with the lives of her husband, three daughters and 363 people. The movement was given this name because the village women embraced or hugged the trees to stop them from being cut. In 1972, in Uttar Pradesh, the chipko movement was led by bachnoi Devi of advani who protected the hill forests from the contractors axe men.

Mining

Mining is the extraction of minerals and other geological materials of economic value from deposits on the earth.

Mining in a wider sense includes extraction of any non-renewable resource such as petroleum, natural gas, or even water. Ores recovered by mining include metals, coal, oil shale, gemstones, limestone, chalk, dimension stone, rock salt, potash, gravel, and clay.

The process of extracting mineral resources and fossil fuels like coal from the earth is called as mining.

Types of mining

- Surfacemining: miningof minerals from shallow deposits
- Underground mining: mining of minerals from deep deposits

Steps involved in mining

- Exploration
- Development
- Exploitation
- Oreprocessing
- Extraction and purification of minerals

Reasons for mining

To obtain material that cannot be grown: mining is required to obtain any material that cannot be grown through agricultural processes, or feasibly created artificially in a laboratory or factory. Mining of stones and metal has been a human activity since pre-historic times. Modern mining processes involve prospecting for ore bodies, analysis of the profit potential of a proposed mine, extraction of the desired materials, and final reclamation of the land after the mine is closed.

Various causes of mining

1. **Advancement in technology:** With the current advancement in technology and technological products such as cell phones, computers, and machinery among others, it is impossible to do away with mining. The demands of minerals from technological companies are increasing and consequently the need for mining activities to meet these demands. For example, data from the us mineral information institute indicate that in a single year, there are approximately 130 million cell phones decommissioned by their owners. These cell phones contain an estimated 46 metric tons of silver, 2100 metric tons of

Copper, 2 metric tons of palladium, 46 metric tons of silver, and 0.04 metric tons platinum.

2. **Urbanization and increased population growth: The** world‘s population is ever growing. This increase coupled with modernization and income growth leads to more demands for residential and working building spaces, transportation vehicles, and consumer products. As a result, the need for more mined products increases.

   Few substitutes for minerals: Suggestions mainly indicate that the mining activities can only decrease if there are substitutes for the mined products. But since substitutes are highly will remain an uphill task to reduce mining activities. Example: few companies are replacing metal with carbon fiber and gas for other fuel sources.

3. **Mining is an economic foundation in some countries: Most** developing countries depend on mining for their economic growth. The international council on mining and metals (in cmm) report that approximately 70 countries heavily rely on the mining industry. Further studies indicate that mining activities constitute 60 to 90 percent of the total foreign direct investment for most countries in the category of low-middle income.
4. **With modernity and technological breakthroughs**: Top mining industries are making breakthroughs in technology and investing heavily in it as well. An example is a current use of sensing technologies and internet of things (iot), autonomous systems, use of drones, simulations, and adaptive supply chains. This silent reconnaissance in technological advancement is attracting new professionals and is also meeting the demands of the local society in terms of providing a sustainable operation.

Impact of mining

Mining operations usually create a negative environmental impact, both during the mining activity and after the mine has closed. In some countries, mining companies are expected to adhere to rehabilitation and environmental codes to ensure that the area mined is eventually transformed back into its original state. However, violations of such rules are quite common.

1. work safety has long been a concern as well, and modern practices have significantly improved safety in mines
2. Mining adversely affects the environment by inducing loss of biodiversity, soil erosion, and contamination of surface water, groundwater, and soil.
3. Mining can also trigger the formation of sinkholes.
4. The leakage of chemicals from mining sites can also have detrimental effects on the health of the population living at or around the mining site.

5. Air pollution is causes as air quality is adversely affected by mining operations
6. Unrefined materials are released when mineral deposits are exposed on the surface through mining.
7. Wind erosion and nearby vehicular traffic cause such materials to become airborne. Lead, arsenic, cadmium, and other toxic elements are often present in such particles and these pollutants can damage the health of people living near the mining site.
8. Diseases of the respiratory system and allergies can be triggered by the inhalation of such airborne particles.
9. Mining also causes water pollution which includes metal contamination, increased sediment levels in streams, and acidmined rainage.
10. Pollutants released from processing plants, tailing ponds, underground mines, waste-disposal areas, active or abandoned surface or haulage roads, etc., act as the top sources of water pollution.
11. Sediments released through soil erosion cause siltation or the smothering of stream beds. It adversely impacts irrigation, swimming, fishing, domestic water supply, and other activities dependent on such waterbodies.
12. High concentrations of toxic chemicals in water bodies pose a survival threat to aquatic flora and fauna and terrestrial species dependent on them for food. The acidic water released from metal mines or coal mines also drains into surface water or seeps below ground to acidify groundwater. The loss of normal ph of water can have disastrous effects on life sustained by suchwater.
13. The creation of landscape blots like open pits and piles of waste rocks due to mining operations can lead to the physical destruction of the land at the mining site. Such disruptions can contribute to the deterioration of the area's flora and fauna.
14. The removal of soil layers and deep underground digging can destabilize the ground which threatens the future of roads and buildings in the area. For example, lead ore mining in galena, kansas between 1980 and 1985 triggered about 500 subsidence collapse features that led to the abandonment of the mines in the area. The entire mining site was later restored between 1994 and1995.
15. Mining leads to a massive habitat loss for a diversity of flora and fauna ranging from soil microorganisms to large mammals. Endemic species are most severely affected since even the slightest disruptions in their habitat can result in extinction or put them at high risk of

Being wiped out

16. A landscape affected by mining can take a long time to heal. Sometimes it never recovers. Remediation efforts do not always ensure that the biodiversity of the area is restored. Species might be lostpermanently.

Construction of large dams

The construction of large dams completely change the relationship of water and land, destroying the existing ecosystem balance which, in many cases, has taken thousands of years to create. Currently there are around 40,000 arge dams which obstruct the world's rivers, completing changing their circulation systems: this is not going to occur without dire environmental impacts. Dams made significant contributions to human development and the benefits derived from them have been considerable. Large dams are designed to control floods and to help the drought prone areas, with supply of water. But large dams have proved to cause severe environmental damage. Hence an attempt has been made to construct small dams. Multiple small dams have less impact on the environment. Dams ensure a year round supply of water for domestic use and provide extra water for agriculture, industries and hydropower generation.

Effect of dam construction on environment:

1. **Soil erosion: one** of the first problems with dams is the erosion of land. Dams hold back the sediment load normally found in a river flow, depriving the downstream of this. In order to make up for the sediments, the downstream water erodes its channels and banks. This lowering of the riverbed threatens vegetation and river wildlife.
2. **Loss of species**: one of the reasons dams are built is to prevent flooding. However, most ecosystems which experience flooding are adapted to this and many animal species depend on the floods for various lifecycle stages, such as reproduction and hatching. Annual floods also deposit nutrients and replenish wetlands.
3. **Lack of supply of fish**: as fisheries become an increasingly important source of food supply, more attention is being paid to the harmful effects of dams on many fish and marine mammal populations. The vast majority of large dams do not include proper bypass systems for these animals, interfering with their lifecycles and sometimes even forcing speciesto extinction.
4. **Spread of disease: Dam** reservoirs in tropical areas, due to their slow-movement, are literally breeding grounds for mosquitoes, snails, and flies, the vectors that carry malaria, schistosomiasis, and river blindness.
5. **Changes to earth's rotation:** Nasa geophysicist dr. Benjamin fong chao found evidence that large dams ause changes to the earth's rotation, because of the shift of water weight from oceans to reservoirs. Because of the number of dams which have been built, the earth's daily rotation has

apparently sped up by eight-millionths of a second since the 1950s. Chao said it is the first time human activity has been shown to have a measurable effect on theearth's motion.

Effects of dam on tribal people:

- Tribal people are ill-treated by modern society.
- Many of the displaced people were not recognized and resettled or compensated.
- Tribal people and their culture cannot be questioned and destroyed.
- Displacement and cultural change affects the tribal people for both mentally and physically.
- Tribal people will not suit with the new areas and hence they will be affected by many diseases.
- The greatest social cost of big dam is the widespread displacement of tribal people; such a biodiversity cannot be tolerated.

General problems due to dam construction:

1. Dams alter river flows, change nature‘s flood control mechanisms such as wetlands and flood plains, and destroy the lives of local people and the habitats of wild plant and animal species, particularly is the case with mega dams.
2. Dam construction and submersion leads to significant loss of farmland and forest and land submergence .siltation of reservoirs, water logging and salination in surrounding lands reduces agricultural productivity
3. Significant and irreversible loss of species and ecosystems, deforestation and loss of biodiversity, affects aquaculture
4. Socio economic problems for example, displacement, rehabilitation and resettlement of tribal people.
5. Displacement of people and species - people living in the catchment area, lose property and livelihood
6. Impacts on lives, livelihoods, cultures and spiritual existence of indigenous and tribalpeople
7. Dislodging animal populations and disruption of fish movement and navigational activities
8. Natural disasters – reservoirs induced seismicity, flash floods etc. and biological hazards due to large-scale impounding of water – increase exposure to vector brone diseases, such as malaria, schistosomiasis, andfilariasis.

BIODIVERSITY

Biodiversity is the variation among living organisms from different sources including terrestrial, marine and desert ecosystems, and the ecological complexes of which they are a part. More than 10 million different

species of animals, plants, fungi and micro-organisms inhabit the earth. They and the habitats in which they live represent the world's biological diversity, or biodiversity as it is often called. Humans use at least 40,000 species of plants and animals on a daily basis for food, shelter, clothing and medicinal needs.

FUNCTIONS OF BIODIVERSITY: Two main functions of biodiversity are

It is the source on which the entire human species depends on for food, fibre, shelter, fuel and medicine.

It depends on biosphere which in turn leads to stability in climate, water, soil, air and overall health of biosphere.

CONCEPTS OF BIODIVERSITY

The concept of biodiversity may be analyzed in 3 different levels. They are

1. Ecosystem diversity
2. Species diversity
3. Genetic diversity

Community or Ecosystem diversity

A set of biotic components (plants, animals and microorganisms) and abiotic components (soil, air, water, etc.) interacting with each other is known as an ecosystem. Ecosystem or ecological diversity means the richness and complexity of a biological community, including tropic levels, ecological processes (which capture energy), food webs and material recycling. The diversity at an ecological level or habitat level is known as ecosystem diversity.

Ex: River ecosystem- Rivers include fish, aquatic insects, mussels and a variety of plants that have adapted.

Ecosystem diversity is the aggregate of different environmental types in a region. It explain the interaction between living organisms and physical environment in an ecosystem

- A discrete group of organisms of the same kind is known asspecies.
- Species diversity is the diversity between different species.
- The sum of varieties of all living organisms at the species level is known as species diversity.
- Species diversity describes the number of kinds of organisms within individual communities or ecosystems.
- The biotic component is composed of a large number of species of plants, animals and microorganisms which interact with each other and with the abiotic component of the environment .**Ex:** The total number of species living on earth is approximately more than million. However, only around 1.5 million are found and assigned scientific names. Eg: **Plant species:** Apple, Mango, Wheat, Grapes, And Rice etc., **Animal species:** Lion, Tiger Elephant, And Deer etc.

Genetic diversity

- A species with different genetic characteristics is known as a sub-species or "genera".
- Genetic diversityis a measure of the variety of versions of same gene within individual species.
- Within individual species, there are varieties that are slightly different from one other. These differences are due to differences in the combination of genes.
- Genes are the basic units of hereditary information transmitted from one generation to the other **ex: (i)** Rice varieties - All rice varieties belong to the species "*oryzasativa*". However there are thousands of rice varieties that show variation at the genetic level in the form of different size, shape, color and nutrient content.

(Ii)Teak wood varieties: The various teak wood varieties available are - Indian teak, Burma teak, Malaysian teak etc.

Forest Ecosystem or ecological diversity means the richness and complexity of a biological community, including tropic levels, ecological processes (which capture energy), food webs and material recycling

Forest biodiversity

Forests are the most diverse ecosystems on land, because they hold the vast majority of the world's terrestrial species. Some rain forests are among the oldest ecosystems on earth. Timber, pulpwood, firewood, fodder, meat, cash crops, fish and medicinal plants from the forest provide livelihoods for hundreds of millions of people worldwide. But only a fraction of known species has been examined for potential medicinal, agricultural or industrial value.

A continuing threat

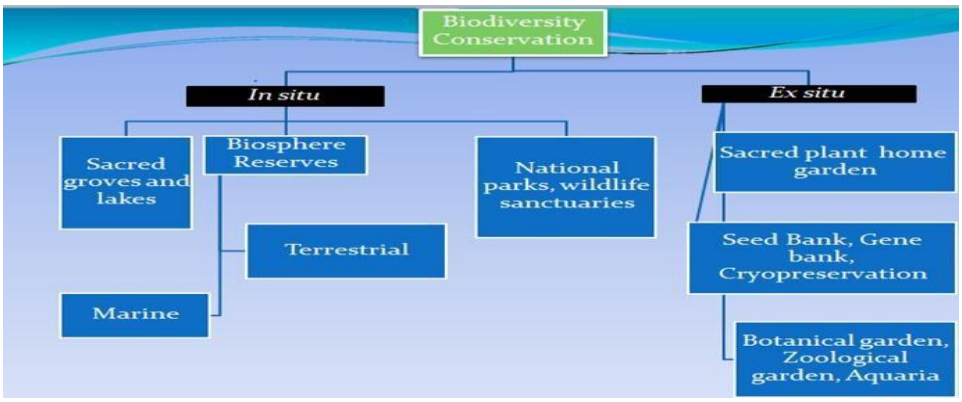
Forest biodiversity is threatened by rapid deforestation, forest fragmentation and degradation, hunting and the arrival of invasive species from other habitats. We are losing 12 million hectares of forest a year, much of it tropical rainforest with its unique and rich biodiversity.

Methods to protect biodiversity

1. One of the best ways to conserve forest biodiversity is to establish protected forest areas.
2. But these areas must be of a certain size, or consist of a well-designed network of forest areas, to allow the local forest ecosystems to continue operating effectively.
3. The forest surrounding the protected area must then be carefully managed so that it serves as a buffer zone.
4. These surrounding forests also allow local communities to earn a livelihood without infringing on the protected forest.
5. There have been numerous efforts aimed at safeguarding the world's biodiversity by protecting species in areas outside their original habitats. For example, seeds of some

of the most economically important trees are being conserved in seed centers and gene-banks as a way of protecting their genetic diversity.

6. But a large number of forest species have seed that do not survive storage, and many species of animals and plant-life are hard to protect once removed from their ecosystems.



Water resources

Water claims to be an important resource. An important use of water in our country is for irrigation. Besides, Water is also required in large amounts for industrial and domestic consumption.

Uses

- Is essential for all forms of life.
- Many uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually, all of these human uses, require fresh water.
- No plant or animal species can survive without water. If water in our body drops by 1% we feel thirst, if it drops by 10% we face death.

Hydrological cycle:

- Water from various water bodies
- Evaporated by solar energy
- Enters in to the atmosphere as clouds
- Falls again on earth as rain or snow
- Ultimately returns to the ocean.

Flow chart

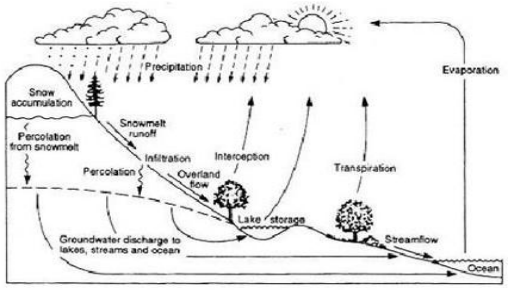


Fig. Water Cycle

Underground water

- Aquifer: layers of highly permeable rock that can store water is called an aquifer. Layer of sand and gravels are good aquifers.
- Clay and crystalline rocks are not good aquifers.

Effects of over utilization of water

1. **Decrease of ground water:**
   - Increased usage decreases the ground water.
   - Insufficient rain fall
   - Building construction activities sealing the permeability of thesoil.
2. **Ground subsidence:** If ground water withdrawal is greater than it‘s recharge rate, then the sediments in the aquifers get compacted. As a result shrinkage of land surface takes place. It leads to

- Structural damages to the buildings
- Fracture in pipes.
- Reversing the flow of canals.

3. **Lowering of water table**: over utilization of ground water in arid and semi-arid regions for agriculture disturbs the state of equilibrium of the hydrological cycle.
   - Lowering of water table
   - Decrease the number of aquifers
   - Change the speed and direction of water.
4. **Intrusion of salt water:** In coastal area over exploitation of ground water leads to the intrusion of salt water from sea. Therefore that water cannot be used for drinking and agriculture.
5. Over utilization of water causes earth quakes, landslides and famines.
6. **Drying up of wells:** Due to over utilization, ground water level decreases much faster than can be regenerated. It leads to drying up of dug well and bore wells.
7. **Pollution of water:** Near the agricultural land ground water decreases therefore water containing nitrogen enters into the ground and pollute the ground water. Water which contains excess nitrate content is not suitable fordrinking.

Reasons for decline of groundwater

Population continues to rise at an unprecedented and unsustainable rate; many more areas are expected to experience this imbalance in the near future.

Population explosion: world population is > 6 billion and will continue to increase significantly during the next few decades - enormous demands on the world's limited freshwater supply. The total annual freshwater withdrawals today are estimated at 3800 cubic kilometers, twice as much as just 50 years ago (world commission on dams, 2000).

- **Overutilization of surface and groundwater:** occurs at various levels. Use of more water than really needed by human beings. Many agriculturists use more water than necessary to grow crops. Industries in order to maximize short-term economic gains, does not bother its liquid waste and releases it into streams, rivers andthe sea.
- **Deforestation:** once hill slopes are removed of forest cover, the rainwater rushes down the rivers and is lost. Forest cover permits water to be held in the area permitting it to seep into the ground. This charges the underground stores of water in natural aquifers. This can be used in drought years if the stores have been filled during a good monsoon. This soil and water management and afforestation are long-term measures that reduce the impact of droughts. The destruction of forests influences the regulation of natural water cycle. The

Removal of dense and uniform cover over the hilly zones leads to occurrence of floods in drainage basins. Nations situated in tropical climates including India experience disastrous floods caused by the indiscriminate deforestation of the slopes above the valleys.

- **Hydropower generation:** large amount of water is used for generating power which otherwise used for human needs.
- **Dams** - for agriculture and power generation
- **Rain fall:** the erratic and inadequate rainfall results in reduction in storage in subsurface reservoirs. The building construction activities are sealing the permeable zone, reducing the area for percolation of rainwater into subsurface and increase in surface runoff. India's increasing demand for water for intensive irrigated agriculture, for generating electricity, and for consumption in urban and industrial centers, has been met by creating large dams. Dams support 30 to 40% of this area.

FLOOD

It is an over flow of water. It happens when the magnitude of flow of water exceeds the carrying capacity of the channel within its bank.

1. **Causes of flood**
   - Heavy rainfall, melting of snow and sudden release of water from dams. (flash floods)
   - Reduction in the carrying capacity of thechannel.
   - Deforestation, mining and over grazing increase the runoff from rains and the level of flood raises.
2. **Effect of flood**
   - Water spreads in the surrounding area andsubmerges them.
   - Cultivated land gets affected.
   - Extinction of civilization.
3. **Flood management**
   - Floods can be controlled by dams.
   - Channel management control flood.
   - Flood hazards reduced by forecasting or floodwarning.
   - Flood may also be reduced by reduction of run off by increasing infiltration through appropriate afforestation in the catchment area.

DROUGHT

- Drought is nothing but scarcity of water, which occurs due to
- Inadequate rain fall
- Late arrival of rainfall
- Excessive withdrawal of groundwater. Lack of water for the needs of agriculture,

livestock, industry or human population may be termed as a drought. Drought causes serious damages to plants, animals and human life.

Causes of drought

- When annual rain fall is below normal and less than evaporation, drought iscreated.
- High population.
- Intensive cropping pattern Ex: Maharashtra - there has been no recovery from drought for the last30 years due to over exploitation of water by sugarcane crop.

Effects of drought

- Drought causes widespread crop failure leading to acute shortage of food and adversely affects human and livestock population.
- Drought causes hunger, malnutrition and scarcity of drinking water an also Changes the quality of water.
- Worst situation of drought causes desertification.
- Raw materials of agro based industries are critically affected during drought time, hence industrial and commercial growth decreases.
- Drought increases the degradation of natural resources.
- Drought causes large migration of people andurbanization.

Drought management

- Indigenous knowledge is essential.
- Rain water harvesting system.
- Construction of reservoirs to improve ground water level.
- Modern irrigation technology (drip irrigation) very useful to conserve water.
- Afforestation activities also improve the potential of water in thedrought area.
- Crop mixing and dry forming are the suitable methods which minimize the risk ofcrop failures in dry

ENERGY RESOURCES

Energy distribution in the world

- Developed countries like USA and Canada constitute only 5% of the world's population but consume 25% of the world's available energy.
- Energy consumed by a person in a developed country for a single day is equal to energy consumed by a single person in a poor countryfor one year.
- Developed country GNP increases and energy consumption increases. In the poor countryGNP and energy consumption are less.

TYPES OF ENERGYRESOURCES:

1. Renewable energy resource (or)Non-conventionalenergy resources
2. Nonrenewable energy resources (or) Conventional energyresources

RENEWABLE ENERGY SOURCES:

Energy which can be regenerated.

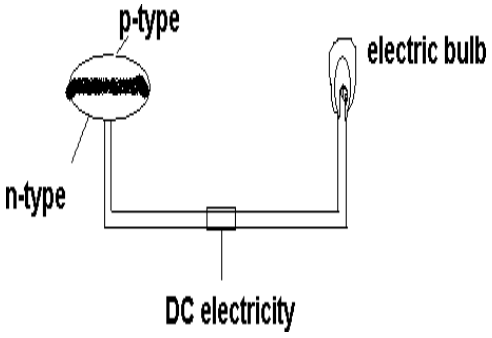
- Unlimitedsupply
- Provides energy security.
- Fits into sustainable development concept.
- Reliable and the devices are modular in size.
- Decentralized energy production.
- Types of renewable energy resources

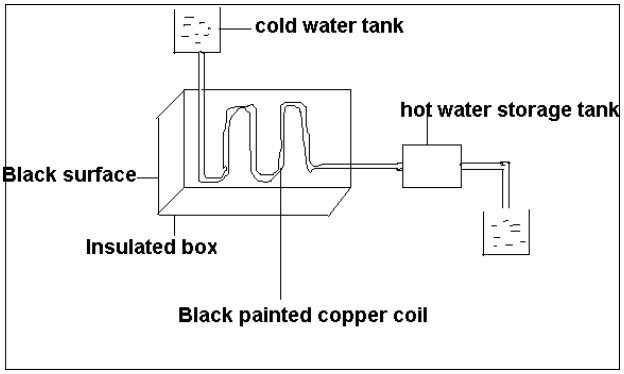
Solar energy: Nuclear fusion reaction of sun produces enormous amount of energy. Several techniques are available for collecting, storing and using solar energy.

- Solar cell (or) Photovoltaic cell (or) PV cell: Solar cell consists of p- type semiconductor (Si doped with B) and n-type semiconductor (Si doped with P). P-type forms top layer and n-type forms bottom layer.

- Solar rays fall on the top layer, the electrons from valence band promoted to the conduction band which crosses the p-n junction into n-type semiconductor. Potential difference between the two layers is created which causes flow of electrons.

Uses: It is used in calculators, electronic watches, street light, water pumps etc.





1. **Solar battery:**

   Large number of solar cells connected in series is called solar battery. It is used in remote areas where continuous power supply is a problem.

