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Part I (D)- Paper - I

ENVIRONMENTAL STUDIES

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UNIT-I

INTRODUCTION OF ENVIRONMENTAL STUDIES

1.1 Introduction:

The word environment is derived from the French word "environneer" which means to encircle or surround. All the biological and non biological things surrounding an organism are included in environment. As per Environmental Protection Agency 1986, Environment includes all the physical and biological surroundings of an organism along with their interactions. Environment is defined as *"the sum total of water, air, land and the inter-relationships that exist among them and with the human beings, other living organisms and property or materials."*

1.2 Components of Environment:

The environment is composed of four important components namely Atmosphere, Hydrosphere, Lithosphere and Biosphere.

Atmosphere:

The important component of the environment is the atmosphere that surrounds us. The atmosphere may be divided in to four regions namely:

Troposphere: It surrounds us on the earth up to a height of around 10-15 kilometers. The troposphere contains a mixture of gases of varying composition, mainly consisting of Nitrogen 78%, Oxygen 20%, Argon 0.9%, Carbon dioxide 0.03% and other gases such as helium, hydrogen etc.

Stratosphere: The layer of atmosphere above the troposphere is called Stratosphere. It consists of a thick blanket of ozone stretched to a length of about 40-50 kilometers. This layer is also called ozonosphere. It protects all the living beings on earth from the dangerous ultraviolet rays (UV Rays) emitting from the sun. Ozone in the ozone layer absorbs the ultraviolet radiation.

Mesosphere or Ionosphere: The layer of atmosphere up to about 90-100 KM. above the ozonosphere is called the Ionosphere. It is named so because any neutral atom or molecule is stripped off its electron by the ultraviolet rays to from ions here. The temperature in the Ionosphere is very low and goes down to about (-) 1100^0 C.

Thermosphere: The region above the Ionosphere is called Thermosphere, rightly so as the temperature in this zone increases gradually up to 1200^0 C above 100 KM. The region above the thermosphere is called Exosphere.

Hydrosphere:

Hydrosphere forms a very prominent part of the environment as water is an essential item required for all the living beings. Three

fourth of the earth is covered with water in the form of oceans contain 35% of dissolved salts is mainly Sodium Chloride. Scientists have established that "life" originated in the oceans. Oceans play an important in maintaining the water cycle (Hydrological Cycle) of the earth.

Lithosphere:

The earth we live on forms the Lithosphere. More precisely the solid outer layer of earth is called Lithosphere. It is somewhat loose in texture and acts as the main source of nutrients for plants that grow on it. The composition of top soil is as follows. Inorganic salts and oxy salts such as sulphates, silicates, carbonates etc-60%, organic matter in the form of putrefied plants, animal products -30%, water-5%, air- 5%. The top soil alone is suitable for the growth of plants and for agriculture. The diameter of the earth we live on is 12,756K.M.

Biosphere:

All the living organisms of plant and animal origin constitute the Biosphere. Besides these two, the Biosphere also contains very small living organisms invisible to naked eye called the microbes. There are more than one million known animal species on the earth. Similarly there are more than one lakh plants species. Biosphere maintains the oxygen cycle, Carbon dioxide cycle and Nitrogen cycle constant i.e. Biosphere helps to maintain the quantities of Nitrogen (78%), Oxygen (21%), and Carbon dioxide (0.03%) constant in the atmosphere. For example: Animals and plants utilize the oxygen in the respiration process where organic wastes are oxidized to carbon dioxide. Plants also take part in the photosynthesis in which carbohydrates are produced by the reaction between carbon dioxide and water in the presence of

sunlight and chlorophyll. As explained above the four components of the environment thus play an important role in serving for the sustenance of life on the earth and help for the well being of man. Any damage to the balance of these four components destroys the nature. The responsibility new rests on man who is intelligent and judicious to restore and maintain the ecological balance and preserve life on the unique planet.

Keeping in view the complex nature of environment, knowledge inputs from various disciplines of science, social science, law, engineering, economics, education, management and mass communication are included in environmental studies. Environmental studies, therefore, is a multi-disciplinary subject where we deal with different aspects using a holistic approach.