2. **Solar water heater:**

   It consists of insulated box painted with black paint with glass lid. Inside the box black painted copper coil is present. Cold water is allowed to flow, it is heated up and flows out into a storage tank from which water is supplied through pipes.

3. **Wind energy:**

   Moving air is called wind. The energy recovered from the force of the wind is called wind energy It‘s speed is high.

4. **Wind mills:** When a blowing wind strikes the blade of the wind mill, it rotates continuously. And rotational motion of the blade drives number of machines like water pump, flour mills and electric generators.

5. **Wind farms:** When a large number of mills are installed and joined together in a definite pattern – it forms wind farm. It produces large amount of electricity. The minimum speed for wind generator is 15 Km/hr.

Advantages:

- It does not cause air pollution
- Very cheap
- Ocean energy:

6. **Tidal energy (or) Tidal power:** Ocean tides are due to gravitational force of sun and moon which produce enormous amount of energy. High tides – rise of water in the ocean. Low tides – fall of water in the ocean. Tidal energy can be used by constructing a tidal barrage. During high tides sea water enters into the reservoirs and rotates the turbine, produce electricity. During low tides water from reservoir enters into the sea rotate the turbine produce electricity.

7. **Ocean thermal energy:** Temperature difference between surface water and deeper level water in ocean generates electricity. The energy available due to the difference in temperature of water is called ocean thermal energy. The ocean temperature difference should be 200C. Amonia is converted into vapours on the surface of warm water, it increases the vapour pressure which rotate the turbine and generates electricity. Deeper level cold water is pumped to cool and condense the vapour in to liquid.
8. **Geo thermal energy:** Temperature of the earth increases at a of 20 –750C per/km when we move down the earth. The energy utilized from the high temperature present inside the earth is called geothermal energy.
9. **Natural geysers:** Hot water or steam comes out of the ground through cracks naturally is called natural geysers.
10. **Artificial geysers:** Artificially a drill hole up to the hot region and by sending a pipe into it. The hot water or steam is used to rotate the turbine and generate electricity.
11. **Bio mass energy:**
12. **Bio mass:** Organic matter produced by plants or animals used as source of energy
13. **Bio gas:** Mixture of methane, carbon dioxide and hydrogen sulphide. Methane is the major constituent. It is obtained by anaerobic fermentation of animal dung (or) plant wastes in the presence of water.
14. **Bio fuels:** Fuels obtained by the fermentation of biomass. Ex: Ethanol, methanol
15. **Ethanol:** Produced from sugar cane. Calorific value is less.
16. **Methanol:** Obtained from ethanol Calorific value too less.

Gasohol: Mixture of ethanol and gasoline India trial is going on to use gasohol in cars and buses. **Hydrogen fuel:** Hydrogen produced by pyrolysis, photolysis and electrolysis of water. It has high calorific value. Nonpolluting one because the combustion product is water.

Disadvantages:

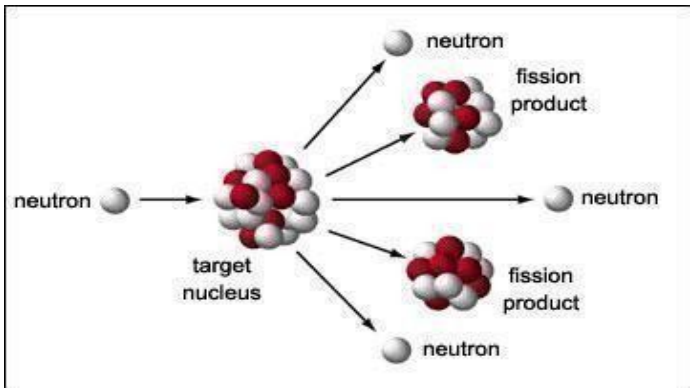
- Hydrogen is highly inflammable and explosive. Safe handling is required.
- Difficult to store and transport.

Non renewable energy sources:

Energy which cannot be regenerated is called as non-renewable.

Coal: It is a solid fossil fuel.

Disadvantages:



When coal is burnt large amount of CO2 is released which causes global warming. S, N produces toxic gases during burning.

Petroleum: Crude oil is a liquid consists of more than hundreds of hydrocarbons and small amount of impurities. The petroleum can be refined by fractional distillation. In the world level 25% of oil reserves are in Saudi Arabia. At present rate of usage, the world crude oil reserves are expected to get exhausted in just 40years.

Liquefied petroleum gas (LPG): Petroleum gases obtained during FD and cracking can be easily converted into liquid under high pressure as LPG. It is colorless and odorless gas, but during cylindering mercaptans are added to detect leakage.

Natural gas: These are found above oil in oil wells. It is a mixture of methane and other hydrocarbons. Calorific value is high. There are two types. Dry gas and wet gas.

Nuclear energy: Dr.H.Bhabha is a father of nuclear power development in India. 10 nuclear reactors are present in India. It produces 2% of India‘s electricity. Nuclear energy can be produced by two types of reactions.

Nuclear fission and nuclear fusion. Nuclear fission; It is a nuclear change in which heavier nucleus split into lighter nuclei on bombardment of fast moving neutrons. Large amount of energy is released through chain reaction.

Ex: Uranium with fast moving neutron gives barium and krypton in addition to three neutrons; in the second stage it gives nine neutrons and so on. This process of propagation of the reaction

by multiplication is called chain reaction.

Nuclear fission: It is a nuclear change in which lighter nucleus is combined together at extremely high temperature (1 billion 0C) to form heavier nucleus and a large amount of energy is released.

Ex: Isotopes of hydrogen combine to form helium molecule.

CASE STUDY

Wind energy in India: India generating 1200 MW electricity using the wind energy. Largest wind farm situated near Kanyakumari in Tamilnadu. It produces 380 MW electricity.

Hydrogen fuel car: General motor company of china discovered an experimental car (fuel H2) can produce no emission only water droplets and vapors come out of the exhaust pipe. This car will be commercially available by 2010.

QUESTION BANK

	PART – A
1	Describe natural resources
2	Write about Genetic biodiversity in brief
3	Point out the two main functions of biodiversity
4	List any two methods to avoid deforestation
5	Define biodiversity
6	Infer sustainability and sustainable development
7	Define the term deforestation
8	What is mining
9	Write any two effects of dam construction on environment
10	Write any two causes of flood

	PART-B
1	Infer the methods to protect the biodiversity
2	Compare renewable and non-renewable resources
3	Explain the types of energy resources
4	Explain the types of biodiversity
5	Write about fuel conservation and the methods of conservation of natural resources
6	List and explain the various causes of mining
7	Explain the general problems due to dam construction
8	Write about the reasons for the decline of the ground water
9	List and explain the effect of drought

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SCHOOL OF MANAGEMENT STUDIES

UNITIII - ENVIRONMENTAL STUDIES -SBAA1204

SYLLABUS - UNIT 3 ENVIRONMENTAL POLLUTION

Environmental pollution: types, causes, effects and controls; Air, water, soil and noise pollution.-Nuclear hazards and human health risks. - Solid waste management: Control measures of urban and industrial waste. -Pollution case studies.

INTRODUCTION

Pollution may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or man- made. The agents that pollute are called pollutants.

Pollutants

Pollutants are by-products of man‘s action. The important pollutants are summarized below:

- **Deposited matter—**Soot, smoke, tar or dust and domestic wastes.
- **Gases—**CO, nitrogen oxides, sulphur oxides, halogens (chlorine, bromine and iodine).
- **Metals—**Lead, zinc, iron and chromium.
- **Industrial pollutants—**Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants—**Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants—**Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants—**Radioactive substances and radioactive fall-outs of the nuclear test.

Classification of Pollutants

On the basis of natural disposal, pollutants are of two types:

(i) Non-degradable pollutants

These are the pollutants, which degrade at a very slow pace by the natural biological processes. These are inorganic compounds such as salts (chlorides), metallic oxides waste producing materials and materials like, aluminum cans, mercuric salts and even DDT. These continue to accumulate in the environment.

(ii) Biodegradable pollutants

These include domestic sewage that easily decomposes under natural processes and can be rapidly decomposed by natural/ artificial methods. These cause serious problems when accumulated in large amounts as the pace of deposition exceeds the pace of decomposition of disposal. On the

basis of the form in which they persist after their release into the environment, pollutants can be categorized under two types:

(i) **Primary pollutants:** These include those substances, which are emitted directly from some identifiable sources. This include-

- Sulphur compounds: SO_2, SO_3, H_2S produced by the oxidation of fuel.
- Carbon compounds: Oxides of carbon ($CO+CO_2$) and hydrocarbons.
- Nitrogen compounds: NO_2 and NH_3.
- Halogen compounds: Hydrogen fluoride (HF) and hydrochloric acid (HCl).
- *Particles of different size and substances:* These are found suspended in air. The fine particles below the diameter of 100u are more abundant and include particles of metals, carbon, tar, pollen, fungi, bacteria, silicates and others.

(ii) **Secondary pollutants.** The secondary pollutants are produced by the combination of primary emitted pollutants. in the atmosphere. In bright sunlight, a photochemical reaction occurs between nitrogen oxides; oxygen and waste hydrocarbons from gasoline that forms peroxyacetyle nitrate (PAN) and ozone (O_3), Both of them are toxic components of smog and cause smarting eyes and lung damage.

(iii) **Smog.** The fog deposited with smoke and chemical fumes forms a dark and thick covering, the smog. Smog is very common in almost all the industrial areas as the smog is trapped for many days by the stagnant air. It is harmful both for animals and plants.

AIR POLLUTION

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

SOURCES OF AIR POLLUTION

Various sources of air pollution are fossil fuels, industries, agricultural activities, wars, natural causes arid emissions from vehicles.

(i) Burning Fossil Fuels

Burning of wood, charcoal and other fossil fuels causes air pollution by the release of carbon dioxide (CO_2), carbon sulphur dioxide etc. Petroleum consists mainly of hydrocarbons, sulphur and nitrogen.

(ii) Emissions from Automobiles

Vehicles are mainly responsible for more than 80% of total air pollution. The major pollutants released from automobiles, locomotives, aircraft etc., include CO, unburnt hydrocarbons and

nitrogen oxide.

(iii) Industries

Paper and pulp factories, petroleum refineries, fertilizer plants, and steel industries, thermal power plants are the main sources of air pollution. They add various harmful gases like CO, SO_3, NO, Hydrocarbons etc., to the atmosphere. Textile factories release cotton dust into the air. Cities experiencing this type of pollution are Kanpur, Surat and Ahmedabad. The pesticide and insecticide industries are posing serious threat to the environment. Food processing industries and tanneries emit offensive odors. Release of poisonous gases from accidents also poses serious threats. e.g. Bhopal Gas Tragedy in which methyl isocynate (MIC) gas leakage killed several people. In Tokyo, about 34 tons of carbon particles mixed with other suspended particles settle per square kilometer every day.

(iv) Agricultural Activities

Spraying of insecticides and weedicides also cause air pollution. These, when inhaled create severe problems to both animals and man.

(v) Wars

Various forms of explosives used in war pollute the air by releasing poisonous gases. This greatly disturbs the ecology of the area. Nuclear explosions pollute air by radioactive rays. The effects of nuclear explosions on Hiroshima and Nagasaki are well-known examples.

(vi) Natural Causes

Gas emissions from active volcanoes, marsh gas, spores of fungi and pollens are the natural causes of air pollution.

COMMON AIR POLLUTANTS

Air pollutants are of two main types ~gaseous and particulate. Oxides of carbon. Nitrogen and sulphur are gaseous pollutants. Particulate pollutants may be solid or liquid particles, larger particles settle down quickly viz., sand and water droplets whereas small dust particles remain suspended in air for a long time. These are added into the atmosphere by the processes of blasting, drilling, crushing, grinding and mixing.

(i) Carbon Dioxide

CO_2 content of air has increased by 20% during the last century. CO_2 causes nausea and headache. It‘s increase in the air may cause greenhouse effect, rise in the atmospheric temperature. This may melt the polar ice resulting in rise in level of oceans and flooding

of coastal regions.

(ii) Carbon Monoxide

It is a very poisonous gas and is produced by incomplete combustion of fuel. If inhaled. It combines with hemoglobin and reduces its oxygen-carrying capacity. This leads to laziness, reduced vision and death.

(iii) Oxides of Nitrogen

These include NO and NO_2, which are released by automobiles and chemical industries as waste gases and also by burning of materials. These are harmful and lower the oxygen carrying capacity of blood.

(iv) Oxides of Sulphur

SO_2 and SO_3 are produced by burning of coal and petroleum and are harmful to buildings, clothing, plants and animals. High concentration of SO_2 causes chlorosis (yellowing of leaves), plasmolysis, damage to mucous membrane and metabolic inhibition. SO_2 and SO_3 react with water to form Sulphuric and sulphurous acids. These may precipitate as rain or snow producing acid rain or acid precipitation.

(v) Photochemical Oxidants

Formed by the photochemical reactions between primary pollutants, viz. oxides of nitrogen and hydrocarbons. Nitrogen oxides in the presence of sunlight react with unburnt hydrocarbons to form peroxyacyl nitrate (PAN), Ozone, aldehydes and some other complex organic compounds in the air.

(vi) Hydrocarbons

These are unburnt discharges from incomplete combustion of fuel in automobiles. These forms PAN with nitrogen oxides, which is highly toxic.

(vii) Particulate Matter

Industries and automobiles release fine solid and liquid particles into the air. Fly ash and soot from burning of coal, metal dust containing lead, chromium, nickel, cadmium, zinc and mercury from metallurgical processes; cotton dust from textile mills; and pesticides sprayed on crops are examples of particulate pollutants in the air. These are injurious to respiratory tract.

(viii) Aerosols

Aerosols are chemicals released in the air in vapour form. These include fluorocarbon (carbon compound having fluorine) present in emissions from the Jet aero planes. Aerosols deplete the ozone layer. Thinning of ozone layer results in more harmful ultraviolet rays reaching the earth, which are harmful to skin, and can lead to skin cancer also.

(ix) Radioactive Substances

These are released by nuclear explosions and explosives. These are extremely harmful for health.

(x) Fluorides

Rocks, soils and. minerals containing fluorides release an extremely toxic gas called hydrogen fluoride on heating. This gas is highly injurious to livestock and cattle.

POLLUTION IN INDIA

India supports a large network of factories and industries. These factories are generally localized in eight or ten large industrial centres. These are also a great source of air as well water pollution. To be on a safer side delocalization of industries is the need of the time. This would lead to an even distribution of pollutants and faster degeneration of pollutants. The major pollutants coming out from these industries are -

(i) **Industrial Pollutants**. The common air pollutants from industries are SO2, CO, CO2, H2S and hydrocarbons together with dust, smoke and grit. These are produced by the burning of coal and petroleum and by the combustion of lignite at thermal power stations. The chemical industries release HCl, chlorine, nitrogen oxide and oxides of copper, zinc, lead and arsenic. The fertilizer factories at Gorakhpur and Ahmedabad; the steel industries at Bhilai, Rourkela, Jamshedpur and Durgapur pollute the air with above-said gases.

(ii) **Automobile Exhausts**. Automobiles run by petrol and diesel produce CO, nitrogen oxides and hydrocarbons. Hundreds and thousands tons of hydrocarbons and CO are emitted into air daily. Metropolitan cities harbor lakhs and crores of automobiles. Every gallon of petrol consumed by automobiles produces 3 pounds of carbon monoxide and 15 pounds of nitrogen oxide.

(iii) **Ionizing Radiations** from Radioactive Substances. Ionizing radiations include alpha, beta particles and the gamma rays etc. These are produced by atomic explosions and testing of atomic weapons.

Effects of Air Pollution

Effect on Plants

(i) SO_2 causes chlorosis and also results in the death of cells and tissues.

(ii) Fluorides and PAN damage leafy vegetables such as lettuce and spinach.

(iii) Oxides of nitrogen and fluorides reduce crop yield.

(iv) Smog bleaches and blaze foliage of important leafy plants.

(v) Hydrocarbons cause premature yellowing, fall of leave and flower buds, discoloration and curling of sepals and petals.

(vi) Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.

(vii) Ozone damages cereals, fruits, and cotton crop.

Effect on Man

The effect of pollutants on animals and man are as follows-

(i) Ozone causes dryness of mucous membranes, changes eye vision, causes headache, pulmonary congestion and oedema.

(ii) Ozone has been reported to produce chromosomal aberrations.

(iii) SO_2 causes drying of mouth, scratchy throat, smarting eyes and disorders of respiratory tract.

(iv) SO_3, CO and NO_2 diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.

(v) Cotton dust leads to respiratory disorders *e.g.* bronchitis and asthma.

(vi) Smoking of tobacco causes cancerous growth in lungs.

Change in Climate

CO_2 content of air is increasing due to deforestation and combustion of fuel. This increase is affecting the composition and balance of gases in the atmosphere. Increase in CO_2 concentration may increase the atmospheric temperature, producing green house effect A rise of global temperature by more than 2-3 degrees may melt glaciers and polar ice. This would lead to a rise in ocean level and consequent flooding and submergence of coastal areas. Rainfall pattern may also change, affecting agricultural output in various regions of the world. Aerosols deplete the ozone layer in the stratosphere. Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth. This may cause, sunburn, blindness and inactivation of proteins, RNA, DNA and plant pigments.

Aesthetic Loss

Dust and smoke spoils the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists. Foul odors emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air Pollution

Following measures have been suggested to control air pollution-

(i) Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it

(ii) Particles larger than 50 mm are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.

(iii) The height of chimneys should .be increased to the highest possible level to reduce pollution at the ground level.

(iv) SO_2 pollution can be controlled by extracting sulphur from the fuel before use.

(v) Pollution control laws should be enforced strictly.

(vi) Trees should be planted on the roadside, riverbanks, parks and‘ open places as they keep the environment fresh.

(vii) Population growth, which is the main cause of pollution should be checked.

(viii) Nuclear explosions should be restricted.

Water Pollution

Water is extremely essential for life, this common fact is known to all. It is required to meet our basic needs in day to day life viz., cooking, drinking, bathing, disposal of sewage, irrigation, generating electricity in power plants, cooling and manufacturing different products in industries and the disposal of industrial wastes. During all these processes the undesirable substances are added to the water resources to a great extent. This alters the basic chemistry of water in rivers and streams.

Sources of Water Pollution

(i) Domestic sewage

This includes household‘s wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water based paints.

(ii) Industrial effluents

The industrial wastes are discharged in the adjoining rivers and streams through flush lines of factories. The textiles, sugar and fertilizers factories, oil refineries, drugs manufacture, rubber, and rayon fibers, the paper industries and the chemical factories all produce Chemical pollution.

(iii) Agricultural source

Increased use of fertilizers has become essential for high yielding crop plants. Excess of nitrates used as fertilizers seep into ground water is carried into lakes and pond. On entering the drinking water supply system these create several health problems.

(iv) Pesticides

These include insecticides, fungicides, nematicides, rodenticides, herbicides and soil fumigants.

These contain chlorinated hydrocarbons, organophosphates, metallic salts, carbonates, acetic acid derivatives etc. many pesticides are non-degradable. They pass through the food chains and accumulate in fatty tissues thus causing several health hazards.

(v) Thermal pollution

Power plants and nuclear power stations are the main sources of thermal pollution of water where water is used for cooling and becomes hot. The hot water on entering the main water body raises its temperature, which kills fishes and other aquatic animals and increases the rate of respiration in aquatic plants.

(vi) Pathogenic organisms

Sewage and domestic waste from houses introduces pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.

(vii) Mineral oils

Oil from oil spills and washings of automobiles finds way into river water through sewers.

(viii) Underground water pollution

Underground water particularly in cities and industrial areas is no more pure and safe. The sources of underground water pollution are sewage, seepage, pits, industrial effluents, septic tanks, fertilizers and pesticides, garbage etc.

(ix) Marine water pollution

River and stream network sources of water ultimately end up ocean and seas. Thus, these acts as the sink of all natural and man-made water based pollutants. The main sources of oceanic pollution are discharges of oil, greases, petroleum products, detergents, sewage and garbage including radioactive wastes.

Effect of Water Pollutants

The main effects of water pollutants are:

1. Compounds of mercury, arsenic and lead are poisonous and chemically harmful as they even affect water treatment plants e.g. organic sulphur compounds interfere with nitrification.
2. Mercury when dissolved in water is absorbed by aquatic plants and enters the food chain. Lead impairs metabolism and brings about congenital deformities, anemia etc.
3. Cadmium damages kidneys and liver.
4. Inorganic nitrates and phosphates promote growth of oxygen-consuming algae, which result in the death of fishes and other aquatic animals.

5. Presence of dyes and compounds in the discharged water changes the color of water.
6. Soap, detergents and, alkalis result in foam formation.
7. Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odors of water.
8. The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life (Eutrophication).
9. Bio magnifications are the increase of toxic materials at each tropic level of a food chain.

For example, DDT after reaching a water system is absorbed by the microorganisms on which smaller fishes feed. From them, DDT reaches the carnivorous animals. Since bigger fishes consume more food, large amounts of DDT accumulates in their body.

CONTROL OF WATER POLLUTION

(i) Separate ponds and tanks to be used for cattle and animals.

(ii) Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.

(iii) In towns where sewage facilities are not available, septic tanks should be made in the houses.

(iv) Rivers and lakes should not be used for bathing or washing as it contaminates water. .

(v) Domestic sewage and industrial wastes should be treated before discharging them into drains.

Treatment of waste Water

Domestic sewage and industrial wastes should be properly treated before these are drained in the mainstream water. Treatment involves the following two steps:

(i) Sewage treatment

It involves following steps:

Primary treatment. It involves physical processing of sedimentation, flotation and filtration where sewage water is passed through screens to remove larger particles and then through grinding mechanism to reduce the larger particles to smaller size. The sewage is finally passed through settling tanks to remove suspended impurities.

Secondary treatment. Sewage obtained after primary treatment is sent to aeration tank where it is mixed with air and sludge laden with bacteria and algae. The algae provide oxygen to the bacteria and decompose organic matter into simple compounds. Chlorination is finally done to

remove bacteria.

Tertiary treatment. In the third and last step water is passed through ion exchangers to remove dissolved salts.

(ii) **Treatment of industrial effluents**

Treatment of industrial effluents involves neutralization of acids and bases, removal of toxic compounds, coagulation of colloidal impurities, precipitation of metallic compounds and reducing the temperature of effluents to decrease thermal pollution.

SOIL POLLUTION

Soil Pollution

Like water and air, soil is also equally important for living organisms. It supports plants on which. all other living organisms depend. The process of soil formation is so slow that the soil may be regarded as a non-renewable source. Therefore, the study and control of soil pollution is important. Any substance that reduces soil productivity is called **soil pollutant.**

Sources of Soil Pollution

There are several materials, which adversely affect physical, chemical and biological properties of the soil and thus reduce its productivity. These are

1. Chemicals present in industrial waste.
2. Pesticides and insecticides that are sprayed on crops. .
3. Fertilizers and manures that are added to the soil to increase the crop yield.

Effect of Soil Pollutants

Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms. Pesticides are absorbed by the plants and then transferred to other organism. Hence, they affected food chains and food webs. Excretory products of livestock and human beings used as manure pollute the soil besides giving high yield. The faulty sanitation and unhygienic practices of the people add to the soil pollution. Pathogens present in the wastes and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.

Types of Soil Pollution

It is of the following types-

(i) Positive soil pollution

Reduction in the productivity of soil due to the addition of undesirable substances like pesticides, herbicides, fertilizers, etc. is called positive pollution. These pollutants have

cumulative effect and kill the soil organisms.

(ii) Negative soil pollution

It is caused by the removal 01 useful components from soil by erosion, deforestation and improper methods of agriculture.