- For understanding the physical and chemical structure of a biotic component of environment along with mass and energy transfers we have to make use of the basic concepts of physics, chemistry, geology, atmospheric sciences, oceanography and geography.
- Life sciences including botany, zoology, microbiology, genetics, and biochemistry help in understanding the biotic components and their interactions.
- Genetics and biotechnology are emerging as useful tools for finding remedy to environmental problems. A synthesis of civil engineering, hydraulics, chemical engineering, information technology, mechanical engineering and nanotechnology provide the technical solutions to environmental pollution

control, waste treatment and disposal that are extremely important for protection of the environment.

- Mathematics, statistics, computer science likewise serve as effective tools in environmental modeling. Subjects like economics, management and sociology provide the inputs for dealing with the socio-economic aspects associated with various developmental activities.
- Environmental laws provide the guide lines and legal measures for effective management and protection of the environment.
- Environmental education and mass communication are two important subjects that are instrumental in disseminating environmental awareness.

1.4 Scope of Environmental Studies:

Scope of environmental studies is broad based and it encompasses a large number of areas and aspects, broadly listed below.

- Natural resources their conservation and management
- Ecology and bio-diversity
- Environmental pollution and control
- Social issues in relation to development and environment
- Human population and environment
- Economy and environment
- Institutions and Governance

These are the basic aspects of environmental studies, which have a direct relevance to every section of the society. Environmental studies can be highly specialized, which may concentrate on more technical aspects like Environmental Sciences, Environmental Engineering, Environmental Management, Environmental Biotechnology etc.

1.5 Importance of Environmental Studies:

Environmental studies is very important science it deals with the most worldly issues like safe and clean drinking water, hygienic living conditions, clean and fresh air, fertile land, healthy food and development, that is essential for sustainable life of the man. There is a need for trained man power at every level to deal with environmental issues. Environmental law, business administration and environmental engineering and emerging as new career opportunities for environmental protection and management. With the pollution control laws becoming more stringent, industries are finding it difficult to dispose of the produced wastes. In order to avoid expensive litigation various companies are now trying to adopt green technologies (eco-friendly), which would reduce pollution. In India the pollution control boards are seriously implementing pollution control laws and insisting on up gradation of effluents to meet the prescribed standards before they are discharged on land or in to a water body. This is in fact essential if we want to live in a clean, healthy, and aesthetically beautiful, safe and secure environment for a long time and wish to hand over a clean and safe earth to our children, grand children and great grand children.

1.6 Need of Public Awareness

Students and the educated people should make the illiterate public to understand about the dangers of polluting the environment and strive to provide the living beings with a friendly environment and problem free ecosystem. The following are certain Do's and Don'ts for the public to live in pollution free environment. There are reasons for all these Do's and Don'ts.

Do's: (i.e. what to do)

- Grow as many green plants as possible.
- Use water in an economical manner.
- Educate the farmers about the judicious use of fertilizers, pesticides and chemicals.
- Prevent soil and air pollution.
- Protect natural water resources like lakes, rivers and ponds.
- Conserve forests and wild life.
- Use Eco-friendly materials.
- Reduce the usage, reuse, and repair and recycle materials for better environment.
- Be a responsible citizen give respect to environmental laws.

Don'ts: (i.e. what not to do)

- Resort to cutting of trees and deforestation.
- Do not waste water especially drinking water.
- Do not dump pesticides and poisonous chemicals in dwelling places.
- Do not abuse fire, electricity and other important forms of energy.
- Proper care should be taken to prevent the spread of communicable and infectious diseases among public.
- Do not pollute lakes, rivers and soil with industrial wastes.
- Do not pollute the environment by the abuse of vehicles with smoky exhausts and unbearable noise from the engines.
- Do not use Ozone Depleting Sprays (or) Aerosols (or) Chemicals.
- Do not obstruct the drains by dumping your domestic waste.

- Do not pollute your surroundings by burning plastic, rubber and other toxic materials.