Salination of Soil

Increase in the concentration of soluble salts is called salination. This adversely affects the quality and productivity of soil. It takes place in two ways: accumulation of salts dissolved in irrigation water on the soil surface due to intensive farming and poor drainage, and deposition of salts as white crust during summer months drawn by capillary action from the lower surface to the top surface.

Control of Soil Pollution

Various measure to control soil pollution are-

1. Transfer stations for bulk shifting of refuse should be constructed in cities and big towns.
2. Pneumatic pipes should be laid for collecting and disposing wastes.
3. Materials like paper, glass and plastics can be recycled.
4. Metals should be recovered from scrap and disposed materials.
5. Use of chemical fertilizers should be reduced by the use of bio fertilizers and manures.
6. Use of pesticides can be reduced by adopting biological control of pests.
7. Use of cattle dung and agricultural wastes in biogas plants should be encouraged.
8. Deforestation can check soil erosion to a great extent.

Land Degradation

Besides pollution, land and soil face several other problems. Removal of topsoil is called soil erosion. Soil erosion factors are water, wind, ocean, waves and glaciers, felling of trees, overgrazing by cattle, over-cropping etc. Erosion occurs both in wet and dry regions. It leads to floods.

Soil Erosion in India

Soil erosion is a worldwide phenomenon, but it is especially high in Central Africa, China, India, Nepal, Australia, Spain, USA and USSR. India loses about 40,000 hectares of land every year as an effect of wind and water erosion. Damage to the topsoil is 18.5% of the total world‘s loss. This is due to overgrazing by livestock. The population of livestock in India is the highest in the world. Overgrazing damages the topsoil, which reduces soil fertility.

(i) Deforestation of overgrazing

Over-grazing is the main cause of soil erosion in India. Roots of grasses act as binding material and keep the soil intact, which upon grazing are destroyed.

Desertification

Loss of soil productivity by erosion of top soil results in the formation of deserts. Deserts are spreading in all continents. Desertification takes place by shifting of sand dunes by wind and .over-grazing. That desert in India is spreading at the rate of 12,000 hectares of land every year.

(ii) Shifting cultivation

Tribal communities follow the practice of cutting down trees and setting them on fire and then raising the crops on the resulting ash. This is called Jhuming in northeastern India. It is harmful if the Jhuming cycles are longer than ten years but short cycles destroy forests and cause soil erosion. e.g. Asia and Africa. .

(iii) Developmental activities

Large areas of fertile and productive croplands, woodlands and grasslands are lost to various developmental activities such as rapid urbanization, building of airports, industries, railways, roads, mining and construction of dams.

Control of Land Degradation

Following ways can control Land degradation

1. Restoration of forests and grass cover can help in prevention of soil erosion and floods.
2. By replacing shifting cultivation with crop rotation, mixed cropping or plantation cropping. Providing adequate drainage to irrigated and flood-prone lands can prevent salinity.
3. Desertification can be controlled by spread of appropriate plant species and by raising trees as wind breaks.

Noise Pollution

Noise can be defined as unwanted/unpleasant sound. So noise pollution is unwanted sound dumped into the atmosphere without regard to the adverse effects it may have. In our country urbanization and industrialization have become twin problems. Cities and towns have sprouted up where industries are concentrated. Lack of town‘ planning had led to residential, commercial and industrial areas being mixed up. Houses, schools and hospitals are situated near industries. All the boons of industrialization and civilization such as motors, horns, heavy and light machinery, work and movement, blaring radios, supersonic aero planes have become disturbing

and irritant. Our ears can hear ordinary conversation between 30-60 decibels. Modern conversation has a noise value of 60 decibels. A decibel value greater than 80 decibels causes noise pollution. Noise becomes troublesome above 140 decibels.

Effect of Noise Pollution

1. Constant noise affects a man physically and mentally. Physical effects include blood vessels to contract, skin to become pale, muscles to constrict and rise in blood pressure leading to tension and nervousness.
2. High intensity sound emitted by industrial plants, bottling machines, supersonic aircrafts, when continued for long periods of time not only disturbs but also permanently damages hearing.
3. Offices, industries and crowded places where constant noise prevails can produce temper tantrums, headaches, fatigue and nausea.
4. Loud and sudden noise affect the brain. Intermittent noise leads higher incidence of psychiatric illness and also a danger to health of pregnant mothers and small infants.
5. Noise has harmful effects on nonliving materials too, *e.g.* cracks develop under the stress of explosive sound.

Control of Noise Pollution

Following methods can control noise pollution:

1. Limited use of loudspeakers and amplifiers.
2. Excursing control over noise producing vehicles.
3. Industrial workers should be provided with ear plugs.
4. Delocalisation of noisy industries far away from dwelling units.
5. Within a radius of 10 miles of airport, no buildings or factories should be allowed.
6. Plants and trees should be planted all around the hospitals, libraries and schools and colleges.
7. Personal protection against noise can be taken by using, cotton plugs in the ear.

Radiation

The radiations from the atomic blasts cause several health hazards. The radiations carry high energy and remove electrons from atoms and attach them to other atoms producing positive and negative ion pairs. Hence, they are known as ionizing radiations. The ionization property of these radiations proves to be highly injurious to the protoplasm. The ionizing radiations of ecological concern are classified as follows:

Corpuscular Radiations

These consist of streams of atomic or subatomic particles, which transfer their energy to the matter they strike.

- ***Alpha particles*** **-** These particles are large and travel few centimeters in the air. These cause large amount of local ionization.
- ***Beta particles***
- These are small particles characterized by having high velocities. They can travel a few meters in space. These are capable of entering into the tissues for few centimeters. Since alpha and beta particles have low penetration power they can produce harmful effects only when absorbed, ingested or deposited in or near living tissues.
- ***Electromagnetic radiations***
- Electromagnetic radiations include waves of shorter wavelengths. These are capable of traveling long distances and can readily penetrate the living tissue. These include gamma rays. These can penetrate and produce effect even without being taken inside.
- **Other Types of Radiations**
- Besides radioactive radiations, some other radiations are also present in the atmosphere.
- ***Neutrons***

  These are large uncharged particles, which do not cause radiation by themselves, but they produce radioactivity in non-radioactive materials through which they pass.
- **X-rays**

  These are electromagnetic waves very similar to gamma rays, but originate from the outer electron shell of radioactive substances, which are not dispersed in nature.
- **Cosmic rays**

  These are radiations from the outer space, which contain alpha and beta particles together with gamma rays.

Sources of Radiations

The radiations are produced from the radioactive elements, which are known as radionuclides or radioactive isotopes, e.g. Uranium. Radium, Thorium, and Carbon-14. These contribute to background radiation. But isotopes of certain metabolically important elements like Carbon-14, Cobalt-60, Calcium 45, Iodine-131, Phosphorus-32, etc. are not ecologically harmful but are used as tracers. The third category of radionuclides comprises of fission products of uranium and certain other elements. These are cesium, strontium, and plutonium etc.

Biological Effects of Radiation

The effects of radiation have revealed that acute doses are found to be deleterious and may kill the organisms, whereas the increase in radiation in biological environment leads to different kinds of mutations. The effects of Cobalt-60 or Cesium-137 gamma radiations have now been studied on communities and on ecosystems at different places. The research concludes that Irradiations eliminate varieties in species. The sensitivity of cells, tissues and organisms to radiation varies. The cells with larger chromosomes are more sensitive. Herbaceous communities and early stages of succession are resistant than the mature forest.

Nuclear Fall Outs or Radioactive Fall Outs

The atomic blasts not only produce the local ionizing radiations at that time but the radioisotopes produced as a result of explosion enter the atmosphere and continue to fallout gradually over broad geographic areas for a very long time. These are known as nuclear fallout or radioactive fallout. These are dangerous for life as they also produce ionizing radiations.

Biological Effects of Fall outs

The fallout of radionuclides combines with various metals and dust and from colloidal suspension combines with organic compounds to form complexes. The smaller particles of radionuclides adhere tightly to the leaves of plants and produce radiation damage to leaf tissue besides entering the tissues also. Through grazing animals these enter the food chain directly at the primary consumers level. Radionuclides, which combine with organic substances, enter the food chain through producer tropic level. Therefore, the radionuclides fall out manages to enter the body of all living organisms. Radioactive Strontium-90 poses a health hazard in human beings and other higher vertebrates. It continues to deposit in the bones and causes bone cancer and leukemia. Radioactive Cesium-137 is known to cause irreversible genetic changes in different organisms. The fallout radiations do cause changes in the genetic constitution of organisms, resulting in gene mutations and chromosomal aberrations. Their considerable, doses may kill,

cripple and alter the animals and plants in the areas.

Control of Radiation Pollution

Following measures can help in controlling the radioactive pollution:

(i) Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.

(ii) Leakage of radioactive elements from nuclear reactors, laboratories, transport, careless handling and use of radioactive fuels should be checked.

(iii) Level of radiation pollution should be monitored regularly in risk areas.

(iv) Disposal of radioactive wastes deserves special attention.

Case studies

Hiroshima and Nagasaki Episode

The tale of Hiroshima and Nagasaki is a painful experience. It is for the first time that an atomic bomb has been exploded over human population. The incident took place on August 6,1945 at 8:15 a.m. The bomb with an approximate temperature of around 100 million 0°C was exploded on a fine morning in Hiroshima (Japan). The temperature of the city hiked like anything, almost like an oven. After three days, Nagasaki too suffered the ravages of a nuclear attack. More than 1,00,000 people were reported to die just after the event took place. Since radiations from nuclear elements remain active even after, the generations to follow up also suffered from various diseases. Even the babies in the mother‘s womb were affected and a few perished. Blindness, deafness, skin diseases and cancers, distortion of bones and other parts became the fortune of human civilization.

Chernobyl Accident

This incident took place in Ukraine on April 26, 1986. There was a Chernobyl nuclear power plant in Ukraine after which the event has been named. Approximately four million people had been reported to suffer from the accident. The accident contaminated neighboring environment up to several kilometers. The sites were evacuated and resettlement was done for the affected people. The radiations released affected ground water and surface waters, affecting large areas of Europe. 131 Iodine and 137 Cesium are the most dangerous amongst the 20-odd radioactive elements released during Chernobyl disaster. As per the Soviet Health Ministry, 31-persons died shortly after the disaster. Of the 276,614 people who worked for rehabilitation and cleaning operations, a total of 1065 died by the end of 1990.

Marine Pollution

All river drainages end up in the seas. On the way to sea, rivers carry large amounts of sewage, garbage, and agricultural discharge, biocides, including heavy metals. Besides this discharge of oils and petroleum products and dumping of radionuclides waste into sea also cause marine pollution. Huge quantity of plastic is being added to sea and oceans. Over 50 million lb plastic packing material is being dumped in sea of commercial fleets. Many marine birds ingest plastic that causes gastro-intestinal disorders. The chemical principle in PCBs causes more damage as thinning of eggshell and tissue damage of egg. Radionuclide waste in sea includes Sr-90, Cs-137, Pu-239, and And Pu-240. The pollutants in sea may become dispersed by turbulence and ocean currents and finally becomes a part of food chain. Bioaccumulation in food chain may result into loss of species diversity. The pollution in Baltic sea along the coast of Finland, took place largely from sewage and effluents from wood industries. This pollution effect brought changes. in species diversity in the bottom fauna. In less polluted water there was rich species diversity, which tended to decrease with increasing pollution load. In heavily polluted areas, macroscopic benthic animals were absent, but chirognomy larvae occurred at the bottom. In marine water the most serious pollutant is oil. Spill of oil or petroleum products due to accidents/ deliberate discharge of oil polluted waste brings about pollution. About 285 million gallons of oil are spilled each year into ocean, mostly from transport tankers. Oil pollution causes damage to marine fauna and flora including algae, fish, birds, and invertebrates. About 50,000 to 2,50,000 birds are killed every year by oil. The oil is soaked in feathers, displacing the air and thus interferes with buoyancy and maintenance of body temperature. Hydrocarbons and benzpyrene accumulate in food chain and consumption of fish by man may cause cancer. Detergents used to clean up the spill are also harmful to marine life.

Thermal Pollution

The increase in water temperature by industrial units such as steel and iron factories, electric powerhouses and atomic power plants may be called as thermal pollution. Some of the industries generate their own power supply where water is used to cool the generators. This hot water is released into the main stream, causing a warming trend of surface waters. If the drainage is poorly flushed, a permanent increase in the temperature may result. Many organisms are killed instantly by the hot water resulting into a high mortality. It may bring other disturbance in the ecosystem. The eggs of fish may hatch early or fail to hatch at all. It may change the diurnal and seasonal behavior and metabolic responses of organisms‖ It may lead to unplanned migration of

aquatic animals. Macrophysics population may also be changed. As temperature is an important limiting factor, serious changes may be brought about even by a slight increase in temperature in a population. Heat stress (5-1 one above the normal growing temperature of organism) induces expression of specific gene families called heat shock genes, which lead to the synthesis of a new set of proteins called heat shock proteins. Heat shock proteins have been found in every organism from unicellular prokaryotes to multicultural organisms including Homo sapiens. Heat Shock Proteins synthesis lead to acquired thermo tolerance, i.e. the ability of an organism to withstand a normally lethal temperature. Thermo tolerant genotypes show adaptations at various levels of organization besides showing qualitative and quantitative differences in heat shock proteins as compared to the thermo sensitive genotypes.

Solid Waste Management

Environmental problems also include solid waste disposal. At all levels of development human beings produce domestic wastes. These comprises of kitchen wastes, ashes from fires, broken utensils and worn-out clothing. The industrial revolution leads to the concentration of people in urban areas with very high population density. This resulted in addition of new sources of wastes from shops, institutions and factories. In developed countries services for the regular removal of domestic and trade wastes have been in operation for last many years. Many changes have taken place in our society. The character of the wastes has altered with rising living standards, changes in retail distribution methods and fuel technology. Grave environmental concerns have come up with rise in construction of new buildings, supermarkets, and industrial wastes of many kinds. In the industrialized countries, therefore, basic health and environmental problems have been solved in the storage and collection of solid wastes, although major problems remain in regard to resource recovery and disposal. The technology of wastes handling is now highly developed. Many institutions give technical training and support. However developing nations like India are facing the problems of urbanization with high population densities. The developing countries are aware of the importance of avoiding the environmental pollution. The quality of urban environment is a matter of growing concern and the importance of solid wastes management is increasingly being recognized.

Sources and Characteristics

Solid wastes generally refer to describe non-liquid waste materials arising from domestic, trade, Commercial, industrial, agriculture and mining activities and from the public services. Disposal of sludge‘s (liquid waste) of some kind fall within the scope of solid waste management. These

arise primarily from industrial sources and from sewage treatment plants. Solid wastes comprise countless different materials; dust, food wastes, packaging in the form of paper, metals, plastics or glass, discarded clothing and furnishing, garden wastes and hazardous and radioactive wastes. The method and capacity of storage, the correct type of collection vehicle, the optimum size of crew and the frequency of collection depend mainly on volume and density. Just as solid wastes comprise a vast number of materials, they arise from a multitude of separate sources as well as many kilometers of streets upon which solid wastes accumulate. Thus, the four main aspects of solid wastes management are: (*i*) storage at or near the point of generation, (*ii*) collection, (iii) street cleansing, (iv) disposal. The main constituents of solid wastes are similar throughout the world, but the proportions vary widely. As personal income rises, paper increases, kitchen wastes decline, metals and glass increase, total weight generated rises and the density of the wastes declines. Clearly, the amount of work involved in refuse collection depends upon the weight and volume of wastes generated and the number of collection points from which the wastes have to be removed.

Health and environmental implications

Improper handling of solid wastes results in increased potential risks to health and to the environment both. Direct health risks concern mainly the workers in this field, who need to be protected, as far as possible, from skin contact with wastes. For the general public, the main risks to health are indirect and arise from the breeding of disease vectors, primarily flies and rats. More serious, however, and often unrecognized, is the transfer of pollution to water, which occurs when the leach ate from a refuse dump enters surface water or wastes, either in the open air, or in plants that lack effective treatment facilities for the gaseous effluents. Traffic accidents can result from wastes accumulated and dispersed on to streets and roads. They have caused death and injury to people in the surrounding areas. There also persists the specific danger of the concentration of heavy metals in the food chain. These metals can be taken up by the plants growing on land on which sludge has been deposited, creating risks to the animals which graze and the humans who consume these animals.

Economic implications

Labour and transport absorb the major part of the operating cost of solid wastes management services. The level of mechanization that should be adopted for solid wastes management systems relates directly to the cost of Labour, as compared to that of plant and energy. There is not much variation, worldwide, in energy or mechanical plant costs, but there is wide variation in

the range of labour costs. Thus, there are no universally applicable solid wastes management systems. Every country must evolve indigenous technology based on the quantity and character of the wastes, the level of national wealth, wage rates, equipment, manufacturing capacity, energy costs etc. It is necessary to deploy a complete set of technical skills, which derive from several professional disciplines. These include civil and mechanical engineering, chemical engineering, transport organization, land use planning and economics.

Refuse Collection

A refuse collection service requires vehicles and Labour. For their efficient development, three components are basic:

(1) Travel to and from the work area,

(2) The collection process, and

(3) The delivery process.

The use of large, widely spaced communal storage sites is usually a failure because the demand placed on the householder goes beyond his willingness to cooperate. Communal storage points should, therefore, be at frequent intervals, Madras and Bangalore provide fixed concrete containers. They are fairly successful because they place reasonable and acceptable duty on the residents, thus very little domestic waste is thrown in the street.

In another system of block collection, a collection vehicle travels a regular route at prescribed intervals, usually every two days or every three days, and it stops at every street intersection, where a bell is rung. At this signal the residents of all the streets leading from that intersection bring their wastes containers to the vehicle and hand them to the crew to be emptied. A crew of one or two men is adequate in number, as they do not need to leave the vehicle.

Sanitary Landfill Disposal

Land disposal (burying of wastes) is the only approved method of disposal, which is performed at a single site. Incineration, composting, and salvage are either a form of refuse handling or processing. They are not complete methods of disposal, and they require disposal of residue. Sanitary landfill can be defined as the use of solid wastes for land-reclamation, a typical example being the restoration, by filling to the original level of man made surface dereliction such as a disused surface, mineral excavation. Solid wastes may also be used to improve natural features by raising the level of low-lying land to enable it to be used or cultivation or industrial development. Thus, sanitary land filling has two essential features, which differentiate it from crude dumping:

(i) Only sites that will be improved not degraded, by a change of level are selected.

(ii) Simple engineering techniques are used to control the manner in which the wastes are deposited, so that dangers to public health and the environment are avoided.

Unfortunately most of the world‘s wastes are disposed off by uncontrolled dumping which blights the land for any future use and causes serious risks of water pollution and vector breeding. Very few cities operate sanitary land filling to standards, which totally control health and environmental dangers; most of those that do are in the industrialized countries.

Control of Hazards

(i) Control over pathogens is dependent upon a rigorous policy of covering the wastes soon after deposit. This serves both to isolate the wastes and to retain the heat, which is quickly generated during aerobic decomposition.

(ii) The main source of insects will be the eggs of flies. Which have been deposited in the wastes before they arrive at the site. Most of these will be buried deep in the wastes and will succumb to the temperature increase.

(iii) Fire at a sanitary landfill can arise from innumerable causes, hot ashes in a vehicle delivering wastes: a cigarette thrown by a worker; the sun‘s ray though a fragment of glass on the surface. With some kinds of wastes the consequence of fire may be very serious and underground fires have been known that ultimately caused the collapse of the surface into voids caused by the fire.

(iv) The pollution of static water, ditches, river or the sea occurs when a sanitary landfill adjoins a body of water. The normal source of the leach ate causing this pollution is rain falling on the surface.

Incineration

Open burning, barrel burning, and other related uncontrolled forms of burning have a long history of use. Many liquid wastes and pathological wastes are best disposed of by incineration. Originally, solid waste incineration was practiced to reduce the quantity of refuse or disposal. After it was proven that heat could destroy most pathogens, incinerators were used in hospitals for destruction of pathological wastes. With few exceptions, incinerators are not ―good neighbors,‖ and the environmental nuisances of dust. Noise and air pollution have provoked communities to an anti-incinerator philosophy. To overcome this negative community feeling is going to require that incineration prove its worth and that imagination be used in the design of future units. Incineration of solid wastes yields the highest percent of volume reduction except for Pyrolysis. Unlike a

sanitary landfill, incineration of solid wastes can be performed on the premises of apartments, supermarkets, departments‘ stores, and similar establishments.

Composting

Composting involves the biological stabilization of solid matter either under aerobic or anaerobic conditions. The end product of composing is an organic material, which could have beneficial value as a soil conditioner or plant mulch. In addition to producing a modified solid waste material, which can be useful in land reclamation, composting does yield a volume reduction of solid waste by about 40-60% of the compost able fraction *pyrolysis*

Pyrolysis is a thermal process where oxidation of the organic fraction is not allowed to occur. Instead, the organic matter is evolved from the refuse with heat, leaving an ash consisting mostly of carbon and any inorganic matter, e.g. metal and glass are not removed before Pyrolysis. Some of the gases, which have been volatized, are condensed while the remainder is burned to supply the heat (energy) needed to pyrolyze the material. Since oxidation is prevented, the Pyrolysis process must be performed in an atmosphere of argon, helium or nitrogen.

Role of an Individual in Prevention of Pollution

Which are the most viable, efficient and economical ways to eliminate pollution problems? We very often see people blaming public and government sectors to control pollution through controlling market mechanisms and government blaming people to avoid and check pollution. Who would control whom? Many ecologists and environmental scientists believe in that pollution problems can be overcome by using market mechanisms to reduce pollution rather than rigid rules and regulations. However, on the other hand man should identify and gear up his own potential to curb down pollution. Man could achieve this by identifying his own role at individual level in prevention of pollution. This is possible through environmental awareness, education and enlightenment.

Ways and means by which pollution problems can be greatly reduced at individual level are:

1. Masses at personal level should determine to consume optimum level of resources, which would lead a comfortable life. Because excessive resource consumption is in someway related to pollution problems and hazards (natural and anthropogenic both).
2. Waste disposal at personal level should be optimally reduced as waste destruction by any means causes pollution.
3. Maintenance of vehicles should remain proper as to avoid introduction of harmful gases and other pollutants in to the atmosphere.
4. Generators and other household gadgets that add to pollution of environment should be kept well

maintained.

5. Use of chemical fertilizers should be limited as to avoid water pollution e.g. DDT
6. Timely disposal of waste to prevent decomposition of household refuge as to check foul odours and spread of disease by insects, flies and other pathogenic bacteria.
7. Industrialists should check for proper disposal of treated water from factory units as to avoid thermal pollution of water bodies. They should also deploy a water treatment plant to prevent the flow of hazardous material.
8. Service centres of vehicles should minimize the disposal of organic solvents into the main drains.

POLLUTION CASE STUDIES

A case study of groundwater pollution in India

An example of groundwater pollution cause by excessive extraction is that fluoride contamination. Fluorisis is not a localized problem. It has spread across 19 states and across a variety of ecological regions ranging from the Thar desert, the Gangetic plains and the Deccan plateau. Each of these regions are distinct in terms of rainfall, soil type, groundwater recharge regime, climatic conditions and hydrology. High fluoride concentration in groundwater is a natural phenomenon in several countries such as China, Sri Lanka, West Indies, Spain, Holland, Italy and Mexico. Experts claim that a fluoride belt stretches across the Middle East across Pakistan and India and then into Southeast Asia and the South of China. According to a report of the Rajiv Gandhi National Drinking Water mission, the bedrock of the Indian peninsula consists of a number of fluoride bearing minerals. When the bedrock weathers the fluoride leaches into water and the soil. Although the Indian peninsular bedrock has always been the same, this problem has only surfaced during the last three decades. This is related to the over extraction of groundwater which has resulted in the tapping of aquifers with high fluoride concentrations. The beginnings of this phenomenon can be traced back to the 1970s and the 1980s when there was massive state investment in rural water development for irrigation as well as for drinking. Encouraged by state subsidies on diesel and electricity, people invested in diesel and submersible pumps in a bid to extract groundwater through borewells. This policy aggravated the fluoride problem. Fluoride mainly enters the human body through drinking water where 96 to 99 percent of it combines with the bones as it has an affinity for calcium phosphate in the bones. Excess intake of fluoride can lead to dental fluorosis, skeletal fluorosis or non-skeletal fluorosis. Dental fluorosis is characterized by discoloured, blackened, mottled or chalky white teeth. Skeletal fluorosis leads to severe and permanent bone and joint deformities. Non-skeletal fluorosis leads to gastro-

intestinal problems and neurological disorders. Fluoride can damage the foetus and adversely affect the IQ of children. Once fluoride is detected in water, the only solution is to deflouridate it. Various technologies are available for this process. However the type of technology to be selected depends upon the fluoride levels in the water and the volume of water to be deflouridated. None of the Indian technologies are however fool-proof. Deflouridation plants and household water treatment kits are stop-gap solutions.

A case study of pesticide pollution in India

One of the most terrifying effects of pesticide contamination of ground water came to light when pesticide residues were found in bottled water. Between July and December 2002, the Pollution Monitoring Laboratory of the New Delhi based Center for Science and Environment (CSE) analyzed 17 brands of bottled water both packaged drinking water and packaged natural mineral water commonly sold in areas that fall within the national capital region of Delhi. Pesticide residues of organo chlorine and organo phosphorus pesticides which are most commonly used in India were found in all the samples. Among organo chlorines, gammahexachlorocyclohexane (lindane) and DDT were prevalent while among organo phosphorus pesticides, Malathion and Chlorpyrifos were most common. All these were present above permissible limits specified by the European Economic Community, which is the norm, used all over Europe. One may wonder as to how these pesticide residues get into bottled water that is manufactured by several big companies. This can be traced to several facts. There is no regulation that the bottled water industry must be located in _clean' zones. Currently the manufacturing plants of most brands are situated in the dirtiest industrial estates or in the midst of agricultural fields. Most companies use bore wells to pump out water from the ground from depths varying from 24m to even 152 m below the ground. The raw water samples collected from the plants also reveled the presence of pesticide residues. This clearly indicated that the source of pesticide residues in the polluted groundwater are used to manufacture the bottled water. This is despite the fact that all bottled water plants use a range of purification methods. Thus obviously the fault lies in the treatment methods used. These plants use the membrane technology where the water is filtered using membranes with ultra-small pores to remove fine suspended solids and all bacteria and protozoa and even viruses. While Nano filtration can remove insecticides and herbicides it is expensive and thus rarely used. Most industries also use an activated charcoal adsorption process, which is effective in removing organic pesticides but not heavy metals. To remove pesticides the plants use reverse osmosis and granular activated charcoal methods. Thus even though manufacturers claim to use these process the presence of pesticide residues points to the

QUESTION BANK

	PART – A
1	Define the term pollution
2	List any methods to control noise pollution
2	Define global warming
3	Define water pollution
4	List any two major pollutants released from the industries
5	Define aesthetic loss
6	List any two effects of noise pollution
7	Define soil pollution
8	List the types of soil pollution
9	What is desertification
10	List any two measures of controlling radiation pollution

	PART-B
1	Explain the methods to control water pollution
2	Explain the methods to control soil pollution
3	Explain the sources of water pollution
4	List and explain the classification of Pollutants
5	Describe the methods to control air pollution
6	List and explain the effects of air pollution on plants, animals and man
7	Distinguish thermal and marine pollution
8	Explain solid waste management
9	List and explain methods of controlling urban and solid waste
10	Explain the role of an individual in prevention of pollution

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SCHOOL OF MANAGEMENT STUDIES

UNIT IV -ENVIRONMENTAL STUDIES -SBAA1204

SYLLABUS - UNIT 4 ENVIRONMENTAL POLICIES AND PRACTICES

Environmental Policies & Practices -Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture 2/2 - Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).

Climate change

The average temperature in many regions has been increasing in recent decades. The global average surface temperature has increased by 0.6° + 0.2° C over the last century. Globally, 1998 was the warmest year and the 1990s the warmest decade on record. Many countries have experienced increases in rainfall, particularly in the countries situated in the mid to high latitudes.

In some regions, such as parts of Asia and Africa, the frequency and intensity of droughts have been observed to increase in recent decades. Episodes of El Niño, which creates great storms, have been more frequent, persistent and intense since mid-1970s compared with the previous 100 years. All these are signs that the earth is sick. Its climate is changing, making it more difficult for mankind to survive. The earth is losing its ability to balance itself due to the imbalances created by human activities. Projections of future climate change are derived from a series of experiments made by computer based global climate models. These are worked out on estimates of aspects such as future population growth and energy use. Climatologists of the Intergovernmental Panel on Climate Change (IPCC) have reviewed the results of several experiments in order to estimate changes in climate in the course of this century. These studies have shown that in the near future, the global mean surface temperature will rise by 1.4° to 5.8°C. Warming will be greatest over land areas, and at high latitudes. The projected rate of warming is greater than has occurred in the last 10,000 years. The frequency of weather extremes is likely to increase leading to floods or drought. There will be fewer cold spells but more heat waves. The frequency and intensity of El Niño is likely to increase. Global mean sea level is projected to rise by 9 to 88 cm by the year 2100. More than half of the world‘s population now lives within 60km of the sea. They are likely to be seriously impacted by ingress of salt water and by the rising sea. Some of the most vulnerable regions are the Nile delta in Egypt, the Ganges-Brahmaputra delta in Bangladesh, and many small islands including the Marshall Islands and the Maldives, (WHO, 2001). Changes in climate may affect the distribution of vector species (e.g. mosquitoes) which in turn will increase the spread of disease, such as malaria and filariasis, to new areas which lack a strong public health infrastructure. The seasonal transmission and distribution of many diseases that are transmitted by mosquitoes (dengue, yellow fever) and by ticks (Lyme disease, tick-borne encephalitis) may spread due to climate change.

CASE STUDIES

Damage to coral reefs, Pacific

The severity of periodic warming due to El Nino in 1997 in the Pacific led to the most serious death in coral ever known. It is estimated that about 10% of the Earth‘s coral reefs were dead, another 30 % were seriously affected and another 30% were degraded. The Global Coral Reef Monitoring Network Townsville, Australia, has predicted that all the reefs could be dead by 2050.

Butterfly populations in the United Kingdom

Global warming is leading to an early arrival of butterflies in Britain. Scientists say that butterflies can now be spotted much earlier every year in the last two decades. Some, like the red admiral, can now be seen a month earlier than was the case in the mid – 1970s. Others, like the peacock and the orange tip are appearing between 15 and 25 days earlier than in the past. Future rise in temperature is likely to have a detrimental effect on these butterflies. Some butterflies which need cooler temperatures might suffer.

Global warming

About 75% of the solar energy reaching the Earth is absorbed on the earth‘s surface which increases its temperature. The rest of the heat radiates back to the atmosphere. Some of the heat is trapped by greenhouse gases, mostly carbon dioxide. As carbon dioxide is released by various human activities, it is rapidly increasing. This is causing global warming.

The average surface temperature is about 15°C. This is about 33°C higher than it would be in the absence of the greenhouse effect. Without such gases most of the Earth‘s surface would be frozen with a mean air temperature of -18°C.

Acid rain

When fossil fuels such as coal, oil and natural gas are burned, chemicals like sulfur dioxide and nitrogen oxides are produced. These chemicals react with water and other chemicals in the air to form sulfuric acid, nitric acid and other harmful pollutants like sulfates and nitrates. These acid pollutants spread upwards into the atmosphere, and are carried by air currents, to finally return to the ground in the form of acid rain, fog or snow. The corrosive nature of acid rain causes many forms of environmental damage. Acid pollutants also occur as dry particles and gases, which when washed from the ground by rain, add to the acids in the rain to form a more corrosive solution. This is called acid deposition.

Damage from acid rain is widespread in North America, Europe, Japan, China and Southeast Asia. In the US coal burning power plants contribute to about 70% of sulfur dioxide. In Canada oil refining, metal smelting and other industrial activities account for 61% of sulfur dioxide pollution. Motor vehicle exhaust fumes are the main source of nitrogen oxides. The acids in acid rain chemically react with any object they come in contact with. Acids react with other chemicals by giving up hydrogen atoms.

Effects: Acid rain is known to cause widespread environmental damage.

1. Acid rain dissolves and washes away nutrients in the soil which are needed by plants. It can also dissolve

naturally occurring toxic substances like aluminum and mercury, freeing them to pollute water or poison plants.

2. Acid rain indirectly affects plants by removing nutrients from the soil in which they grow. It affects trees more directly by creating holes in the waxy coating of leaves, causing brown dead spots which affect the plant‘s photosynthesis. Such trees are also more vulnerable to insect infestations, drought and cold. Spruce and fir forests at higher elevations seem to be most at risk. Farm crops are less affected by acid rain than forests.

3. Acid rain that falls or flows as ground water to reach rivers, lakes and wetlands, causes the water in them to become acidic. This affects plant and animal life in aquatic ecosystems.

4. Acid rain and dry acid deposition damages buildings, automobiles, and other structures made of stone or metal. The acid corrodes the materials causing extensive damage and ruins historic buildings. For instance the Parthenon in Greece and the Taj Mahal in India have been affected by acid rain.

5. Although surface water polluted by acid rain does not directly harm people, the toxic substances leached from soil can pollute water supply. Fish caught in these waters may be harmful for human consumption. Acid, along with other chemicals in the air, produces urban smog, which causes respiratory problems.

Solutions

The best way to stop the formation of acid rain is to reduce the emissions of sulfur dioxide and nitrogen oxides into the atmosphere. This can be achieved by using less energy from fossil fuels in power plants, vehicles and industry. Switching to cleaner burning fuels is also a way out. For instance using natural gas which is cleaner than coal, using coal with lower sulfur content, and developing more efficient vehicles. If the pollutants have already been formed by burning fossil fuels, they can be prevented from entering the atmosphere by using scrubbers in smokestacks in industry. These spray a mixture of water and limestone into the polluting gases, recapturing the sulfur.

In catalytic converters, the gases are passed over metal coated beads that convert harmful chemicals into less harmful ones. These are used in cars to reduce the effects of exhaust fumes on the atmosphere. Once acid rain has affected soil, powdered limestone can be added to the soil by a process known as liming to neutralize the acidity of the soil.

OZONE LAYER DEPLETION

Ozone is formed by the action of sunlight on oxygen. It forms a layer 20 to 50kms above the surface of the earth. This action takes place naturally in the atmosphere, but is very slow. Ozone is a highly poisonous gas with a strong odor. It is a form of oxygen that has three atoms in each molecule. It is considered a pollutant at ground level and constitutes a health hazard by causing respiratory ailments like asthma and bronchitis. It also causes harm to vegetation and leads to a deterioration of certain materials like

plastic and rubber. Ozone in the upper atmosphere however, is vital to all life as it protects the earth from the sun‘s harmful ultraviolet radiation. The ozone layer in the upper atmosphere absorbs the sun‘s ultraviolet radiation, preventing it from reaching the earth‘s surface.

This layer in the atmosphere protects life on earth from the dangerous UV radiation from the sun. In the 1970s, scientists discovered that chemicals called chlorofluorocarbons or CFCs, which were used as refrigerants and aerosol spray propellants, posed a threat to the ozone layer. The CFC molecules are virtually indestructible until they reach the stratosphere, where UV radiation breaks them down to release chlorine atoms. The chlorine atoms react with ozone molecules which break down into oxygen molecules, which do not absorb UV radiations. Since the early 1980s, scientists detected a thinning of the ozone layer in the atmosphere above Antarctica. This phenomenon is now being detected in other places as well including Australia. Although the use of CFCs has been reduced and now banned in most countries, other chemicals and industrial compounds such as bromine, halocarbons and nitrous oxides from fertilizers may also attack the ozone layer. The destruction of the ozone layer is seen to cause increased cases of skin cancer and cataracts. It also causes damage to certain crops and to plankton, thus affecting natures food chains and food webs. This in turn causes an increase in carbon dioxide due to the decrease in vegetation.

THE ENVIRONMENT (PROTECTION) ACT

The Environment (Protection) Act, 1986 not only has important constitutional implications but also an international background. The spirit of the proclamation adopted by the United Nations Conference on Human Environment which took place in Stockholm in June 1972, was implemented by the Government of India by creating this Act.

Although there were several existing laws that dealt directly or indirectly with environmental issues it was necessary to have a general legislation for environmental protection because the existing laws focused on very specific types of pollution, or specific categories of hazardous substances or were indirectly related to the environment through laws that control land use, protect our National Parks and Sanctuaries and our wildlife. However there were no overarching legislation and certain areas of environmental hazards were not covered. There were also gaps in areas that were potential environmental hazards and there were several inadequate linkages in handling matters of industrial and environmental safety. This was essentially related to the multiplicity of regulatory agencies. Thus there was a need for an authority which could assume the lead role for studying, planning and implementing long term requirements of environmental safety and give directions to, as well as coordinate a system of speedy and adequate response to emergency situations threatening the environment.

This Act was thus passed to protect the environment, as there was a growing concern over the

deteriorating state of the environment. As impacts grew considerably environmental protection became a national priority in the 1970s. The decline in the environmental quality, was evidenced by increasing pollution, loss of forest cover and an increasing threat to biodiversity.

The presence of excessive concentrations of harmful chemicals in the atmosphere and aquatic ecosystems leads to the disruption of food chains and a loss of species. These are symptoms of a rapidly deteriorating environment. The growing risks of environmental accidents and threats to life support systems now loom threateningly over our civilization. The decision taken at the conference in Stockholm strongly voiced these environmental concerns and several measures were made possible for environmental protection. While the need for a wider general legislation to protect our environment is now in place, it has become increasingly evident that our environmental situation continues to deteriorate. We need to implement this Act much more aggressively if our environment is to be protected.

THE AIR (PREVENTION AND CONTROL OF POLLUTION) ACT

The Government passed this Act in 1981 to clean up our air by controlling pollution. Sources of air pollution such as industry, vehicles, power plants, etc. are not permitted to release particulate matter, lead, carbon monoxide, sulfur dioxide, nitrogen oxide, volatile organic compounds (VOCs) or other toxic substances beyond a prescribed level. To ensure this, Pollution Control Boards (PCBs) have been set up by Government to measure pollution levels in the atmosphere and at certain sources by testing the air. This is measured in parts per million or in milligrams or micrograms per cubic meter. The particulate matter and gases that are released by industry and by cars, buses and two wheelers is measured by using air sampling equipment. However, the most important aspect is for people themselves to appreciate the dangers of air pollution and reduce their own potential as polluters by seeing that their own vehicles or the industry they work in reduces levels of emissions.

This Act is created _to take appropriate steps for the preservation of the natural resources of the earth which among other things includes the preservation of high quality air and ensures controlling the level of air pollution.

The main objectives of the Act are as follows:

(a) To provide for the Prevention, Control and abatement of air pollution.

(b) To provide for the establishment of Central and State Boards with a view to implement the Act.

(c) To confer on the Boards the powers to implement the provisions of the Act and assign to the Boards functions relating to pollution.

Air pollution is more acute in heavily industrialized and urbanized areas, which are also densely populated. The presence of pollution beyond certain limits due to various pollutants discharged through

Industrial emission is monitored by the Pollution Control Boards set up in every State.

Powers and Functions of the Boards

Central Board: The main function of the Central Board is to implement legislation created to improve the quality of air and to prevent and control air pollution in the country. The Board advises the Central Government on matters concerning the improvement of air quality and also coordinates activities, provides technical assistance and guidance to State Boards and lays down standards for the quality of air. It collects and disseminates information in respect of matters relating to air pollution and performs functions as prescribed in the Act.

State Pollution Control Boards: The State Boards have the power to advice the State Government on any matter concerning the prevention and control of air pollution. They have the right to inspect at all reasonable times any control equipment, industrial plant, or manufacturing process and give orders to take the necessary steps to control pollution. They are expected to inspect air pollution control areas at intervals or whenever necessary. They are empowered to provide standards for emissions to be laid down for different industrial plants with regard to quantity and composition of emission of air pollutants into the atmosphere. A State Board may establish or recognize a laboratory to perform this function.

The State Governments have been given powers to declare air pollution control areas after consulting with the State Board and also give instructions for ensuring standards of emission from automobiles and restriction on use of certain industrial plants.

Penalties: Persons managing industry are to be penalized if they produce emissions of air pollutants in excess of the standards laid down by the State Board. The Board also makes applications to the court for restraining persons causing air pollution. Whoever contravenes any of the provision of the Act or any order or direction issued is punishable with imprisonment for a term which may extend to three months or with a fine of Rs.10,000 or with both ,and in case of continuing offence with an additional fine which may extend to Rs 5,000 for every day during which such contravention continues after conviction for the first contravention.

THE WATER (PREVENTION AND CONTROL OF POLLUTION) ACT

The Government has formulated this Act in 1974 to be able to prevent pollution of water by industrial, agricultural and household wastewater that can contaminate our water sources. Wastewater with high levels of pollutants that enter wetlands, rivers, lakes, wells as well as the sea are serious health hazards. Controlling the point sources by monitoring levels of different pollutants is one way to prevent pollution by giving a punishment to a polluter. However it is also the responsibility of people in general to inform the relevant authority when they see a likely source of pollution. Individuals can also do several things to reduce

water pollution such as using biodegradable chemicals for household use, reducing use of pesticides in gardens, and identifying polluting sources at workplaces and in industrial units where oil or other petroleum products and heavy metals are used. Excessive organic matter, sediments and infecting organisms from hospital wastes can also pollute our water. Citizens need to develop a watchdog force to inform authorities to take appropriate actions against different types of water pollution. A polluter must pay for his actions. However, preventing pollution is better than trying to cure the problems it has created, or punishing offenders.

The main objectives of the Water Act are to provide for prevention, control and abatement of water pollution and the maintenance or restoration of the wholesomeness of water. It is designed to assess pollution levels and punish polluters. The Central Government and State Governments have set up Pollution Control Boards that monitor water pollution.

Functions of the Pollution Control Boards: The Government has given the necessary powers to the PCBs to deal with the problems of water pollution in the country. The Government has also suggested penalties for violation of the provisions of the Act.

Central and State water testing laboratories have been set up to enable the Boards to assess the extent of water pollution and standards have been laid down to establish guilt and default.

The Central and State Boards are entitled to certain powers and functions which are as follows:

Central Board: It has the power to advise the Central Government on any matters concerning the prevention and control of water pollution. The Board coordinates the activities of the State Boards and also resolves disputes. The Central Board can provide technical assistance and guidelines to State Boards to carry out investigations and research relating to water pollution, and organizes training for people involved in the process. The Board organizes a comprehensive awareness program on water pollution through mass media and also publishes data regarding water pollution. The Board lays down or modifies the rules in consultation with the State Boards on standards of disposal of waste.

The main function of the Central Board is to promote the cleanliness of rivers lakes streams and wells in the country.

State Boards: They have the power to advise the State Government on any matters concerning water pollution. It plans a comprehensive program for the prevention of water pollution. It collects and disseminates information on water pollution and participates in research in collaboration with the Central Board in organizing training of people involved in the process. The Board inspects sewage or trade effluents, treatment plants, purification plants and the systems of disposal and also evolves economical and reliable methods of treatment of sewage and other effluents. It plans the utilization of sewage water for agriculture. It

ensures that if effluents are to be discharged on land the waste is diluted. The State Board advises State Governments with respect to location of industries. Laboratories have been established to enable the Board to perform its functions.

The State Boards have the power to obtain information from officers empowered by it who make surveys, keep records of flow, volume, and other characteristics of the water. They are given the power to take samples of effluents and suggest the procedures to be followed in connection with the samples. The concerned board analyst is expected to analyze the sample sent to him and submit a report of the result to the concerned Board. The Board is required to send a copy of the result to the respective industry. The Board also has the power of inspecting any plant record, register, document or any material object, and can conduct a search in any place in which there is reason to believe that an offence has been conducted under the Act.

Penalties are charged for acts that have caused pollution. This includes failing to furnish information required by the Board, or failing to inform the occurrence of any accident or other unforeseen act. An individual or organization that fails to comply with the directions given in the subsections of the law can be convicted or punished with imprisonment for a term of three months or with a fine of Rs10,000 or both and in case failure continues an additional fine of Rs.5,000 every day. If a person who has already been convicted for any offence is found guilty of the same offence again, he/she after the second and every subsequent conviction, would be punishable with imprisonment for a term not less than two years but which may extend to seven years with fine.

THE WILDLIFE PROTECTION ACT

This Act passed in 1972, deals with the declaration of National Parks and Wildlife Sanctuaries and their notification. It establishes the structure of the State‘s wildlife management and the posts designated for Wildlife Management. It provides for setting up Wildlife Advisory Boards. It prohibits hunting of all animals specified in Schedules I to IV of the Act. These are notified in order of their endangeredness. Plants that are protected are included in schedule VI.

The Amendment to the Wildlife Protection Act in 2002 is more stringent and prevents the commercial use of resources by local people. It has brought in new concepts such as the creation of Community Reserves. It has also altered several definitions. For instance in animals, fish are now included. Forest produce has been redefined to ensure protection of ecosystems. While there are several changes, the new Act still has serious issues concerned with its implementation. Laws are only as good as the ones that can be complied with. The Act is expected to deter people from breaking the law. However, there are serious problems due to poaching. One cannot expect to use the Act to reduce this without increasing Forest Staff, providing weapons, jeeps, radio equipment, etc. for establishing a strong deterrent force.

Penalties: A person who breaks any of the conditions of any license or permit granted under this Act shall be guilty of an offence against this Act. The offence is punishable with imprisonment for a term which may extend to three years or with a fine of Rs 25,000 or with both. An offence committed in relation to any animal specified in Schedule I, or Part II of Schedule II, like the use of meat of any such animal, or animal articles like a trophy, shall be punishable with imprisonment for a term not less than one year and may extend to six years and a fine of Rs 25,000. In the case of a second or subsequent offence of the same nature mentioned in this sub-section, the term of imprisonment may extend to six years and not less than two years with a penalty of Rs.10,000.

FOREST CONSERVATION ACT

To appreciate the importance of the Forest Conservation Act of 1980, which was amended in 1988, it is essential to understand its historical background. The Indian Forest Act of 1927 consolidated all the previous laws regarding forests that were passed before the 1920‘s. The Act gave the Government and Forest Department the power to create Reserved Forests, and the right to use Reserved Forests for Government use alone. It also created Protected Forests, in which the use of resources by local people was controlled. Some forests were also to be controlled by a village community, and these were called Village Forests.

The Act remained in force till the 1980s when it was realized that protecting forests for timber production alone was not acceptable. The other values of protecting the services that forests provide and its valuable assets such as biodiversity began to overshadow the importance of their revenue earnings from timber. Thus a new Act was essential. This led to the Forest Conservation Act of 1980 and its amendment in 1988.

India‘s first Forest Policy was enunciated in 1952. Between 1952 and 1988, the extent of deforestation was so great that it became evident that there was a need to formulate a new policy on forests and their utilization. Large tracts of forestland had already been diverted to other uses. The earlier forest policies had focused attention on revenue generation only. In the 1980s it became clear that forests must be protected for their other functions such as maintenance of soil and water regimes centered on ecological concerns. It also provided for the use of goods and services of the forest for its local inhabitants.