1.7 Institutions Related to Environment:

There are several Institutions act as a very important role in the environmental protection. They are:

Bombay Natural History Society (BNHS):

BNHS was established in the year 1983 located at Mumbai in Maharashtra. It grew in to an important research organization that substantially influences conservation policy in the country. Its influence on wildlife policy building, research, popular publications and people's action has been a unique feature of the multifaceted society. Undoughtedly its major contribution has been in the field of wildlife research.

Centre for Environmental Education (CEE):

CEE was established in the year 1989 located at Ahmadabad in Gujarat. It has a wide range of programs on the environment and produces a variety of educational material. CEE's Training in Environmental Education (TEE) program has trained many environmental educators.

Wildlife Institute of India (WII):

WII was established in the year 1982 located at Dehradun in Uttarkhand as major training establishment for forest officials and also for research in wildlife management. The organization has over the years added an enormous amount of information on India's biological wealth. It also has an Environmental Impact Assessment (EIA) cell. It trains personnel in eco development, wildlife biology, habitat management and nature interpretation.

Botanical Survey of India (BSI):

BSI was established in the year 1980 located at Royal Botanical gardens, Calcutta in West Bengal. However the functions of BSI have started long back ago, due to some reasons it is closed down and reopened. The main function of BSI conservation and protection of all types of flora in India. The BSI currently has nine regional centers. It carries out surveys of plant resources in different regions of India.

Zoological Survey of India (ZSI):

ZSI was established in the year 1916 located at Calcutta in West Bengal. Its mandate was to do a systematic survey of fauna in India. It has over the years collected "type specimens" on the basis of which our animal life has been studied over the years. The older collections of Indian museum as well as Asiatic society of Bengal were then transferred to the ZSI. Today, it has over a million of specimens. This makes it one of the largest collections in Asia. It has done an enormous amount of work on taxonomy and ecology. It currently operates from 16 regional centers.

1.8 Famous Personalities in Environment:

Salim Ali:

He was a famous Ornithologist. He was born on 12th November 1896 at Bombay, Maharashtra. The name is synonymous with ornithology in India and with the BNHS. He also wrote several great books including the famous "Book of Indian Birds". His autobiography, "Fall of a Sparrow" should be read by every nature enthusiast. He was our countries leading conservation scientist and influenced environmental policies in our country for over 50 years. He was died in 20th June 1986.

Indira Gandhi:

She was born on 19th November 1917 at Allahabad, Uttar Pradesh. She was one and only lady Prime Minister in our Country. She was played a very significant role in the preservation of India's wildlife. It was during her period as PM, that the net work of Protected Areas (PAs) grew from 65 to 298. The wildlife protection act 1971 was formulated during the period when she was PM and the Indian Board for Wildlife was extremely active as she personally chaired all its meetings. India gained a name for itself by being a major player in CITES (Convention on International Trade of Endangered Species) and other international environmental treaties and accords during her tenure. BNHS frequently used her good will to get conservation action initiated by the government. She was died in 31st October 1984.

M.S. Swaminathan:

His full name was Mankombu Sambasivan Swaminathan. He was born on 7th August 1925 Madras Tamil Nadu. He was father of green revolution in India. He is one of the India's foremost agricultural scientists and has also been concerned with various aspects of biodiversity conservation both of cultivars and wild biodiversity. He has founded the "MS Swami Nathan Research Foundation" in Chennai, which does work on the conservation of biological diversity.

Medha Patkar:

She was born on 1st December 1954 at Bombay, Maharashtra. She is known as one of the rural India's champion's, has supported the cause of the downtrodden tribal people whose environment is being affected by the dams on the Narmada River.

Sunderlal Bahuguna:

He was born on 9th January 1927 at Maroda village in Uttar Pradesh. He is one of the famous environmental activists and his Chipco-movement has become an internationally well known example of a highly successful conservation action program, through the efforts of local people for guarding their forest resources. High fight to prevent the construction of Tehri dam in a fragile earthquake prone setting is a battle that he continues to wage. The garhwal hills always remember his dedication to the cause for which he has walked over 20,000 kms.

M.C. Mehta:

His full name was Mahesh Chandra Mehta. He was born on 12th October 1946 Rajouri District in Jammu and Kashmir. He is undoughtedly India's famous environmental lawyer. Since 1984 he has filed several PIL's (Public Interest Litigation cases) for supporting the cause of environmental conservation. His most famous and long drawn battles supported by the Supreme Court include protecting the Tajmahal, cleaning up the Ganga River, banning intensive shrimp farming on the coast, initiating the government to implement environmental education in schools & colleges, and a variety of other conservation issues.

1.9 Sustainability and Sustainable Development:

1987 the World Commission (Brundtland Commission) on Environment and Development sought to address the problem of conflicts between environment and development goals by formulating a definition of sustainable development.

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

There has been a growing recognition of three essential aspects of sustainable development.

1. Economic Sustainability.
2. Environmental Sustainability.
3. Social Sustainability.

1. Economic Sustainability: An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government and external debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.

2. Environmental Sustainability: An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.

3. Social Sustainability: A socially sustainable system must achieve fairness in distribution and opportunity, adequate provision of social services including health and education, gender equity, and political accountability and participation.

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UNIT II

ECOSYSTEMS

2.1 Introduction:

The word Ecosystem was first proposed by A.G. Tansley (1935) and considered it as the living world and its habitat. Ecosystem is the basic functional unit of ecology, which we deal since it includes both biotic (the organisms) and abiotic environment (non living). "Ecosystem is nothing but the Interrelation between living and non living components or biotic and abiotic components in environment." These two components influence each other's properties. This is necessary for maintenance of live, there is a continuous interaction among plants, animals and their environment to produce and exchange materials. The term Ecology was first coined by Earnst Hackel in 1869. Modern emphasis to define ecology is the study of the structure and functions of the nature. New ecology is often defined as the study of ecosystems.

2.2 Types of Ecosystems:

Different types of ecosystems of nature, constituting the giant ecosystem- the biosphere. They are as follows.

Natural ecosystems: These operate by themselves under natural conditions without any major interference by man. Based upon on the particular kind of habitat, these are further divided as:

- Terrestrial ecosystems: All types of land related ecosystems are also called as terrestrial ecosystems.Ex. Forest, grassland, deserts etc.
- Aquatic (water open) ecosystems: All types of water related ecosystems are also called as aquatic ecosystems. These are further divided into two types:
- Fresh water ecosystem: Ex. Lakes, Ponds, Rivers.
- Salt water ecosystem: Seas and deep oceans and estuary etc.

Artificial (man-engineered) ecosystems: These are maintained artificially by man where, by addition of energy and planned manipulations, natural balance is disturbed regularly. For example: Deforestation for agriculture croplands like maize, wheat, rice fields etc. The other man made systems is by dam construction there by water is stored in big reservoirs and man tries to control the biotic community as well as physicochemical environment. Some other man made ecosystems are space ecosystem, microorganisms etc.

2.3 Structural Aspects of Ecosystem:

Structural aspects are mainly divided into two types----

1. Components of Ecosystem
2. Ecological Pyramids

1. Components of Ecosystem:

Ecosystem is composed of two types of components namely abiotic components and biotic components

a. Abiotic Components

The Abiotic Components include physical and chemical components and basic inorganic and organic compounds of the environment.

Physical Components: The climate, temperature, light, wind humidity, rainfall and soil etc., are physical components of the ecosystem.

Chemical Components: These are mainly two types---

Inorganic Components: The inorganic components of an ecosystem are as under carbon dioxide, water, nitrogen, calcium, and phosphate. All of these are involved in matter cycles (biogeochemical cycles).

Organic Components: The organic components of an ecosystem are proteins, carbohydrates, lipids and amino acids. *etc.*

b. Biotic Components

The biological components of an ecosystem include both living organisms and products of those organisms. Thus microbes, all categories of plants and animals are included in the ecosystem. The biotic components are broadly categorized as producers, consumers and decomposers.

Producers: They are autotrophic organisms, largely green plants which are able to synthesize their own food materials from simple inorganic substances by utilizing solar energy. Ex: green plants, phytoplankton etc.