The new policy framework made conversion of forests into other uses much less possible. Conservation of the forests as a natural heritage finds a place in the new policy, which includes the preservation of its biological diversity and genetic resources. It also values meeting the needs of local people for food, fuel wood, fodder and non-wood forest products that they subsist on. It gives priority to maintaining environmental stability and ecological balance. It expressly states that the network of Protected

Areas should be strengthened and extended.

In 1992, the 73rd and 74th Amendments to the Constitution furthered governance through panchayats. It gives States the ability to provide power to the local panchayats to manage local forest resources.

The Forest Conservation Act of 1980 was enacted to control deforestation. It ensured that forestlands could not be de-reserved without prior approval of the Central Government. This was created as States had begun to de-reserve the Reserved Forests for non-forest use. States had regularized encroachments and resettled _Project Affected People' from development projects such as dams in these de-reserved areas. The need for a new legislation became urgent. The Act made it possible to retain a greater control over the frightening level of deforestation in the country and specified penalties for offenders.

Penalties for offences in Reserved Forests: No person is allowed to make clearings or set fire to a Reserved Forest. Cattle are not permitted to trespass into the Reserved Forest. Felling, collecting of timber, bark or leaves, quarries or collecting any forest product is punishable with imprisonment for a term of six months, or with a fine which may extend to Rs.500, or both. Penalties for offences in Protected Forests: A person who commits any of the following offences like felling of trees, or strips off the bark or leaves from any tree or sets fire to such forests, or kindles a fire without taking precautions to prevent its spreading to any tree mentioned in the Act, whether standing or felled, or fells any tree, drags timber, or permits cattle to damage any tree, shall be punishable with imprisonment for a term which may extend to six month or with a fine which may extend to Rs.500, or both.

When there is a reason to believe that a forest offence has been committed pertaining to any forest produce, the produce together with all tools used in committing such offences may be seized by any Forest Officer or Police Officer. Every officer seizing any property under this section shall put on the property a mark indicating the seizure and report the seizure to the Magistrate who has the jurisdiction to try the offence. Any Forest Officer, even without an order from the Magistrate or a warrant, can arrest any person against whom a reasonable suspicion exists.

INTERNATIONAL AGREEMENTS

International agreements are formal understandings or commitments legally binding agreement between two or more countries. An agreement / treaty can be called a Convention, a Protocol, a Pact or an Accord. Usually governed by the United Nations.

Types

1. BILATERAL (between two countries)
2. MULTILATERAL (between several countries).

Several hundred International Environmental Agreements are signed.

1. Montreal Protocol on Substances that Deplete the Ozone Layer, Montreal, 1989

2. Kyoto to the United Nations Framework Convention on Climate Change Protocol greenhouse gas emission reductions

3. Convention on Biological Diversity (CBD), Nairobi, 1992

4. Convention on Nuclear Safety, Vienna, 1994

5. Convention on the Protection and Use of Trans boundary Watercourses and International Lakes (ECE Water Convention), Helsinki, 1992.

1. MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

- Under Vienna Convention for the Protection of the Ozone Layer, 1985.
- Global agreement to protect the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS).
- The stratospheric ozone layer filters out harmful ultraviolet radiation, which is associated with an increased prevalence of skin cancer and cataracts, reduced agricultural productivity, and disruption of marine ecosystems.
- Agreed on 26 August 1987,
- Force on 26 August 19891
- 1st meeting in Helsinki, May 1989.
- Initially signed by 46 countries, now all are signatories.
- Countries have binding, time-targeted and measurable commitments.
- Developing and developed countries have equal but differentiated responsibilities.

Specific responsibilities related to the phase out of the different groups of ODS;

- Control of ODS trade
- Annual reporting of data
- National licensing systems to control ODS imports and exports.
- The Montreal Protocol has proven to be innovative and successful.
- The first treaty to achieve universal ratification by all countries in the world.
- Leveraging worldwide participation.
- The Montreal Protocol has sent clear signals to the global market and placed the ozone layer, which was in peril, on a path to repair.

2. Kyoto to the United Nations Framework Convention on Climate Change Protocol

- The Earth Summit held on June 4, 1992 in Rio de Janeiro led to the signature of three conventions, the United Nations Framework Convention on Climate Change (UNFCCC) is one among it.
- UNFCCC, an international environmental treaty, states the goal of the Kyoto Protocol as; ‖The stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.‖
- Negotiated in 11th December 1997 at the city of Kyoto, Japan.
- Force on February 16th, 2005, 192 signatory countries
- Legally binding agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by 5.2% compared to the year 1990.
- Affect the energy balance of the global atmosphere in ways expected to lead to an
- Overall increase in global average temperature, known as global warming.

The goal is to lower overall emissions from six greenhouse gases

- Carbon dioxide (CO2)
- Methane (CH4)
- Nitrous oxide (N2O)
- Sulfur hexafluoride (SF6)
- Hydro fluorocarbons (HFCs)
- Per fluorocarbons (PFCs).

3. Convention on Biological Diversity (CBD)

Entered into force on 29 December 1993.

Three main objectives:

1. The conservation of biological diversity
2. The sustainable use of the components of biological diversity
3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

Thematic programme of work corresponds to some of the major biomes on the planet,

Establishes a vision for, and basic principles to guide future work.

- Agricultural Biodiversity
- Dry and Sub-humid Lands Biodiversity
- Inland Waters Biodiversity
- Forest Biodiversity
- Island Biodiversity

6. Marine and Coastal Biodiversity

7. Mountain Biodiversity

The Convention‘s governing body that meets every two years, or as required.

14th meeting of the COP (Conference of the Parties) Sharm El-Sheikh (Egypt) 17-29 Nov 2018

Two conventions in CBD;

- The Cartagena Protocol on Biosafety
- The Nagoya Protocol on Access and Benefit sharing.

The Cartagena Protocol on Biosafety

- It was adopted on 29 January 2000
- Entered into force on 11 September 2003.
- To ensure the safe handling, transport and use of living modified organisms (LMOs) resulting from modern biotechnology that may have adverse effects on biological diversity, taking also into account risks to human health.

The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits

- Aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way.
- It entered into force on 12 October 2014

QUESTION BANK

	PART – A
1	List any two objectives of air (prevention and control of pollution) act
2	Define ozone layer depletion
3	Define global warming
4	Define climate change
5	Write any two solutions to stop the formation of acid rain
6	Write any three objectives of Convention on Biological Diversity

	PART-B
1	Acid rain is known to cause widespread environmental damage. Justify?
2	Explain Forest Conservation Act
3	Explain Wild Life Protection Act
4	Explain the air (prevention and control of pollution) act
5	Explain the environment (protection) act
6	The central and state Boards are entitled to certain powers and functions. Explain
7	Explain the powers and functions of the boards
8	Montreal protocol on substances that deplete the ozone layer. Explain
9	Kyoto to the United Nations Framework Convention on Climate Change Protocol. Explain

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SCHOOL OF MANAGEMENT STUDIES

UNITV - ENVIRONMENTAL STUDIES -SBAA1204

SYLLABUS - UNIT 5 HUMAN COMMUNITIES AND THE ENVIRONMENT

Human population growth: Impacts on environment, human health and welfare. - Resettlement and rehabilitation of project affected persons; case studies. - Disaster management: floods, earthquake, cyclones and landslides. - Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation**.**

Introduction

Human society is governed by interaction and cooperation with other human beings. Latest trends in technology and medical knowledge are available to control human population growth and to improve the health. Still population continues to increase and poverty become greater than ever before. Humans are social animals who have freedom of choice. They largely take decision by heart rather than mind. It is evident from historical records, social situations, ethical and religious considerations and personal desires. Today the greatest hindrance to controlling human population is no more biological but falls into the province of philosophers, theologians, politicians, sociologists, and others. The cause of the population problem is to be understood if we are to deal successfully with the population problem.

Carrying Capacity

The carrying capacity of an area is the number of individuals of a species that can survive in that area over time. In most populations, four broad categories of factors determine the carrying capacity for a population. These factors are: (1) the availability of raw materials,

(1) the availability of energy, (3) the accumulation of waste products and their means of disposal and (4) interactions among organisms. The total of all of these forces acting together to limit populations size is known as environmental resistance, and certain limiting factors have a primary role in limiting the size of a population. In some cases, these limiting factors are easy to identify and may involve lack of food, lack of oxygen, competition with other species, or disease.

Population Characteristics

A population can be defined as a group of individuals of the same species inhabiting an area. Some of the characteristics or a population is nasality (birth rate), mortality (death rate), sex ratio, age distribution, growth rates, and special distribution. **Natality** refers to the number of individuals added to the population through reproduction. In human populations, natality is usually described in terms of the **birth rate**, the number of individuals born per one thousand individuals in the population per year. It is important to recognize that the growth of a population is not determined by the birth rate (natality) alone.

This is expressed as

B (Natality rate) = N_n/t which means = No. of new individuals added to population time.

Mortality is the number of deaths per year. In human population studies, mortality is usually discussed in terms of the death rate, the number of individuals who die per one thousand individuals in

the population per year.

Population Density is population size in relation to some unit of space and time. It varies with food availability and climatic conditions. It can be measured as:

$$D = \frac{N/a}{t}$$

where *D* is population density, *n* = number of individuals, *a* = area and *t* = time.

Population Age Distribution refers to the individuals of different age groups in a population. The natality and mortality is also different for respective ages. Bodenhelmer (1938) recognized three ecological ages as: (*i*) Pre reproductive, (*ii*) Reproductive and (*iii*) Post reproductive

Type of Population - Age structure in different types of populations

Biotic Potential is the maximum reproductive power. The constant percent growth rate of a population under optimum environmental conditions thus represents its biotic potential or reproductive potential. Letter designates it g.

$$g = \frac{\Delta AN / AT}{N}$$

Where, *N* = number, *t* = time, *D* = constant.

The **sex ratio** refers to the number of males relative to the Number of females in the population.

The Human Population Issue

Current population growth has led to famine in areas where food production cannot keep pace with population growth; political unrest areas with great disparities in availability of resources (jobs: goods, food); environmental degradation by poor agricultural practices (erosion, desertification); water pollution by human and industrial waste; air pollution caused by the human need to use energy for personal use and for industrial applications; extinctions caused by people converting natural ecosystems to managed agricultural ecosystems; and. destructive effects of exploitation of natural resources (strip, mining, oil spills, groundwater mining). In addition to population size, the kind of demands a population places on its resources is also important. Highly industrialized populations require much more energy and material resources to sustain their way of life than do the populations of the less-developed world.

A Population Growth Curve

Sex ratios and age distributions within a population directly influence the rate of reproduction within a population. Each species has an inherent reproductive capacity, or **biotic potential,** which is its ability to produce offspring. However, this high reproductive potential results in a natural tendency for populations to increase. For example, two mice produce four offspring, which, if they live, will also produce offspring while their parents are also reproducing. Therefore, the population will tend to grow in an exponential fashion. Population growth tends to follow a particular pattern, consisting of a lag phase, an exponential growth phase, and a stable equilibrium phase. Fig. 15 shows a typical population growth curve. During the first portion of curve, known as the lag phase, the population grows very slowly

because the process of reproduction and growth of offspring takes time. Most organisms do not reproduce instantaneously but must first mature into adults. Mating and the development of the young ones into independent organisms follow this period. By the time the first batch of young has reached sexual maturity, the parents may be in the process of producing a second set of offspring. Since more total organisms now are reproducing, the population begins to increase at an exponential rate. This stage in the population growth curve is known as the exponential growth phase. This growth will continue for as long as the, birth rate exceeds the death rate. Eventually, however, the death rate and the birth rate will come to equal one another, and the population will stop growing and reach a relatively stable population. size and is said to be the stable equilibrium phase. Hence, populations cannot grow continuously because of the concept of carrying capacity.

S-Shaped growth curve - When a species is introduced into a new habitat, the population grows exponentially until the individuals become numerous. The further increase in their number is checked by the environmental resistance factors that the population growth declines until zero population growth is reached. (i.e. constant) and it becomes stable (K). Such curves are called sigmoid curves. *The study of growth curves in S-shaped growth pattern is a self-limiting one where the rate of growth is more and more as density increases. If the limitation is linearly proportional to density we get a symmetrical S-curve so as to approach upper level or limit-K, the carrying capacity. This pattern enhances stability as population regulates itself. Actually the density often overshoots or is more than K and because of time lags in feedback control resulting in oscillations as shown in graphs.*

J-Shaped growth curve - The population increases whenever there is an increase in birth rate over death rate. The factors of environmental resistance do not check population growth or stabilize the growth (zero growth not established) then a J-shaped curve is obtained Fig. 3. It is hard to speculate in the future of human population growth curve whether it will be S-shaped or J-shaped. Growth curve are thus the graphical representation of a population in given time period. It may be of S-shaped or J-shaped as mentioned. When population increase in exponential (E) or geometric fashion (*e.g.* 2, 4, 8, 16, 32,,) until the population runs out of some resources or encounters, some other limitation (N). Growth then comes to a more or less abrupt halt in such cases and density usually declines rapidly until conditions for another rapid growth is restored. Population with this kind of growth form instability unless regulated by factors outside the population.

- Growth rate decreases as density increases. (Self-limiting or inverse density- dependent type.)
- Growth rate is high until density become high and factors from outside of the population become limiting. (Density independent type.)
- Growth rate is highest at intermediate density.

Causes of Population Growth

- - There is an ultimate carrying capacity for the human population and limiting factors will come

into play to cause populations to stabilize. However, unlike populations of other kinds of organisms, human populations are also influenced by a variety of social, political, economic, and ethical factors. Humans have accumulated knowledge that allows for predictions about the future and can make conscious decisions based on the likely course of events and adjust their lives accordingly. Part of that knowledge is the certainty that as populations continue to increase, death rates and birth rates will become equal. This can be accomplished by allowing the death rate to rise or by choosing to limit the birth rate. It would seem that controlling human population should be a simple process. Once everyone understands that lowering the birth rate is more human than allowing the death rate to rise, most people should make the –correct‖ decision; however, it is not quite that simple.

Biological Reasons for Population Growth

The study of human populations, their characteristics, and what happens to them is known as demography. Demographers can predict the future growth of a population by looking at several different biological indicators. When we look at birth rates and death rates in various countries of the world, in almost all cases the birth rate exceeds the death rate. Therefore, the size of the population must increase. Some countries that have high birth rates and high death rates, with birth rates greatly exceeding the death rates, will grow rapidly (Afghanistan and Ethiopia). Such countries usually have an extremely high mortality rate among children because of disease and malnutrition. Some countries have high birth rates and low death rates and will grow extremely rapidly ~Guatemala and Syria). Infant mortality rates are moderately high in these countries. Other countries have low birth rates and death rates that closely match the birth rates and will grow slowly (Sweden and the United Kingdom). These and other more, developed countries typically have very low infant mortality rates.. Obviously, the most important determinant of the rate at which human populations grow is related to the number of women in the population who are having children and the number each will have. The **total fertility rate** of a population is the number of children born per woman per lifetime. A total fertility rate of 2.1 is known as **replacement fertility**, since in the long run, if the total fertility rate is 2.1, population growth will stabilize. When population is not growing and the number of births equals the number of deaths, it is said to exhibit zero **population growth**. The age structure of a population also has a great deal to do with the rate of population growth. If a population has a large number of young people who are in the process of raising families or who will be raising families in the near future, the population will continue to increase even if the families limit themselves to two children.

Factors Controlling Population Growth

Man is the only one who has regulated his population by developing new astonishing technologies for better and secured future on one hand. And on other hand, created a problem of population explosion. Some factors are:

(i) Famines in a country or state lead to destruction.

(ii) Natural calamities like floods, droughts, earthquakes and volcanic eruptions, hurricanes etc.

lead to death of thousands of people.

(iii) Epidemic diseases, endemic diseases wipe a big number of populations.

(iv) Wars cause heavy casualties.

(v) Unnatural accidents caused during transportation, fires etc. Some factors that have helped the population growth are:

- High production of food and better technologies for storage, processing and distribution.
- Better medical facilities provided during childbirth and under five years age by immunization.

The factors are many but they can be grouped into three as

(i) **Geographic factor:** Like climate, soil, water, mineral resources, transportation etc.
(ii) **Demographic factor:** Like birth rates (natality), death rates (mortality), sex ratio etc.
(iii) **Socio-economic factors:** Like marriages, job availability, resources etc. In the developed countries, population has started declining because of-

(i) Better medical and family planning facilities.
(ii) The low death and high birth rates.
(iii) The educated people who know about the abuses of overpopulation have small family.

Population and Standard of Living

Standard of living is a difficult concept to quantify since different cultures have different attitudes and feelings about what is good and desirable. Here, we compare averages of several aspects of the cultures in three countries: (1) the United States, which is an example of a highly developed if industrialized country; (2) Argentina, which is a moderately developed country; and (3) Zimbabwe, which is less developed. Obviously, tremendous differences exist in the standard of living among these three countries. What the average U.S. citizen would consider a poverty level of existence would be considered a luxurious life for the average person in a poorly developed country. Standard of living seems to be closely tied to energy consumption.

Population Explosion-Family Welfare Programme

Growth of Human Population

Emigration: The number of individuals going out from a population to join another population in a new locality resulting in decrease of the original population.

Immigration: It is the addition of new individuals to the population from other localities.

Density dependent factors: An increase in population leads to competition, since all its individuals have identical requirements for food and space. Population increase causes scarcity of food, consequently leading to death due to starvation.

Density independent factors: Interaction between populations in a given area can lead to mutual benefits, to competition for resources or dependence of one on the other.

Population explosion: The very great and continuing increase in human population in modern times. This is a great hazard to the development and prosperity of a nation.

Consequences of population explosion:

(i) It can lead to depletion of resources.

(ii) Severe competition for food and space.

(iii) Increase in psychological stress and strain.

(iv) Rapid pollution of environment.

(v) Large scale unemployment.

To meet the demands- of growing population, forests are cut, oceans are exploited and the entire natural equilibrium gets disturbed. A growth human population first faces the problem of food, then shelter and thirdly other socio-economic problems. Even if enough food is produced and the population growth does not show a steady slow growth but explosions then many secondary problems will certainly arise which are more persisting and problematic. Like in increase in competition for shelter, education, medical, rise in price index, ecological crisis etc.

Human Population: Malthus's Human Population Theory

In 1798 T.R. Malthus published an essay on population, the great economist outlined the problem of population graphically and stated that human population tends to increase in geometrical pattern (1-2-4-8.....) whereas the food production increases by arithmetic progression (1-2-3-4.). This is called as theory of human population growth proposed by Malthus. For nearly 150 years Malthus view was nearly forgotten as the advancement of technologies to place. The world population during Stone Age was only 10 million as indicated in records. Earlier the annual growth rate, in last three centuries was roughly 0.4 = 0.5% where as it reached. to 2% in last two decades. The doubling time (the time required by a population to double itself) reduced from 200 years in 1650 A.D. to merely 35 years in 1980. During 1800 A.D. the birth rate and death rate was almost balanced.

World Population Increase

S.No.	Date	Population (million)
1.	5000 B.C.	50
2.	800 B.C.	100
3.	200 B.C.	200
4.	1200 A.D.	400
5.	1700 A.D.	800
6.	1900 A.D.	1,600
7.	1965 A.D.	3,200
8.	1990 A.D.	5,300
9.	2020 A.D. (estimate)	8,230

Source: Population Reference Bureau, Inc., Washington, DC.

Current Population Trends

Currently, the world population is over 5.5 billion. By the year 2010, this is expected to increase to just over 7 billion people. In Africa, Asia, and Latin America, which already have nearly 80 percent of the world population. The total population of Africa, Asia, and Latin America will increase from the current 4.4 billion to over 7 billion by 20 I 0, when they will contain 83 percent of the world‘s people. These regions not only have the highest population growth rates, but also have the lowest per capita gross national product (GNP). The GNP is an index that measures the total goods and services generated within a country. This large difference in economic well-being is reflected in dissimilarity in the standard of living, an abstract measure of the degree to which necessities and comforts of daily life are met.

Consequences of Continued Population Growth

As the human population continues to increase, the pressure for the necessities of life will become greater. Differences in standard of living between developed and less-developed countries will remain great because most population increases will occur in less-developed countries. The supply of fuel and other resources is dwindling. The pressure for these resources will intensify as the industrialized countries seek to maintain their current standard of living. People in less developed countries will continue to seek more land to raise the crops needed to feed themselves unless major increases in food production per hectare occur. Developed countries may have to choose between helping the less developed countries while maintaining their friendship, or isolating themselves from the problems of the less developed nations.

Population growth rates in selected countries (1993)

S.No.	Country	Births per 1,999	Deaths per 1,000	Infant Mortality Rate (deaths per 1,000)	Rate of natural increase (annual %)	Time Needed to double population (years)
1.	Germany	10	11	6.7	0.1	-
2.	Belgium	13	11	8.4	0.2	330
3.	United Kingdom	14	11	7.1	0.3	267
4.	Japan	10	7	4.7	0.3	217
5.	Sweden	14	11	6.2	0.3	210
6.	USSR (Former)	16	11	2.8	0.6	123
7.	United States	16	9	8.6	0.8	82
8.	Canada	15	7	6.8	0.8	87
9.	Argentina	21	8	25.6	1.3	53
10.	Turkey	29	7	59.0	2.2	32
11.	Paraguay	34	6	48.0	2.7	26
12.	Afghanistan	49	22	168.0	2.8	25
13.	Ethiopia	47	20	127.0	2.8	25
14.	Zimbabwe	41	11	59.0	3.0	23
15.	Guatemala	39	7	59.0	3.1	22
16.	Syria	45	7	48.0	3.8	18

Source: Enger & Smith, 1995

Even if the industrialized countries continue to get a disproportionate share of the world‘s resources, the amount of resource per person will decline as population rises. It seems that, as world population increases, the less developed areas will maintain their low standard of living.

Twelve most populous countries in 2025 (population in millions)

S.No.	Country	1950	1992	2025
1.	China	554.8	1,165.8	1,590.8
2.	India	357.6	882.8	1,383.1
3.	United States	152.3	255.6	295.5
4.	Indonesia	49.5	184.5	285.9
5.	Pakistan	79.5	121.7	281.4
6.	Brazil	39.5	150.8	237.2
7.	Nigeria	53.4	90.1	216.2
8.	Bangladesh	32.9	114.4	211.6
9.	Russia	41.8	149.3	170.7
10.	Iran	16.9	59.7	159.2
11.	Mexico	28.0	87.7	143.3
12.	Japan	83.6	124.4	124.1

Source: Data from the Population Reference Bureau, Inc., 1993.

Environmental Implications of Food Production

The human population can increase only at the expense of the populations of other animals and plants. Each ecosystem has a finite carrying capacity and, therefore, has a maximum biomass that can exist within that ecosystem. There can be shifts within ecosystems to allow an increase in the population of one species, but this always adversely affects certain other populations because they are competing‘ for the same basic resources. When the population of farmers increased in the prairie regions of North America, the population of buffalo declined. When humans need food, they turn to agricultural practices and convert natural ecosystems to artificially maintained agricultural ecosystems. Mismanaged agricultural resources are often irreversibly destroyed. In most cases, if the plants were fed to animals, many people would starve to death. In contrast, in most of the developed world, meat and other animal protein sources are important parts of the diet. Many suffer from over nutrition (they eat too much); they are ‒malnourished‖ in a different sense. The ecological impact of one person eating at the carnivore level is about ten times that of a person feeding at the herbivore level. If people in the developed world were to reduce their animal protein intake, they would significantly reduce their demands on world resources.