Consumers: These are heterotrophic organisms, chiefly animals, which ingest other organisms or autotrophs. They are three type:

Primary Consumers: More commonly they are referred to as herbivores. They are heterotrophs that derive nutrition directly from plants. Ex: Grass hopper, Sheep.

Secondary Consumers: They are also called primary carnivores. They are heterotrophs deriving their energy indirectly from the producers by the way of the herbivores. Ex: Frog, Snake

Tertiary Consumers: They are also called secondary carnivores that feed on secondary consumers. Ex: Lion and Tiger.

Decomposers: There are the micro organisms including fungi, bacteria, virus and actionomycetes.

2. Ecological Pyramids:

The word ecological pyramid was first used by Charles Elton in 1927 because ecological pyramids are also called as Eltonian Pyramids. Ecological pyramids are the graphic representation of trophic structure and function of an ecosystem, starting with producers at the base and successive trophic levels forming the apex are knows as an ecological pyramid. Ecological pyramids are of three types.

Pyramid of Numbers: It shows the number of individual organisms at each level,

Pyramid of Energy: It shows the rate of energy flow and/or productivity at successive trophic levels.

Pyramid of Biomass: It is based upon the total biomass (dry matter) at each trophic level in a food chain.

Pyramid of Numbers: The pyramids of numbers show the relationship between producers, herbivores and carnivores at successive trophic levels in terms or their numbers. In grassland the producers, which are mainly grasses, are always maximum in number. This number shows a decrease towards apex, the reason is obvious, number than the grasses. The secondary consumers, snakes and lizards are less in number than

the rabbits and mice. In the top (tertiary) consumers hawks or other birds, are least in number. In this way the pyramid becomes upright.

Pyramid of Energy: The energy pyramid gives the best picture of overall nature of the ecosystem. Here, number and weight of organisms at any level depends on the rate at which food is being produced. It is always upright in shape. At every successive trophic level, there is a huge loss of energy about 90% in the form of heat, respiration etc. Thus, at each next higher level only 10% of the energy passes on. Hence, there is a sharp decline in energy level of each successive trophic level as we move from producers to top carnivores. Therefore the pyramid of energy is always upright.

Pyramid of Biomass: The pyramid of biomass can also be upright or inverted. The pyramid of biomass shows the relationship of population supported at each successive trophic level in terms of real mass of the standing crop that is the quantative relationship of the standing crop. The pyramids of biomass in different types of ecosystem may be compared as under. In grassland and forest there is generally a gradual decrease in biomass of organisms at successive levels from the producers to the top carnivores. In this way, the pyramids are upright.

2.4 Functional Aspects of Ecosystem:

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

1. Food Chain
2. Food Web
3. Energy flow in Ecosystem

1. Food Chain:

The sequence of eating and being eaten in an ecosystem is known as food chain. All organisms, living or dead are potential food for some other organism and thus, there is essentially no waste in the functioning of a natural ecosystem.

Grass → Grasshopper→ Frog → Snake →Hawk (Grassland ecosystem) Phytoplankton → Zooplankton → Small fish → Large fish (Pond ecosystem)

Food chains are divided into two types---

Grazing Food Chain: It starts with green plants (primary producers) and culminates in carnivores.

Example: Grass → Grasshopper → Frog → Snake.

Detritus Food Chain: It starts with dead organic matter which the detritivores and decomposers consume. Partially decomposed dead organic matter and even the decomposers are consumed by detritivores and their predators.

- Examples: Leaf litter→ algae→ crabs→ small carnivorous fish→ large carnivorous fish (Mangrove ecosystem) Dead organic matter→ fungi→ bacteria (Forest ecosystem) Both the food chains occur together in. A network of many food chains is called a food web.

2. Food Web:

A food web is a net working of food chains where different types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level. The food web gives several alternatives of feed on. For example the snakes feed on mice as well as the frogs. Mice are herbivores and

frogs are carnivores. Cats feed on mice as well as birds and squirrels. The availability of alternate food sources reduce the pressure on a particular species and give them scope for recovery. Finally the food web thus maintains ecobalance.

3. Energy flow in an Ecosystem:

Energy is necessary for any ecosystem to run. All the biotic components of the ecosystem perform their duties according to the energy they receive. Energy can neither be created nor destroyed. Energy can be transformed from one form to the other form. The flow of energy through various trophic levels in an ecosystem can be explained with the help of two (2) energy flow models.

1. Single channel energy flow model: This flow of energy takes place in a unidirectional manner through a single channel of green plants or producers to herbivores and carnivores. Such a model and illustrated the gradual decline in energy level due to loss of energy at each successive trophic level in a grazing food chain.

2. Double channel or Y- shaped energy flow model: In nature both grazing food chain and detritus food chain operate in the same ecosystem. However sometimes it is the grazing food chain which predominates. It happens in marine ecosystem where primary production in the open sea is limited and a major portion of it is eaten by herbivores marine animals. Therefore, very little primary production is left to be passed on to the dead or detritus compartment. In a forest ecosystem the huge quantity of biomass produced cannot be all consumed by herbivores. Rather a large proportion of the live biomass enters into detritus (dead) compartment in the form of litter. Hence the detritus food chain is more important there. The double

channel or Y-shaped model of energy flow shows the passage of energy through these two chains, which are separated in time and space.

2.5 Ecological Succession:

The change of plant and animal communities in an orderly sequence in an area, resulting in establishment of stable or climax community is called ecological or biotic succession.

Ecological succession is characterized by the following features:

1. It tends to progress from unstable biotic community to stable biotic community, i.e. complete adjustment with the environment.
2. Its several stages are so regular and directional that an ecologist can often predict the sequence of future communities.
3. In successive several stages there is tendency towards increase in species diversity, total biomass, niche specialization and humus content of the soil.
4. It tends to progress from simple food chains to complex food webs.
5. The habitat tends to modify from aquatic or dry conditions to mesic (moderately wet) conditions.
6. Succession of plant and animal communities occurs side by side. However, plant succession is easily visible.

Types of Succession:

Depending upon the nudity of area, biotic succession is of two types – Primary succession and secondary succession.

1. Primary Succession: The biotic succession that occurs on a substratum devoid of earlier life (i.e. bare rock, lava sediment, new island, newly formed pond or lake, etc.) is called primary succession.

The sequence of successional stages of a primary succession is called prisere.Primary succession takes a very long time to reach the climax stage.

2. Secondary Succession: The biotic succession that occurs in an area which have become bare due to destruction of previously existing biotic community by fire, drought, land slide, earthquake etc., is called secondary succession. The sequence of successional stages of secondary succession is called subsere. Secondary succession takes comparatively much less time to reach the climax stage.

Importance of Succession:

The ecological succession is of great practical importance in many activities of man in the following manner:

1. It provides information, which helps to have a controlled growth of one or more species in a forest by preventing the invasion of other species in the area.
2. Pastures can be maintained by not allowing biotic succession to proceed further through grazing or fire.
3. It also helps in reforestation and forest management programmes.

2.6 Major Types of Ecosystems:

Forest Ecosystem:

Forest ecosystem is an important ecosystem. It is a terrestrial or land ecosystem. It is a complex ecosystem with all tall standing trees as the dominant plants and the variety of plants beneath the trees. There is also the presence of animals and birds. Temperate and rainfall determine the forest ecosystem. The forest ecosystem is of great concern from the point of view of environment. The rate of

exploitation of forests by man is increasing day by day. This causes a serious concern to all the nations of the world because of its impact over global climate and on species sources of animals. The forest ecosystem has two components. They are:

1. Abiotic Components.

2. Biotic Components.

1. Abiotic Components: The abiotic components of the forest ecosystem include inorganic and organic substances present in the soil and in the atmosphere. Temperature, light, rainfall, soil, minerals, litter etc. are important abiotic factors of forests.