The current situation with respect to world food production and hunger is very complicated. It involves the resources needed to produce food, such as arable land, labour and machines, appropriate crop selection, and economic incentives. It also involves the mal- distribution of food within countries. This is often an economic problem, since the poorest in most countries have difficulty finding the basic necessities of life, while the richer have an excess of food and other resources. Improved plant varieties, irrigation and improved agricultural methods have dramatically increased food production in some parts of the world. In recent years, India, China and much of southern Asia have moved from being food importers to being self-sufficient, and in some cases food exporters.

Population trends in India

India accounts for nearly. 1.5 per cent of the world population. Population has undergone an approximately three-fold increase during the last 80 years. According to the census of 1901, there were 235,396,327 people in this country. The number slightly came down in 1921 as a result of some epidemics. In _1951, the population was 361,008,0,90, which went up to 439,234,771 and 548,159,652 in 1961 and 1971, respectively. The main reason for the rapid growth is fall in death rate as a result of better medical care. The sex ratio in India‘ in 1981 was 1071 males per 1000 females. In Punjab in 1981, there were 1138 males per 1000 females whereas the number of males to females in Kerala was 969: 1000. The age ratio of Indian population shows that there is high proportion of young people belonging to the pre-reproductive age group i.e. 42.2 per cent in the age group of 0-14 years.

Population estimates for some of the states in India (1991)

S.No.	State/Union territory	Population
1.	Uttar Pradesh	1,38,760,417
2.	Bihar	86,338,853
3.	Maharashtra	78,706,719
4.	West Bengal	67,982,732
5.	Andhra Pradesh	66,304,854
6.	Madhya Pradesh	66,135,862
7.	Tamil Nadu	55,638,318
8.	Karnataka	44,817,398
9.	Rajasthan	43,880,640
10.	Gujarat	41,174,060
11.	Orissa	31 ,512,070
12.	Kerala	29,011,237
13.	Assam	22,294,562
14.	Punjab	20,190,795
15.	Haryana	16,317,715
16.	Delhi	9,370,475

Measures to Control over Population

Various methods for discouraging population growth in shortest period are:

(i) To educate the people about the abuses of overpopulation (Population education), food production, self-employment.

(ii) To provide free family planning aids (Family planning methods).

(iii) Motivating people to undergo sterilization process (Birth control) .

(iv) More incentives to families observing family planning norms (Limited family)

(v) By imposing legal restrictions (by laws).

(vi) Over-population is one of the numerous problems facing India. The solution of the population problem is very urgent. The population problem can be solved by major steps, which are given below:

- **Education:** The enormous rate at which Indian parents have been producing children is because of illiteracy and ignorance. People should be educated about the consequences of over-population and uses of planned and small family.
- **Family planning:** The expression family planning means a deliberate effort, and the adoption of suitable methods, to restrict the growth of family. That is to say family planning involves a deliberate limitation on the size of family. Following are some of the important family planning measures:
  - Use of contraceptives (Mechanical, Chemical and Natural methods): Contraception means the prevention of conception. There are many contraceptive techniques available for use e.g. Today etc.
  - Sterilization
  - Abortion

- Use of other natural methods

Mechanical method

- **Condom** (For male's use): The condom is a sheath of rubber, which fits over the erect penis. It is placed on the penis of male before it is introduced into the vagina for copulation.
- **Diaphragm** (For female's use): The diaphragm is a rubber cup stretched over collapsible metal spring coil. It is designed to fit over the cervix (the mouth of uterus).
- **Intrauterine Contraceptive Device (IUD):** It is a small metal or plastic device, which is designed to fit inside the uterus mouth. A doctor must fit and remove **IUD**.
- **Norplant:** A new implant has been cleared by Health Ministry of India. The implant placed below the skin, ensures the contraceptive power up to 5 years. It is new contraceptive to India and there is some resistance to woman's body. Initially it will be used in urban areas.

Chemical Method

- **Jellies, creams and foam:** A number of different spermicidal jellies, creams, and foams are available for use of contraceptive agents. These jellies, creams or foams are inserted into vagina five to fifteen minutes before copulation to take place. Oral contraceptive: These are popularly known as pill are combinations of synthetic sex. Hormones (estrogens and progesterone) e.g. overall, mala. They suppress the production of ovum by hormones and alter the adulatory cycle.
- **Sterilization:** It is surgical technique by which the passage of sperms or ovum is disconnected. Both men and women can be sterilized without losing their ability to function sexually.
- **Vasectomy:** In man the sterilization procedure is called a vasectomy. In this procedure the vesa differentia, the tubes that lead from the testes to the ejaculatory ducts, are cut so that the sperm produced in the testis cannot reach the ejaculatory ducts to enter the ejaculate.
- **Tubectomy:** In females tubectomy is done. In this procedure, the fallopian tubes, which transport the egg from the ovaries to the uterus are cut and tied off.

Environment and Human Health

Webster Collegiate Dictionary defines health as –the state of being hale and sound in body mind or soul especially from physical disease or pain. The concept of health incorporates physical state free from diseases, social and mental caliber of a human being. Community refers to a group of persons living at one place that shares and have social contact. A healthy man is an asset to the country, but a sick man is a burden. Community health services provide medical treatment of various diseases, controls the spread of communicable diseases, control of pests and insects, social welfare health service, maternity

and child welfare services, school medical services, hospital, research institutions etc. Lack of nutrition, clothing and improper housing, etc. spread many communicable diseases. Maternal and infant mortality rate raises poverty also leads to child abuse, liquor and drug addiction, exploitation and crime against women, etc.

Environment and health are inter-dependent. Physical environment include climate, sound and radioactive pollution sunrays and heat, air pressure, water and air directly or indirectly affect our health. A person is surrounded by biological environment where insects and many other biological microbes, which in turn spread diseases. Social and economic environment also determine the standard of health. Man‘s social environment is developed in a family and family is the basic unit of a society. Small-sized families where family members are happy and prosperous their health will be in good condition. In large families rearing of children become a difficult task. Meeting the demands of nutritious food and health are not given priority with the result children‘s personality and overall development suffers.

(i) Socio-economic factor

Leads to inadequate family resources, which cannot fulfill the wants and thus reduces the health standards and food problem is more prevalent in poor families. Lack of sanitary habits and inappropriate nutritional food will develop communicable and harmful diseases. Illiteracy is one of the major defects to raise the standard of living, sanitation and health.

(ii) Communicable disease problem

In India communicable diseases generally spread on a large scale. The contaminated food and water intake, dirt, sewage waste, improper light and pure air, Improper ventilation arrangements in the house, stagnant water and dirt, overcrowding, lavatory and cleanliness are some of the causes for the spread of diseases. Communicable diseases may spread through air, contact, contaminated food and water directly. Cholera diarrhea, typhoid etc., are some of the diseases. Insects and microbial parasites spread malaria and plague like diseases.

IMPORTANCE OF ENVIRONMENT

Vegetative plants and trees are called autotrophy because they can produce their own food through the process of Photosynthesis, this category is primary productive unit and their entire living organism depends on the vegetation for acquiring food. Photographs like insects, animals, birds and all human beings cannot produce their own food. Some microorganisms like bacteria, fungus, microbes, etc., derive food from dead plants and animals. Thus, all the living organisms are interdependent for their survival.

Human being is always adjusting to the ever-changing environment and in the past he has never attempted to alter it. But after twentieth century there has been a tremendous increase in physical wants and desires. Fast development in every sphere of life has undergone

with the ever-increasing wants and demands for food products. Ever increasing pressure on land has caused forestland to be utilized for cultivation.

There is all-round development and progress in the field of science and industries, new technology is being introduced and I variety of products are now being produced. As a result environmental pollution has increased. New technology has provided us goods to make our lives happier, more comfortable and luxurious, pollution hazards and its ill effect are being observed in every sphere of life. There is general reduction in physical power and energy, also deterioration of health standards. Development and destruction are co-related and give rise to many problems due to environmental pollution, water pollution, air pollution, destruction of forests, disappearing wild life, radiation effect, on living organisms.

Man is acquiring essential resources from the nature itself. Hence, it is essential to protect and preserve the natural resources. Natural disaster and destruction have increased the temperature on the earth is steadily rising. Certain drastic steps are needed in order to save our planet.

DISEASES

(a) **Through respiration:** By nose, mouth, lungs, cough, sneeze, spit, spreads cold, measles, tuberculosis, pneumonia, etc.

(b) **Through intestine:** Human excreta spread typhoid, diarrhoea, intestinal worms, cholera, poliomyelitis, etc.

(c) **Skin:** Scale of the skin, skin pus like smallpox, measles, etc.

(d) **Through blood:** AIDS, malaria, yellow fever, dengue, filarial, etc., are some of the diseases which spread through blood.

1. DIPHTHERIA

It is an acute infectious and communicable disease caused by involvement of respiratory system. The microorganisms of this disease attack the tonsils, trachea, nasal passage and sound box and secrete a false membrane of oxotoxin, which cause inflammation. In severe conditions it causes difficulty in breathing. This disease is quite common among the children of the age of 6 months to five years. It can also occur up to the age of 15 years. The mortality rates are 50% in respect of diphtheria occurring below the age of 5 years.

- **Pathogenic organism: The** microbes spreading diphtheria belong to bacillus group and are of three types:
    - Diphtheria gravies
    - Diph. Intermedius
    - Diph. Miti

Mode of spread: The spread of this disease may be by:

(a) Direct contact chiefly through the carriers, whether sick or healthy. Nasal carriers are more dangerous than throat carriers.

(b) Indirect transmission through infected articles such as, clothes, toys, utensils, etc.

Incubation period: It is of 2 to 5 days duration when the microbes enter the body.

Infective period: After the patient shows the symptoms of diphtheria and the period when

Microorganism leave the body is of 2-5 weeks on an average.

Symptoms: Initially the patient feels weak, nausea, and loses appetite and alertness.

Immunization: D.P.T. (Diphtheria, Whooping cough, Tetanus) vaccine is introduced to the child at the age of 6 weeks to 9 months in three doses. This vaccine is given at the interval of one month. A booster dose is given at the age of 2 years.

Prevention and Control

- The patient should be isolated.
- Disinfections of the home, bedding clothes, toys, utensils, etc., is done thoroughly.

2. WHOOPING COUGH OR PERTUSIS

Whooping cough or pertussis is an acute respiratory infections disease caused by *Bacillus pertusis* involving trachea, bronchi and bronchioles creating intense cough. Whooping cough occurs in all ages. Effect of cold weather and in colder regions enhances the incidence of disease.

- Spread of disease: Since it is an infectious disease main source is the nasal discharge and cough. It spreads directly from person to person.
- Incubation period: It is of seven to fourteen days.
- Infective period: Three weeks after the symptoms are observed. Symptoms: The patient coughs frequently and its severity increases at night loss of appetite insomnia, weakness persists. Immunization: Vaccine is prepared from dead bacillus and is administered along with D.P.T. (Diphtheria, pertussis, tetanus).

3. TUBERCULOSIS

It is a chronic bacterial disease and highly infectious. Tuberculosis spreads through air and affects the lungs of the person. It is caused by tubercle bacillus. This is prevalent both in tropical and temperate climate.

Spread of disease: Tuberculosis spreads in the following manner:

(a) The infection spreads by inhalation of droplets expelled by the patient through, sneezing, coughing, yawning etc.

(b) Through direct contact

(c) Infected articles, clothes, utensils, etc. may spread the disease.

Incubation period: Incubation period is about four to six weeks.

Symptoms: Initially, the patient feels easily exhausted, fatigue doing ordinary work and

feels excessive fatigue. Loss of appetite, hoarseness of throat, pain in the chest due to infected lungs. Patient sweats profusely at knight and feels weak.

Immunization: Child should be given B.C.G. (Bacillus Chalmette Guerine) vaccine by intra-dermal injection within the first three months of age.

Control and prevention: Following steps need to be undertaken to control the spread of tuberculosis:

Health and general sanitary conditions of the community should be taken good care of. Every human being should live in fresh air and sunshine. Workers of cotton and ginning mills, coalmines, tobacco bidi making etc. should wear protective shield to prevent inhalation of dust or silica dust. Patient should be isolated. The disinfections of clothes, utensils, articles rooms etc. should be properly ensured.

4. CHOLERA

Cholera is an acute infectious disease caused by the infection of intestinal canal, characterized by sudden vomiting, watery diarrhea, cramps in legs and leads to fast dehydration.

Pathogenic organisms: Cholera producing microorganisms are Vibrio species and they can belong to two sub-groups:

1. Vibrio cholera
2. Vibrio El tor

Vibrio cholera: *Vibrio cholera* is found in stools and vomits of the patient. It is active, mobile and grows in alkaline medium. It dies at 55°C in minutes. In contaminated water the organism can survive for two weeks. Insects, particularly housefly disseminate this disease.

Vibrio El tor: The other germ Vibrio el tor spreads in the Bay of Bengal and coastal areas in large scale through direct contact, unhygienic conditions, over-crowding, fair and feast on festivals incubation period: The duration of incubation period is very short, ranging from a few hours to five days.

Period of communicability: Lasts until the patient is free from cholera germs.

Symptoms: Patient starts vomiting and suffers loose motions. This may lead to loss of water and minerals in the body.

Immunization: Vaccine is prepared from dead Vibrio cholera and is given when there is a danger of spread of cholera.

Prevention and Control

- All deject should be collected in the can in which quick lime is placed at the bottom.
- Anti-fly measures should be adopted.
- Avoid eating of rotten fruit, boiling of water and milk, protection from

flies and dust.

- Phenyl, bleaching powder and other disinfectant should be sprayed in the area.
- Segregation and disinfections of soiled clothes, articles used by the patient.

5. MALARIA

Malaria spreads in the rainy season. The malarial parasite is a protozoon named _Plasmodium‘. It survives in the red blood corpuscles of the human blood. Man acquires infection by the bite of an infected female anopheles mosquito, which inject the malarial parasites in the form of spores.

The malarial parasite is of four types:

(i) ***Plasmodium:*** It has a life cycle of 48 hours causing fever after every two days. .

(ii) ***Plasmodium malaria:*** It has a life cycle of 72 hours causing fever after every three days.

(iii) ***Plasmodium falciparum:*** Irregular fever may occur after every ‘48 hours. The symptoms are very severe and of malignant type: high fever, delirium and death

(iv) ***Plasmodium ovale:*** This virus produces mild kind of malaria. They are found mostly in Africa.

(v) *Incubation Period:* The time when the insect bites and till the symptoms appear is called incubation period, which is as follows:

1. Plasmodium vivex-14 days
2. Plasmodium malaria-30 days
3. Plasmodium falciparum-12 days

Spread of disease: Female anopheles mosquito spreads malaria disease. For the spread of the disease, the optimum conditions are a mean temperature of 20° to 30°C with 63% humidity. Economic conditions, insufficient food, over-crowding, increase the incidence of malaria. Irrigation, leakage in canals, water logging, and rice cultivation may serve as the breeding place for mosquitoes.

Symptoms

The cold stage*:* The patient feels cold and suffers from fever, headache, nausea and vomiting.

Anemia and enlargement of spleen and liver are the after- effects of the disease.

Prevention of Malaria:

Malaria can be prevented in the following manner:

- Proper drainage, removal of stagnant water.
- To destroy mosquitoes at some stage of his life cycle i.e., during larva stage, or adults. Use of oil, diesel, kerosene. Gammexane, etc. can destroy the

breeding.

- Cutting of vegetation, which has grown thickly, and servers as a breeding place in the daytime. Putting net, wire grill on doors and windows.

6. TETANUS

A toxin of tetanus bacillus induces tetanus or lockjaw, followed by wound. *Tetanus bacillus* lives in the contaminated soil of road, gardens and agriculture land. These microbes survive in the intestinal track of horses and cattle. They attack the nervous system and causes instant death.

Spread of disease: The bacillus enters the body through various wounds and spread their toxin in the blood stream like during operations, unhygienic deliveries of babies, etc.

Incubation Period: Generally it is of 8 to 10 days.

Immunization: Tetanus toxoid vaccine is given along with D.P.T. (Diphtheria, Pertusis, Tetanus). Intra-muscular injection is given in three doses at the interval of one month. One booster dose is given at the age of 5-6 years and another booster dose is repeated When the child is 10 years and 16 years of age. Tetanus vaccine is given as a preventive Measure.

Prevention

All wounds should be treated carefully especially if there is a fear of contamination With refuses or soil wound should be thoroughly cleaned with disinfectant or 3% iodine Solution. In addition, ATS (Anti Tetanus-serum) injection should be given.

Human Rights

A right may be defined as something to which an individual has a just claim. Human rights are those that individuals have by virtue of their existence as human beings. The right to life itself and the basic necessities of food and clothing may be considered fundamental human rights. Human rights traditionally have been put in two categories as:

Natural rights and Civil rights.

Natural rights are those that belong to individuals by virtue of their humanity: the right to remain alive, to sustain life with food and shelter and to follow the dictates of their conscience.

Civil rights are based on positive law: they are derived from laws and judicial decisions.

Civil or legal rights are those granted by a government.

The entitlements are defined in the Universal Declaration of Human Rights adopted by the United Nation‘s General Assembly on Dec. 10, 1948, as ‒a common standard of achievement for all people and nations‖. It urged the right to political, economic, social

and cultural self-determination the right to peace, the right to live in a healthful and balanced environment and the right to share in the Earth‘s resources.

Here, we are dealing with that part of Human natural rights which encompasses protection of environmental issues as these ultimately govern human health and survival:

- The right to life.
- The right to an adequate standard of living and social security.
- The right to education.
- For children, the right to freedom from exploitation.
- The right of access to health-care services, with States aiming to reduce infant and child mortality and abolish traditional practices prejudicial to health.
- The right of access to clean air to breathe.
- The right of access to drink-clear and clean water.
- The right to live in noise pollution free environment.
- The right of access to gifts of nature/ resources.
- The right to live in a disease free environment.

VALUE EDUCATION

Aims of Health Education

The aims for community health education are as follows:

(i) Healthy practices in day-to-day living should be inculcated among the children from a very early age. This is how they will be able to understand the importance of health, hygiene and sanitation.

(ii) The knowledge about our body and various organs of our body and their functions helps a person to understand the disease, its causes and common ailments.

Such factors which affect the health standards like smoking, eating tobacco, drug addiction intake of liquor etc., can be checked by resorting to some law and amendments to Improve the health standards. .

(iii) In order to create a clean environment in a city or town, people should be encouraged and awareness be created. Clean and safe drinking water system, good sanitary lavatories be provided at crowded places.

(iv) Proper arrangements for providing better health services to the people should be ensured and they should be introduced to various governmental health programme like mother and child welfare, child welfare services, family planning, etc.

(v) Training programme for officers, health workers, private doctors, nurses, midwives, etc. should be undertaken from time to time.

(vi) Health education can be imparted in an effective manner by personal contact programme.

(vii) Personal hygiene, regular exercise and rest, importance of nutritive foods, ventilation and its effect on health, clean sanitary environment, causes of pollution and its prevention are some of the general topics for health education.

(viii) Practical knowledge should be provided about communicable diseases, serious heal problems and first aid and emergency services.

Principles of Health Education

Every individual learns and understand something from his culture and social background. Based on school health programme adult-education programme is planned accordingly. Before understanding various teaching methods one should know the principles behind learning. These principles are as follows:.

(i) Every individual has learning capacity throughout his life.

(ii) Learning capacity is not affected by advancing age of an individual, but by lack of interest and desire for learning.

(iii) For learning the same material, all individuals will not learn the same way. This variation is due to the background experiences and individual's circumstances and exposure.

(iv) Individuals own effort will play a significant role in making a change in habits and concepts. Learning is not the outcome of one individual saying something to other individual, but it is learnt through his own efforts and willingness.

(v) An individual learns for love, satisfaction. and basic human needs of survival, food and social approval. .

(vi) People learn faster when they are acquainted with the objectives and goals. Means of achieving those goals and use the resources properly should be clear.

(vii) An individual take an appropriate time to learn something new, so one should be given enough time to absorb what he has learnt.

Purification of water at domestic level

Purification of water at domestic level can be achieved by the following methods:

1. Distillation
2. Boiling
3. Filtration
4. Chemical method of sterilization
5. Ultra-violet sterilization.

(i) **Distillation:** In the process of distillation water is heated and evaporation takes place, whereby water changes back to water when cooled. This process is called condensation. The condensed water is the purest form of water, free from microbes

and impurities.

(ii) **Boiling:** It is boiled for ten minutes to kill the microbes present in it and also removes the temporary hardness of water.

(iii) **Filtration:** Different varieties of filters are used to purify the water at domestic level.

Chemical methods for water sterilization

(i) **Aluminum sulphide:** It is largely used to purify muddy water.

(ii) **Chlorine:** Chlorine gas or tablet is added to destroy disease-producing germs. It is a very cheap and convenient method.

(iii) **Potassium permanganate:** It oxidizes the organic matter and destroys 98% of the microorganisms in four to six hours.

(iv) **Purification by the use of ultra-violet rays:** Ultra-Violet rays have the power of destroying microorganisms from the water without any chemical change. They exert their action only when the water is fairly clear and bright.

VENTILATION

Ideal ventilation is possible only when there is sufficient pure air. Ventilation is defined as the –Science of maintaining atmospheric conditions which are comfortable and suitable to the human body.‖ Ventilation incorporates comfortable and appropriate balance of gases, also optimum temperature adequate humidity, movement or flow of air and free from disease producing microorganisms.

(a) Internal Ventilation

Proper ventilation of the rooms is known as _internal ventilation. Lack of efficient and adequate ventilation leads to many discomforts and diseases. When the carbon-dioxide concentration exceeds 0.04% and reaches 0.06% then the air in the room gets suffocating. Every person needs 3000 cu feet of air every hour and if the impurities in the air exceed 0.02%, the air is regarded as impure and unhealthy.

(b) External Ventilation

Fresh air flows into the house from the surroundings and open space. This type of ventilation is known as external ventilation. This is ensured by making the streets wide and straight, providing open space, parks and gardens.

Artificial Ventilation

Artificial ventilation is easily controlled and, installed. The means of artificial ventilation are coolers, air conditioner, which are more frequently, used equipment‘s. Humidifiers and dehumidifiers are used where there is problem of humidity. Exhaust fans also play an important role in bringing in fresh air and flushing out polluted and impure air.

Inadequate Ventilation and Health

Inadequate ventilation has following effect on the occupants of the room:

(i) Lack of oxygen leads to early fatigue and reduces alertness.

(ii) Results in sweating, heat exhaustion and faintness.

(iii) Foul odours from skin, mouth, stomach and clothes produces uneasiness, sickness etc.

(iv) Unventilated environment leads to digestive disorder loss of appetite, anemia, metabolic disturbances, etc.

(v) Cold, cough, infectious diseases, influenza, pneumonia etc. are some of the problems of inadequate ventilation.

(vi) Gases from exhaust vehicles and industries damage the eyes and trachea.

The Aids Pandemic

The AIDS (Acquired Immune Deficiency Syndrome) virus has caused a worldwide epidemic, which can be called a pandemic because it continues to spread throughout the world. Millions of people have been infected. The virus was first identified as the cause of AIDS in the late 1970s. Since then, individuals with the infection have been reported in nearly every country in the world. Estimated mortality rates are about 60 percent, according to the U.S. Centres for Disease Control and Prevention. The disease is spread through direct physical contact, between individuals in which body fluids containing the, virus enter the bloodstream. Sharing of contaminated needles among intravenous drug users and sexual contact are the most-likely methods of passage. In the United States, the disease was once considered a problem only for the homosexual community and those who use intravenous drugs. This perception is rapidly changing. Many of the new cases of AIDS are being found in women infected by male sex partners and in the children of infected women. In parts of Africa, the disease has always been primarily a heterosexual disease.

In the poor countries of central Africa, many believe that permissive sexual behaviour and prostitution have created conditions for a rapid spread of the disease. In addition, there is little opportunity for medical care. Many people have already died from the disease. Others who are currently infected will die in the near future. Some villages are already beginning to notice a change in the structure of their populations. With the death, of young infected‘ adults, villages are composed primarily of older people and children. The disease is spreading at an alarming rate, and, it has no cure as yet and no vaccine so far. The disease is almost fatal. People in the age group 20-39 are more susceptible to getting AIDS.

Causative germ of AIDS is a virus named HIV (Human Immunodeficiency Virus). It has been detected in body fluids like blood, semen, saliva, tears and urine. It attacks the immune system (i.e. the‘ cells that fight against infections) and the patient suffers seriously from even minor infections of other diseases. Even cancers appear when the immune system fails.

Incubation period i.e. the time between receiving the infection and the‘ appearance of symptoms may even be more than 10-12 years. During this period the persons show positive results for HIV infection and they are popularly called HIV-positive. Most individuals, when

AIDS is fully developed, die within 3 years from other infections or cancers. Symptoms during this period may include swollen lymph nodes, fever, night sweats and weight loss.

Transmission of Aids

The AIDS virus is highly infective. It is transmitted by any one of the following methods:-

(i) **Sexual intercourse** between a man and woman, when anyone of two is infected. (The virus occurs in the fluids of the reproductive passages). Prostitution is the biggest source to spread the infection. Safest is the single partnership wife and husband relationship.

(ii) **Homosexual intercourse** (anal sex) with an infected person. The disease is more common in homosexual males.

(iii) **Contaminated blood transfusions.** In many situations the patients have to be given blood transfusions as in excessive bleeding resulting from injury, or during surgery, etc. Some children are born with the disease thalassemia with defective hemoglobin of the blood. Such children have to be given regular blood transfusions usually every 3-4 weeks and very often the blood transfused is from professional donors.

(iv) **Mother to child transmission.** The germ from the infected mother may cross through the placenta and reach the embryo in the womb.

(v) **Injection needles** if shared by more than one person may introduce the virus from one individual to another. The disease is quite. Common in drug abusers. For the same reason, doctors in hospitals now use only disposable syringes, which are used just once. AIDS is not transmitted by contact with patient‘s clothes and other articles, shaking hands, eating together and sharing bathrooms and toilets.

Women and Child Welfare

Women and Environment

As child bearers, family caretakers and consumers; as food-products, fuel and water gatherers and users; as field, forest, factory and office workers, women are primary managers, and often preservers of natural resources. Women‘s work is generally undervalued. As a result, women constitute a disproportionate number of the poorest groups of people and are victims of hunger, illiteracy, poor health, scarce social and technical services, inadequate population policies and other consequences of poverty. In addition, women‘s participation and influence is inadequately represented in decision-making spheres concerning environment and development issues affecting the quality of their lives.

Child Power

Children begin to acquire an extremely important economic role. They do many crucial tasks like caring for younger children, fetching fuel, fodder and water and grazing animals, so that the adults can undertake waged labour. –Children have become the unwitting victims of the continuing energy hunger in a family below the poverty line, is compelled to meet its

energy needs only by producing several children.‖ But this will not only have important implications for the education, health and nutrition of children but also for the country‘s massive family planning programmes and the health of women. If underfed and overworked, women are also expected to bear many children, the impact on their health will obviously be drastic.

Some organizations working for women and child welfare are:

- National Institute of Public‘ Co-operation and Child Development (NIPCCD)
- World Health Organization
- Central Social Welfare Board
- Voluntary Health Association of India
- Indian Council of Child Welfare
- United Nations Children‘s Fund and others.

(A) Central Social Welfare Board

Central social welfare board was established in 1953 under the social Welfare Ministry. It generally assists in the improvement and development of social welfare activities. Grant in aid programme, welfare programme development, control and evaluation work, training and motivation are the main objectives of the social welfare board. Its functions are:

(a) The spirit of continued partnership between statutory and voluntary welfare services to act as complementary and supplementary to each other.

(b) Provides technical and financial aid to the Panchayat Raj Institutions in accordance with the schemes and principles approved by the government of India.

(c) Promotes social welfare activities intended for family, women, children and the handicapped. Assistance in case of unemployment, under employment, old age, sickness, disablement and other cases of unders erved organization.

(d) It is change over from un-organized charity to the systematic line of support by state government wherever considered necessary or desirable.

(e) Need for rationalizing the system of rendering financial assistance to voluntary organization for the uncovered areas.

(f) Conducting of regular surveys regarding the needs and requirements of the social welfare organization.

(g) Co-ordination and cooperation among the voluntary organizations functioning at all levels, amongst themselves and with the governmental agencies, between the concerned government departments at central and state level, district and local levels.

Other functions of Central Social Welfare Board

(i) **Mahila Mandal Programme***:* Various voluntary Mahila Mandals are getting assistance from the central social welfare board.

(ii) Holiday Homes for Children are organized for 15 days for socially and economically

backward families. The camp aims at giving training to children in discipline, sense of group living and team spirit, help in national integration, apart from exposure to new surroundings.

(iii) ***Creches Programme:*** This programme provides day care services for children of working and ailing mothers.

b) VHAI-Voluntary Health Association of lndia

Indian Women's Sabha: The Indian Women's Sabha organizes Maternity and child health centres. The branches of this Sabha ate found all over the country, clinics, hospitals, adult education centres, milk distribution centres and family planning programmes are managed by the women's Sabha.

c) Indian Council of Child Welfare (ICCW)

Indian council of child welfare was established in 1952 for the welfare of children and providing health services to them. The council has its branches in every state with its headquarters at New Delhi. The main functions of the institution are:

- Initiate, undertake or aid directly or through its branches or affiliated bodies schemes for the furtherance of child welfare in India.
- It provides dissemination of knowledge and information and to educate public opinion for child welfare programmes on a scientific basis.
- Establish a central bureau for the study and collection of data and statistics in respect of child welfare work.
- It cooperates with national and international organizations having similar objectives.

United Nations Children's Fund (UNICEF)

- It is an international agency, a subsidiary body of the General Assembly. It came into being on 11th December 1946 after the Second World War. Now the words _international' and _emergency' have been dropped from the name of the organization. It is now called United Nations Children's Fund but abbreviation in vogue is still UNICEF. UNICEF has completed 48 years of service in India. UNICEF is not financed through the regular U.N. budget, but by voluntary contributions from the member countries, besides individual organizations. 10% of its resources come from the sale of UNICEF greeting cards. Aid is given only for those projects, which aim to prevent disease and promote health of the mothers and children. India and UNICEF has completed 48 years in the year 1997 and has provided assistance, training programmes and many regional projects started from time to time. UNICEF has changed many facets and programmes for the ever-changing health standards. In 1959 WHO and F AO along with UNICEF started a nutritional programme for the children of less than 5 years of age. Then it was changed to Extended Nutritional Programme, which was organized through Mahila Mandals. In 1963 this programme was made more useful by giving nutrition to children and also to pregnant and lactating mothers and named as Applied Nutrition Programme. In the decade 1980-90, UNICEF expanded its services to remote rural areas.

Functions of UNICEF

(i) Child Development and Survival

UNICEF provides priority to infant and children‘s health and nutrition programmes. Child and infant mortality rate during the decade 1985-95 declined from 110/1000 children to 8711000.

(ii) Universal Immunization

Expanded Programme on immunization (EPI). This programme was started by the W.H.O. in 1974 for providing immunization against six fatal diseases i.e. measles, poliomyelitis, diphtheria, whooping cough or Pertusis, tetanus and tuberculosis. This fulfills the concept of providing primary health protection for all children.

(iii) Nutrition

UNICEF assist in conducting the Applied Nutrition Programme by establishing nutrition centres, school and community gardens. Provides funds for training and nutrition programme at rural level.

(iv) Primary Health Care

The UNICEF sponsors Child health care programmes. It provides funds for the training of doctors, nurses, and public health officers, health workers. UNICEF is providing equipment and material for primary health centres and sub-centres as well as hospitals and laboratories, which support them.

(v) Formal and Informal Education

UNICEF provides stipends for refresher training to teachers including primary-school teachers.

(vi) Water and Sanitation

Water and sanitation are part of health programming and UNICEF co-operates in programmes to supply safe water and improved sanitation.

(vii) Urban Services

UNICEF provides stipends to more women and girls for training in child care, home-crafts, food preservation and income-earning skills and provide stipends to train local leaders to help organize activities in their own villages and communities.

vii) **Information and Electronic Revolution**

With the beginning of the electronic age in recent years, Our world has become a place where information and communication are regarded as the most valuable resources. Our world has now shrunk to a _global village‘ and we now have access to places our grandparents didn‘t know existed. Information from cosmopolitans to unexplored frontiers are all now available at a drop of a hat, it‘s just a matter of mouse-click. Data flows at the speed of light in today‘s wired world, or shall, we say the wireless, paperless and non-messy world. The advent of the Internet has, in a way, brought continents together once again.

Modern technology has also minimized our utilization of resources; *e.g.* today‘s, sophisticated engineering has replaced the blind usage of metals in every production. Thanks to the marvel of lightweight alloys and composite building materials, automobiles now require half as much metal as they typically used to do a generation ago. Today 1,000 soft drinks cans are manufactured with around 6 kg of aluminum, which once used to require 50 kg of steel. In the 1970‘s, when the fear of an impending shortage of metals gripped the world, countries like the United States began stockpiling essential minerals to keep their resource inventory up-to-date. Copper for electric wiring, telephone cables, and electric motors were in short supply. But then glass-fibre optic cables, ceramic magnets, microwave relay systems and satellite communication networks were invented. We now have a copper surplus. Similarly, technology has also cut down our fuel consumption. Diesel engines replaced coal-based steam engines in locomotives, which were, further replaced by more efficient and pollution-free electric engines. The popularity of high-mileage yielding, fuel-efficient vehicles have made the gasoline guzzling vehicles obsolete in the market. Such advancements in the field of information technology have made distance between two places immaterial. Today, people can communicate via teleconference and transmit data through fax machines and computer networks, and save precious time & fuel wasted earlier in traveling for meetings and business appointments. It is no longer necessary for all workers to commute to an office building in the congested city to do their work. Increasingly, workers have home offices linked electronically to co-workers, clients, libraries, databases, and business opportunities elsewhere in the world. Commercial establishments are moving away from the brick-and- mortar set-ups to more affordable, cost-efficient, far-reaching virtual offices on the Internet.

Suggestions

Almost every country in the world is spending more & more in the information technology. Just-in-time delivery systems and recycling further reduce the amount of virgin materials we use. We will probably never reach a point at which we don‘t need to extract resources from nature, but we may greatly lower our consumption rate as well as the rate at which we produce wastes and pollution. This would surely have important environmental benefits.

Resettlement and Rehabilitation of People

–Land for land‖ is a better policy than cash settlement. Even in implementing this policy, the land is not given in the command area in most cases, forestland is either cleared on waste fallow land given without any provision for developing the land or for the supply of necessary inputs; a village is broken up and families dispersed; villagers are usually left to buy private land, take loans from the government, which puts poor villagers at a disadvantage-land prices in neighboring villages shoot up steeply if the government takes up resettlement; the villagers are resettled in distant places, sometimes in a totally alien environment and culture, thus creating insurmountable adjustment problems. Oustees from Pong dam in

Himachal Pradesh were settled in Anupgarh in Rajasthan, bordering on Pakistan. The people were generally left to fend for themselves. Arrangements for drinking water, dispensaries, schools, village roads or drainage of the rehabilitation sites are only completed years later. In the case of the Ukai Dam in Gujarat, resettlement work was undertaken by the _Ukai Nav Nirman Samity. Even so, out of a total of 18,500 affected families, only 3500 families could be resettled.

People who could previously barely manage to survive in their traditional environment are uprooted as a result. The objectives of rehabilitation should be:

1. The people displaced should get an appropriate share in the fruits of development.
2. Creating new settlements with their own environment should rehabilitate them.
3. Removal of poverty should also be an objective of the rehabilitation policy and therefore some land to all.
4. Oustees (even the landless) should be given assurance of employment.
5. While dealing with tribal one should also keep in mind the following five principles of tribal-development accepted during Jawaharlal Nehru's era as _tribal panchsheel.'
6. Tribal should develop along the lines of their own genius and we should avoid imposing anything on them.
7. We should try to encourage their own traditional arts and culture in every way.
8. Resettlement should be in the neighborhood of their own environment. If resettlement is not possible in the command area, top priority should be given to the development of irrigation facilities and supply of basic inputs for agriculture; drinking water, wells, grazing grounds for cattle schools for the children, primary health care units and other amenities should be arranged.
9. In partly affected village, villagers should be given the option of shifting out with others with the same compensation as available to evacuees.
10. Training facilities should be set up to upgrade the skills of affected people and reservation in jobs should be made for the willing adults among the evacuees.
11. Special attention should be given to the rehabilitation of artisans and village crafts people.
12. Villagers should be taken into confidence at every stage or implementation and they should be educated, through open meetings and discussion about the legalities of the Land Acquisition Act and other rehabilitation provisions.
13. The aid of voluntary agencies planning and implementation programme.

Rehabilitation Problem

Involuntary displacement of human population is always traumatic. Irrespective of the causes leading to such migrations the degree of suffering experienced by such people simply cannot be quantified in money values, and even in words it can be described only inadequately. But, unfortunately, ousting of people likely to be submerged under irrigation or hydel power dams is a classic case where

hardships are imposed on people in spite of the ‗pro-people' laws and policies proclaimed by the Government. Below is a critique of the Tehri Dam Rehabilitation.

Compensatory Land

The project authorities commenced the Scheme by allocating 2767 acre of land in the Dehra Dun area, which was already reeling under severe pressure from tourism, limestone quarrying and urban expansion.

Rehabilitation should be collective

In the villages, almost each' family depends on the other. The social and moral obligations towards each other bind them into one cohesive whole. The authorities are rehabilitating individual families and not the village as a whole.

Monetary Compensation

Mere payment of cash is not rehabilitation. Moreover, the amount of cash paid as compensation is insufficient to buy land in other places because of the high rates. The oustees being basically farmers lack the business acumen needed to set up a viable commercial alternative. Since they are not accustomed to having such large sums (relative to their usually small incomes) in a lump sum, they are ignorant as to how they should spend it.

Mismanagement

The project authorities estimated the total affected population in 1981 as 46,000. Using the Census Office figures, the total number affected for 1981 is act 70,000.

Lack of Public Relations

The majority of populace to be displaced consists of *advises*, tribal, scheduled castes that have a unique lifestyle. The traumatic experience of shifting to new areas and new occupations involving drastic changes in their lifestyle weighs heavily on these people. The absence of any public relation efforts has further aggravated the situation.

Housing compensation: It is necessary to highlight a major flaw in the procedure for fixed immovable property like houses, well, barns fence, cattle-stalls, etc. The present procedure evaluates the ―current worth‖ or ―value after depreciation‖ for determining the amount of compensation. This concept is faulty. He should be paid an amount for his house etc., equivalent to the cost of reconstructing a dwelling place equal to the plinth area lost under submergence. This amount (*i.e.*, replacement cost) will obviously be more than the ―current worth‖ of his old dwelling.

Disaster Management

Loss of life and property due to natural disasters like tropical cyclones, floods, droughts, tornadoes, earthquakes, volcanic eruptions etc, is very large. Fortunately warning facilities are available today and by mitigation measures, loss of lives and properties can be minimized. National Meteorological Services of the world to provide warnings to the public for some of the weather related natural disasters. It is not possible to forecast a long period ahead precisely when and where a dangerous natural phenomenon will take place. While natural disasters cannot be prevented, taking

proper long-term and short-term disaster mitigation measures can minimize the loss of life and property. Some common disasters known to occur in our country are as under:

Floods

Floods are defined as a relatively high flow of water discharged from river and stream network, which sets the riverbank margins to overflow and lead to the inundation of low land areas surrounding the riverbed. It is essentially a physical phenomenon. Floods arise from abnormally heavy rains, dam failures, snow melts, river blockages. Flood disasters rank second only to droughts in the total number of people affected worldwide.

Types of Floods

Floods can be classified into three categories as under:

(i) River floods

Rivers get charged due to heavy rains over large catchments areas or by melting of snow or sometimes both especially in the mountainous tracts. The floods take place in river systems with tributaries that may drain into large geographic areas and encompass many independent river basins. Amount of flooding depends on moisture in the soil, vegetation cover, and depth of snow and size of catchments basin.

(ii) Coastal floods

Coastal flooding is associated with tropical cyclones/ harsh winds arising at the ocean surface. Coastal floods are often aggravated by wind induced storm surges along the coastline. Sea and ocean _water floods the inland coasts affecting kilometers of tracts. Ocean tides, storm surges or tsunamis play a definite role. Prolonged and indefinite rains in the rainy season marked from June-September results in extreme flood in coastal river basins.

(iii) Flash floods

These floods occur within six‘ hours of the beginning of rainfall and; are characterized with rising clouds, thunderstorms and tropical cyclones. These result from runoff from a torrential downpour, particularly if the catchments slope is unable to absorb and hold a significant part of water. Other causes of flash floods include dam failure, sudden break up of glaciers etc. These offer potential threats in the areas where the terrain is steep, surface runoff is high, water flows through canyons and where severe rainstorms are likely.

General Characteristics of Floods

1. Man made structures and forest vegetation exhibits different levels of tolerance towards effects of floods.
2. Intensity of damage is governed by the time interval of standing floodwaters.
3. High velocity of running water may uproot or weaken foundations of buildings.
4. Rate of rise and discharge of a river is important as a basis for flood control.
5. Frequency of occurrence estimated over a length of period would determine the kind of activities the flood plain should be put to.

6. Generally the rainy season is characterized by the floods during which agricultural economy suffers a huge loss.

Effects of Floods

1. Rising water, erosion and the force damages the residential and commercial building. They are dangerous for villages lying in the coastal areas as it sweeps away everything, which comes into its path. In mountainous areas it is the chief cause of landslides.
2. Fisherman, local people, cattle, animals and vegetation suffer a great loss of life and property. Most of the deaths are reported to be from drowning.
3. Fresh water supplies by all sources are nearly destroyed and contaminated hence the areas falling under its impact bear a great risk of suffering from water borne diseases.
4. The destruction of food and fodder crops result in acute food shortage.
5. Floods also make soil infertile, as the topsoil is lost due to erosional activity.
6. Floods are also known to preserve, wetlands and recharge ground water.

Flood Control

1. Depth and width of the riverbed could be increased as its capacity to carry larger loads increases manifold and thus reduce the area of the flood plain.
2. A network of canals can be established from the river systems, which generally leads to floods. This would also benefit the agricultural economy/ section. Care must be taken in the design and construction because of the possible environmental impact and necessary safety features.
3. Reservoirs should be made for storing floodwater and releasing them at manageable rates. This would require careful engineering. Dams, and reservoirs would further lead to generation of resources.
4. Newly constructed residential as well commercial buildings should have foundations, which are strong enough to respond to flood conditions.
5. Rivers and streambeds should be stabilized with stone, masonry or vegetation at the banks. This should strictly be followed where rivers pass through cities, specially near bridges.

Post Disaster Requirements

The initial response to flooding authorities/community should include: Search and Rescue operations, water provision, Medical assistance, Disaster epidemiological surveillance assessment, food and and temporary shelter.

The secondary response should include:

Reconstruction of houses, equipment and tools, supply Creation of employment, of animals, and assist with Assistance to farmers, recovery of small business Distribution of farm and fisheries.

Flood Problem In India

The nature of flood problem varies from one river system to another. Two great river systems are discussed below considering the flood problems in India:

Brahmaputra River

The main problem of flooding in the northeastern region arises from the Brahmaputra river and its tributaries. The river in monsoon season overflows its banks and causes a great damage to life and property both. Several times it has affected Kaziranga wildlife sanctuary where rhinoceros population died due to rising floods. In recent years, the erosion along the banks of the Brahmputra has assumed serious proportions. The rivers also carry considerable amount of silt and have a tendency to change its course.

Ganga River System

In this region the northern tributaries of the Ganga, namely the Rapti, the Sharada, the Ghaghra and the Gandak cause extensive flooding along their banks. Drainage congestion is confined to the northwestern parts of U.P., Meerut, Mathura and Agra suffers the most. Bihar suffers a considerable amount of damage due to the flooding of the Burhi Gandak, the Baghirati, the Kamla Balan, the Kosi and the Mahananda. In addition to the crop submergence the area experiences traffic dislocation also. In the Bengal region Baghirati, the Ajoy and the Damodar cause extensive flooding. Here the tidal effect of Bay of Bengal also plays a role in flooding. In Delhi and Haryana it is the Yamuna, the biggest tributary of the Ganga, which causes a marginal amount of flooding. Most of these flooding regions suffer from inadequate channel capacity as well as regulation of river water flow in these channels.

Earthquakes and Seismology

An earthquake is a major demonstration of the power of the tectonic forces caused by end genetic thermal conditions of the interior of the earth. An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings apart and causing gaping fissures to open in the ground. The Richter scale devised by Charles F. Richter in 1935 measures the magnitude or intensity of energy released by an earthquake. Good Friday Earthquake of March 27, 1964 in Alaska (USA) measuring 8.4 to 8.6 on Richter scale is among the greatest earthquakes of the world ever recorded.

The science that studies the behavior and patterns of seismic waves is called seismology. The place of origin of an earthquake is called focus, which is always hidden inside the earth, but its depth varies from place to place. The place of the origin of an earthquake is called _focus‘ which is always hidden inside the earth. The deepest earthquake may have its focus at a depth of even 700 km below the ground surface. Major Himalayan earthquakes, such as the Bihar-Nepal earth quake of August 2, 1988, have their focus around 20-30 km deep. The place on the ground surface, which is perpendicular to the buried _focuses or _hypocenter‘, recording the seismic waves for the first time is called _epicenter‘. The waves generated by an earthquake are called _seismic waves‘ which are recorded by an instrument called seismograph. The lines joining the places of equal intensity of seismic waves on the maps are called is oseismallines.

Causes of Earthquakes

Earthquakes are caused mainly due to disequilibria in any part of the crust of the earth. A number of causes have been assigned to cause disequilibria in the earth‘s crust such as volcanic eruptions, faulting and folding, gaseous expansion and contraction inside the earth, hydrostatic pressure of man-made water bodies like reservoirs and lakes, and plate movements.

(1) Vulcan City

Volcanic activity is considered to be one of the major causes of earthquakes. Vulcan city and seismic events are so intimately related to each other that they become cause and effect for each other. Earthquakes follow each volcanic eruption and many of the severe earthquakes cause volcanic eruptions. The explosive violent gases during the process of Vulcan city try to escape upward and hence they push the crystal surface from below with great force and thus is‘ caused severe earth tremors of high magnitude.

(2) Faulting and Elastic Rebound Theory

The horizontal and vertical movements caused by end genetic forces result in the formation of faults and folds which in turn cause isocratic disequilibria in the crystal rocks which ultimately causes earthquakes of varying magnitudes depending on the nature and magnitude of dislocation of rock blocks caused by faulting and folding. The 1950 earthquake of Assam was believed to have been caused due to disequilibria in crystal rocks;

(3) *Hydrostatic Pressure and Anthropogenic Causes*

Certain human activities such as pumping of ground water and oil, deep underground mining, blasting of rocks by dynamites for constructional purposes, nuclear explosion, storage of huge volume of water in big reservoirs etc. also cause earth tremors of serious consequences. The introduction of additional load through the construction of large dams and impounding of enormous volume of water in big reservoirs behind the dams cause disequilibria of adjusted rocks below the reservoirs.

(4) Plate Tectonic Theory

The earth is composed of solid and moving plates having either continental crust or oceanic crust or even both continental oceanic crusts. The earth‘s crust consists of 6 major plates (Eurasian plate, American plate, African plate, Indian plate, Pacific plate and Antarctic plate) and 20 minor plates. These plates are constantly moving in relation to each other due to thermal convective currents originating deep within the earth. All sorts of disequilibria are caused due to different types of plate motions and consequently earthquakes of varying magnitudes are caused.

CLASSIFICATION OF EARTHQUAKES

Each earthquake differs from the other and thus it becomes difficult to classify all the earthquakes into certain categories.

(1) Classification on the Basis of Causative Factors

(A) Natural Earthquakes are those, which are caused by natural processes i.e. Due to end genetic forces. These are further divided into four subcategories.

(i) **Volcanic Earthquakes** are caused due to volcanic eruptions of explosive and fissure types and are confined to volcanic areas. Severe earthquake caused by violent explosions of Etna volcano in 1968.

(ii) **Tectonic Earthquakes** are caused due to dislocation of rock blocks during faulting activity. Such earthquake is very severe and disastrous i.e. 1906 earthquake of California (USA).

(iii) **Isostatic Earthquakes** are triggered due to sudden disturbance in the Isostatic balance at regional scale due to imbalance in the geological processes.

(iv) **Plutonic Earthquakes** are in fact, deep focus earthquakes, which occur at greater depths.

(B) **Anthropogenic Earthquakes** are caused by human activities such as pumping of water and mineral oil from underground aquifers. and oil reserves respectively, deep underground mining, blasting of rocks by dynamites for constructional purposes

E.g. Koyna earthquake of Maharashtra of 1967 due to Koyna reservoir etc.

(C) Classification on the basis of Focus

On the basis of the depths of their foci these have been divided into 3 types.

(i) **Moderate Earthquake:** Foci are located at the depths between 0-50 km.

(ii) **Intermediate Earthquake:** Foci at the depths between 50-250 km.

(iii) **Deep Focus Earthquake:** Foci at the depths between 250-700 km.

Classification on the basis of Human casualties

(i) **Moderately Hazardous Earthquakes:** If deaths of human range below 50,000 due to seismic tremors e.g. Tabas earthquake of Iran 1978 A.D. (death toll 25,000).

(ii) **Highly Hazardous Earthquakes:** If deaths of human range between 51,000- 1,00,000 due to seismic tremors e.g. in 1935, Quetta, Baluchistan, (death toll 60,000).

(iii) **Most Hazardous Earthquakes:** If deaths of human casualties are above 1,00,000 mark e.g., in 1976 Tang-Shan, China (death toll 7,50,000).

World Distribution of Earthquakes

Earthquakes are, in fact associated with the weaker and are statically distributed areas of the world. Most of the world earthquakes occur in the zones of young folded mountains, the zones of faulting and fracturing, the junction of continental and oceanic margins, the zones of active volcanoes and along the different plate boundaries. The world map of the distribution of earthquakes prepared by seismologists show the occurrence of earthquakes along the following belts.

(i) **Circum-Pacific Belt:** surrounding the Pacific Ocean.

(ii) **Mid-Continental Belt:** representing epicenters located along the Alpine-Himalayan Chains of Eurasia and northern Africa and epicenters of East African Fault zones.

(iii) **Mid Atlantic Belt:** representing the earthquakes located along the mid-Atlantic Ridge-and its

offshoots.

Effects of Earthquake hazardous

Earthquakes and their hazards are determined on the basis of the magnitude of seismic intensity as determined by Richter scale but are decided in the basis of quantum of damages done by a specific earthquake to human lives and property.

(i) Landslides

Weaker landmasses and tectonically sensitive land margins cause landslides and debris falls, which damage settlements and transport systems on the lower slope segments.

(ii) Damage to Life and property

Structures such as buildings, roads, rails, factories, dams, bridges suffer a huge damage thus causing a heavy loss of human life and property both. The vibrations of earthquakes last longer and the amplitudes of seismic waves are greater artificially in filled and leveled depressions, swamp deposits etc. than in the structures of consolidated materials and bedrocks. Two major earthquakes of Bihar-Nepal border in 1934 and 1988 explain the impact of earthquake disasters on human structures and human lives. The damage caused by the Bihar earthquake of 15 January 1934, measuring 8.4 on Richter scale, include 10,700 human deaths, landslides and slumping in an area of 250 km length and 60 km width, ruptures and faults in the ground surface etc.

(iii) Damages to Government Infrastructure

Cities and towns are worst affected due to large concentration of human population, commercial complexes and residential areas. Due to collapse of large buildings there is greater loss of life and property. Due to collapse of buildings ground water pipes are bent and damaged thus water supply is disrupted, electric and telephone poles are uprooted and there is total disruption of power and communication. Other side effects are collapsed sewer system causing epidemics, roadblocks etc.

(iv) Fire Hazard

Earthquakes strongly shake the buildings and thus strong oscillations cause severe fires in houses, mines and factories because of overturning of cooking gas cylinders, contact of live electric wires, churning of blast furnaces, displacement of other electric and fire- related appliances.

(v) Landmass Deformation

Severe earth tremors and resultant, vibrations caused by severe earthquakes result in the deformation of ground surface because of crusts and troughs in the ground surface and faulting activity.

(vi) Flash Floods

Strong seismic events result in the damages of dams and cause severe flash floods. Severe floods are also caused because of blocking of water flow of rivers due to rock blocks and debris produced by severe tremors on the hill slopes facing the river valleys.

(vii) Tsunamis

The seismic waves, caused by the earthquakes traveling through seawater, generate high sea waves and cause great loss of life and property. Since the pacific Ocean is girdled by the earthquakes and volcanoes tsunamis are more common in the pacific with a minimum frequency of 2 tsunamis per year.

CASE STUDY

U.P. Earthquake of 1991

A severe earthquake occurred in Garhwal region of Uttar Pradesh on 20th Oct. 1991. Intensive tremors were felt at 2.53 a.m., which lasted for about 45 seconds. The magnitude of earthquake was measured 6.6 on Richter scale and its epicenter was at Angola, a place near Uttarkashi, Mild tremors are a regular feature of the area. The worst affected areas have been in the district of Uttarkashi, Tehri Garhwal and Chamoli while it also caused sizeable damage in the districts of Dehradun, Pauri Garhwal and Nainital. The roads and bridges are the chief means of communication in hill region, which underwent heavy damage. The economy of such places is based on tourism to a great extent, which suffered a great set back. The overhead drinking tanks and pipelines had developed cracks. Sources of drinking water had been damaged. The earthquake caused intensive damage to the building of various government departments, Forest, Home, Finance and Rural Development.

Cyclones

Cyclones are the centers of low pressure surrounded by closed isobars having increasing pressure outward and closed air circulation from outside towards the central low pressure in such a way that air blows inward in anticlockwise on northern hemisphere and clockwise in southern hemisphere. They range in shape from circular, elliptical to V shape. From locational viewpoint cyclones are classified into two principal types e.g. i) extra-tropical cyclones/temperate cyclones ii) tropical cyclones.

(I) Temperate Cyclones

Temperate cyclones are atmospheric disturbances having low pressure in the centers produced in the middle latitudes characterized by converging and rising air, cloudiness and precipitation. They are formed in the regions extending between 350- 65" latitudes in both hemispheres due to convergence of two contrasting air masses e.g. After their formation temperate cyclones move in easterly direction under the influence of westerly winds and control the weather conditions in the middle latitudes.

(i) Shape, Size and Speed

Temperate cyclones are of different shapes e.g. circular, semi-circular, elliptical, elongated or V, but all of them are characterized by low pressure in their centres and closed isobars. The pressure difference between the centre and periphery is about 10-35 mb. It means that pressure increases from the centre towards outer margin. Average large diameter of an ideal cyclone is about t 900 km while short diameter measures t 000 km. The temperate cyclones move eastward under the influence of westerly winds with average velocity of 32 km per hour in summer and 48 km per hour in

winters.

(ii) Wind Systems

Since there is low pressure in the centre of temperate cyclone and air pressure increases outward and hence winds blow from the periphery towards the centre but these winds do not reach the centre straight rather they cut the isobars at the angle of 20° to 400 due to friction and Coriolis force and thus wind direction becomes anticlockwise in the northern hemisphere and clockwise in the southern hemisphere. Since temperate cyclones are formed due to convergence of two contrasting air masses and hence it is natural that there are variations in the nature and direction of winds in different parts of the cyclones.

(iii) Temperature

Different temperatures are noted in different parts of temperate cyclones because of their origin due to convergence of two thermally contrasting air masses. The southern part of cyclone records higher temperature because of the dominance of warm air while the north-eastern, northern and north-western parts record low temperature because of the dominance of cold polar air mass. The western part records lowest temperature.

(iv) Source Regions and Tracks of Movement

The areas frequented by temperate cyclones mostly lie in the middle and high latitudes extending between 350-650 latitudes in both the hemispheres. These cyclones move, on an average, in easterly direction. (1) Cyclones after originating in the north Pacific off the north-east and eastern coasts of Asia move in easterly and north-easterly direction towards the Gulf of Alaska and ultimately merge with Aleutian Lows from where they follow southerly direction and reach as far south as southern California. The cyclones moving inland dissipate and are occluded at the windward western slopes of the Rocky Mountains.

(v) Origin of Temperate Cyclones

Though the formation and development of temperate cyclones is a quick process but it passes through a series of successive stages. The period of a cyclone from its inception (cyclogenesis) to its termination (proteolysis or occlusion) is called the _life cycle of cyclone‘; which is completed through six successive stages.

(a) **The first stage** involves the convergence of two air masses of contrasting physical properties and directions. Initially, the air mass (warm and cold) move parallel to each other and a stationary front is formed. This is called initial stage.

(b) **The second stage** is also called as _incipient stage‘, during which the warm and cold air masses penetrate into the territories of each other and thus a wave-like front is formed.

(c) **Third stage:** This is the mature stage when the cyclone is fully developed and isobars become almost circular.

(d) **Fourth stage:** Warm sector is narrowed in extent due to the advancement of cold front than warm front, as cold front comes nearer to warm front.

(e) **Fifth stage:** Starts with the occlusion of cyclone when the advancing cold front finally overtakes the warm front and an occluded front is formed.

(f) **Sixth stage:** Warm sector completely disappears, occluded front is eliminated and ultimately cyclone dies‘ out.

(II) Tropical Cyclones

(i) General Characteristics

Cyclones developed in the regions lying between the tropics of Capricorn and Cancer are called Tropical Cyclones which are not regular and uniform like extra tropical or temperate cyclones. There are numerous forms of these cyclones, which vary considerably in shape, size, velocity and weather conditions. The weather conditions of low latitudes mainly rainfall regimes are largely controlled by Tropical Cyclones.

(a) Size of tropical cyclones varies considerably. On an average their diameters range between 80 km and 300 km.

(b) Weak cyclones move at the speed of about 32 km per hour while hurricanes attain the velocity of 180 km per hour or more.

(c) Tropical cyclones become more vigorous over the oceans but become weak and feeble while moving over land areas. This is why these cyclones affect only the coastal areas e.g. Tamil Nadu, Orissa and West Bengal coasts of India.

(d) The centre of the cyclone is characterized by extremely low pressure.

(e) Tropical cyclones are not characterized by temperature variations in their different parts because they do not have different fronts.

(f) There are no different rainfall cells hence each part of the cyclones yields rainfall.

(g) Tropical cyclones are not always mobile. Normally, they move from east to west under the influence of trade winds

(h) Tropical cyclones are confined to a particular period of the year (summer season).

(ii) Types of Tropical Cyclones

Generally they are divided into 4 major types:

(a) Tropical disturbances or easterly waves

(b) Tropical depressions

(c) Tropical storms

(d) Hurricanes or typhoons

(iii) Origin of Tropical Cyclones

On an average, tropical cyclones are formed due to development of low pressure of thermal origin. They develop when the following requirements are fulfilled:

(a) There should be continuous supply of abundant warm and moist air. Tropical cyclones originate over warm oceans having surface temperature of 27°C.

(b) Higher value of Coriolis force is required for the origin of these cyclones.

(c) They are associated with inter-tropical convergence (lTC), which extends from 50 -300N latitudes during summer season.

(d) There should be anti-cyclonic circulation at the height of 9000 to 15000 m above the surface disturbance.

(iv) Distribution of Tropical Cyclones

There are 6 major regions of the tropical cyclones e.g. (1) West Indies, Gulf of Mexico, and Caribbean Sea. (2) Western North Pacific Ocean including Philippines, Islands, China Sea, and Japanese Islands. (3) Arabian Sea and Bay of Bengal. (4) Eastern Pacific coastal region off Mexico and Central America. (5) South Indian Ocean of Madagascar (Malagasi), and (6) Western South Pacific Ocean, in the region of Samoa and Fiji Island and the east and north coasts of Australia.

(v) Environmental Impact of Tropical Cyclones

Tropical cyclones are very severe disastrous natural hazards which inflict heavy loss to human lives and property in terms of destruction of buildings, transport systems, water and power supply systems, disruption of communication system, destruction of standing agricultural crops, domestic and wild animals, natural vegetation, private and public institutions etc. Through damages caused by high velocity winds, floods and storm surges.

ANTICYCLONES

General Characteristics

Surrounded by circular isobars anticyclone is such a wind system which has highest air pressure at the centre and lowest at the outer margin and winds blow from the centre outward in clockwise direction in the northern hemisphere and anticlockwise in the southern hemisphere fig.13. Thus, anticyclones are high-pressure systems and more common in the subtropical high pressure belts but are practically absent in the equatorial regions. Anticyclones were classified into (*i*) **warm anticyclones**, and (*ii*) **cold anticyclones** by Hanzilk in 1909.

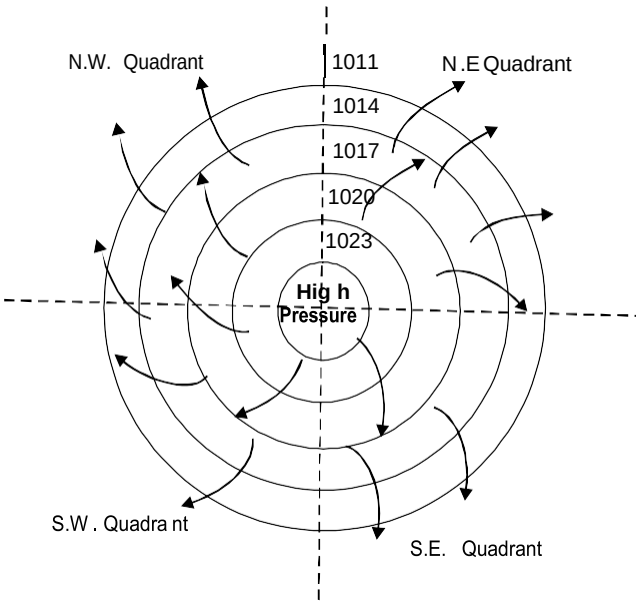

Figure: Generalized representation of air pressure and wind system in an anticyclone.

They are characterized by the following properties.

(1) They are usually circular in shape. The difference of pressure between the centre and periphery of anticyclone ranges between 10-20 mb.

(2) They are much larger in size and area than temperate cyclones.

(3) Anticyclones follow cyclones. They move very sluggishly. The average velocity of anticyclones is 30-50 km per hour.

(4) Winds descend from above at the centre and thus weather becomes clear and rain less because the descending winds cause atmospheric stability.

(5) Temperature in anticyclones depends on weather, nature of air mass and humidity in the air.

(6) Anticyclones do not have fronts.

1. Wind Systems and Temperature

Wind system is not fully developed in anticyclones because of weak pressure gradient. On an average, wind circulation is of divergent system wherein winds spread in all directions from high- pressure centre to low-pressure periphery. The winds are very much sluggish in the rear portion in comparison to the front portion. The centre is characterized by light breeze.

These arise due to the descent of either polar cold air mass or warm tropical air mass. Cold anticyclones are associated with extremely low temperature and they cause cold waves during winter season but when they come in summer season, weather becomes pleasant.

2. Shapes and Size

Anticyclones are generally of circular shape but are very large in size. They become so large in size that their diameters become 9,000 km.

3. Weather Conditions

Generally, anticyclones are rainless and sky is free of clouds because of the fact that descending air in the centre of anticyclone is warmed up at dry adiabatic rate due to subsidence. This causes rise in temperature, which reduces normal lapse rate of temperature, with the result the stability of air increases resulting into marked increase in the aridity of air. This is why anticyclones are indicative of dry weather.

4. Landslides

Among physiographic units, the two northern units of the Greater Himalayas (7500- 8500m), and the Inner Himalayas (Trans-Himalayan zone), an intervening system of high plateau and valleys lying between the two great mountain ranges, are considered along with middle mountains, the traditional centres of population. The upper northern section of these middle mountains remains largely‘ under upper montane forest (2900-4000 m), below which is the belt of intensive agriculture. Lithology is highly varied, including sedimentary, metamorphism, and granites. However, there are extensive areas of phyllites and schists; these are deeply weathered and the prevailing steep slopes render them highly susceptible to erosion and slope failure (mostly through landslides). Presently, according to gross yet reliable estimate, the landslides occupy about 1% of land surface in only five central districts of Himachal Pradesh. They have a total volume of more than 2.2 x 106 m^3 and a mean age of 6.5 years.

This helps to evaluate the denudation rate, which is about 12 mm/year (all erosive processes). Landslides have about 2.5-mm/ year denudation rates. One of the main causes of landslides is road construction.

ENVIRONMENTAL MOVEMENT

An environmental movement can be defined as a social or political movement, for the conservation of environment or for the improvement of the state of the environment. The terms _green movement‘ or _conservation movement‘ are alternatively used to denote the same.

The environmental movements favour the sustainable management of natural resources. The movements often stress the protection of the environment via changes in public policy. Many movements are centred on ecology, health and human rights.

Major Environmental Movements in India

1. .Bishnoi Movement

- Year: 1700s
- Place: Khejarli, Marwar region, Rajasthan state.
- Leaders: Amrita Devi along with Bishnoi villagers in Khejarli and surrounding villages.
- Aim: Save sacred trees from being cut down by the king‘s soldiers for a new palace.

Amrita Devi, a female villager could not bear to witness the destruction of both her faith and the village‘s sacred trees. She hugged the trees and encouraged others to do the same. 363 Bishnoi villagers were killed in this movement. The Bishnoi tree martyrs were influenced by the teachings of Guru Maharaj Jambaji, who founded the Bishnoi faith in 1485 and set forth principles forbidding harm to trees and animals. The king who came to know about these events rushed to the village and apologized, ordering the soldiers to cease logging operations. Soon afterwards, the maharajah designated the Bishnoi state as a protected area, forbidding harm to trees and animals. This legislation still exists today in the region.

2. Chipko Movement

- Year: 1973
- Place: In Chamoli district and later at Tehri-Garhwal district of Uttarakhand.
- Leaders: Sundarlal Bahuguna, Gaura Devi, Sudesha Devi, Bachni Devi, Chandi Prasad Bhatt, Govind Singh Rawat, Dhoom Singh Negi, Shamsher Singh Bisht and Ghanasyam Raturi.
- Aim: The main objective was to protect the trees on the Himalayan slopes from the axes of contractors of the forest. Mr. Bahuguna enlightened the villagers by conveying the importance of trees in the environment which checks the erosion of soil, cause rains and provides pure air. The women of Advani village of Tehri-Garhwal tied the sacred thread around trunks of trees and they hugged the trees, hence it was called _Chipko Movement‘ or _hug the tree movement‘. The main demand of the people in these protests was that the benefits of the forests (especially the right to fodder) should go to local people. The Chipko movement gathered momentum in 1978 when the women faced police firings and other tortures. The then state Chief Minister, Hemwati Nandan Bahuguna set up a committee to look into the matter, which eventually ruled in favor of the

villagers. This became a turning point in the history of eco-development struggles in the region and around the world.

3. Save Silent Valley Movement

- Year: 1978
- Place: Silent Valley, an evergreen tropical forest in the Palakkad district of Kerala, India.
- Leaders: The Kerala Sastra Sahitya Parishad (KSSP) an NGO, and the poet-activist Sughathakumari played an important role in the Silent Valley protests.
- Aim: In order to protect the Silent Valley, the moist evergreen forest from being destroyed by a hydroelectric project.

The Kerala State Electricity Board (KSEB) proposed a hydroelectric dam across the Kunthipuzha River that runs through Silent Valley. In February 1973, the Planning Commission approved the project at a cost of about Rs 25 crores. Many feared that the project would submerge 8.3 sq km of untouched moist evergreen forest. Several NGOs strongly opposed the project and urged the government to abandon it. In January 1981, bowing to unrelenting public pressure, Indira Gandhi declared that Silent Valley will be protected. In June 1983 the Center re-examined the issue through a commission chaired by Prof. M.G.K. Menon. In November 1983 the Silent Valley Hydroelectric Project was called off. In 1985, Prime Minister Rajiv Gandhi formally inaugurated the Silent Valley National Park.

Environmental Ethics

Environmental ethics is the part of environmental philosophy which considers extending the traditional boundaries of ethics from solely including humans to including the non-human world.

Role of Indian Culture & Religion in the Environmental Conservatism

The plant species saved from centuries by primitive people for their use in variety of rituals, ceremonies, cults, taboos and beliefs are broadly categorized as:

(i) Conserving plants through social and religious (Sacred) ceremonies, cults and belief.

(ii) Conserving plants through astrological practices and others.

Conserving plants through social and religious (Sacred) ceremonies, cults and belief

- Large number of trees, shrubs and herbs are conserved in many sacred groves and other places for their religious and cultural importance viz. Saraca Asoka, Ficus religiosa, Aeglee marmelos, Musa paradissiaca, Mangifera indica, Cannabis sativa, Terminalia arjuna, Coccos nucifera, Sesbaia grandiflora etc.
- Psychoactive plants contain Psychotropic chemical substance that crosses the blood-brain barrier and acts primarily upon the central nervous system where it affects brain function, resulting in changes in perception, mood, consciousness, cognition, and behavior.
- Plants conserved for magical healing: Thousands of years ago magical and mystical powers were ascribed to certain plants. It is no wonder, since today we still turn to plants for food, shelter, clothing, weapons, and even healing. Mangifera indica Saraca Asoka.

Conserving plants through astrological practices and others.

- Psychoactive plants used in tantra: The term ―tantra‖ refers to a great many religious practices and beliefs.
- It is so difficult to define, that some religious historians argue the word has little meaning other than to mark extreme or taboo practices (Urban, 2003).
- Conserving plants through Vastu Shastra: Vastu Shastra being an ancient science deals with position of diff rent rooms in residential buildings, factories and industries.
- Vastu can be applied on flowers and plants in the house. The plants play significant role in activating positive energy to our day to day life.

QUESTION BANK

	PART – A
1	List any two factors to control population growth
2	Define population age distribution
3	Define population density
4	Define biotic potential
5	Define sex ratio
6	Define the total fertility rate of a population

	PART-B
1	Explain the role of Indian culture and religion in the environmental conservatism
2	Explain the different types of flood
3	List and classify earthquakes
4	Explain the causes of earthquakes
5	Distinguish A shaped and S shaped population growth curve
6	Human population growth: Impacts on environment, human health and welfare. Explain
7	List and explain the measures to control over population
8	Explain environment and human health
9	Explain resettlement and rehabilitation of people

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