2. Biotic Components: The biotic components of the forest ecosystem are mainly trees of many species. Besides trees, there are also shrubs and ground vegetation. In the forest ecosystem, there are:

a. Producers

b. Consumers

c. Decomposers

a. Producers: In the forest ecosystem, the major producers are trees of different species. The other producers are shrubs and undergrowth.

b. Consumers: The consumers are of three (3) types. They are:

i. Primary Consumers

ii. Secondary Consumers

iii. Tertiary Consumers

i. Primary Consumers: The primary consumers are the smaller herbivores or animals feeding on tree leaves, such as ants, flies, beetles. Leafhoppers, bugs, spiders, etc. and the larger animals grazing on leaves, shoots and fruits, such as elephants, deers, moles. Flying foxes, mongooses, etc.

ii. Secondary Consumers: The secondary consumers are the carnivores like snakes, birds, lizards, foxes, etc. feeding on herbivores.

iii. Tertiary Consumers: The tertiary consumers are the top carnivores like lions, tigers, etc. that eat carnivores of the secondary consumer level.

c. Decomposers: The decomposers are many varieties of micro-organisms, such as fungi, bacteria, virus and worms, etc.

Grassland Ecosystem:

Grassland ecosystem comprises different types of grasses with a little amount of shrubs and a few trees. But the main vegetation of the grassland ecosystem is grass. Many grazing animals or herbivores and insects are found in the grassland ecosystem. The edaphic conditions of grassland ecosystem do not permit the growth of trees. That is why; there are very few trees in the ecosystem. A grassland ecosystem is a luxuriant growth of grasses. The grassland ecosystem is found in tropical and temperate regions of the world. The grassland ecosystem has two components. They are:

1. Abiotic Components.
2. Biotic Components.

1. Abiotic Components: The abiotic components are the inorganic and organic substances present in the soil and in the atmosphere. In addition to minerals, some organic materials are also present.

2. Biotic Components: The biotic components comprise three (3) types they are:

a. Producers

b. Consumers

c. Decomposers

a. Producers: The producers include grasses and a few herbs and shrubs.

b. Consumers: The consumers include three (3) types

i. Primary Consumers

ii. Secondary Consumers

iii. Tertiary Consumers

i. Primary Consumers: Primary Consumers include animals feeding on grasses like cows, buffaloes, sheep, deer, etc.

ii. Secondary Consumers: The secondary consumers include carnivores like snakes. Lizards fox, etc, feeding on herbivores.

iii. Tertiary Consumers: Tertiary consumers include top carnivores like fox, lion, tiger, etc. feeding on secondary consumers.

c. Decomposers: The decomposers include wide variety of micro-organisms including fiungi, algae, bacteria, etc. they decompose the dead organic matter and help to bring minerals back to the soil.

Desert Ecosystem:

Desert ecosystem occurs in regions of very high temperature and very low rainfall. Desert ecosystem occupies a greater part of the land. Due to high temperature and low availability of water, desert ecosystem is poorly represented by flora and fauna. In the desert ecosystem, soils contain very little organic matter. Desert ecosystem is present in regions where the animal, rainfall is less than 25 cm and the temperature is very high, Sahara desert in Africa, Thar Desert in India, etc. About 17% of the total land area of the worlds is under desert ecosystem. The desert ecosystem has two components. They are:

1. Abiotic Components.

2. Biotic Components.

1. Abiotic Components: The abiotic components comprise organic substances poorly present.

2. Biotic Components: The biotic components include:

a. Producers

b. Consumers

c. Decomposers

a. Producers: The producers cover desert shrubs, some grasses and very few trees. There are three life forms of plants adapted to desert conditions. They are: The annuals which grow only when there is adequate moisture. The succulents, such as the cacti which have high capacity to store water the desert shrubs which have numerous branches and a special root system which help them to adapt to desert conditions.

b. Consumers: The consumers comprise desert animals. Camels and goats are the important desert animals. Apart from camels and goats, insects, reptiles, etc. are also found.

c. Decomposers: The decomposers are fungi and bacteria. The consumers are very few due to scarcity of flora and fauna.

Pond Ecosystem:

Pond ecosystem is an aquatic ecosystem. It is a fresh water ecosystem. It is a good example of small, self-sufficient and self-regulating ecosystem. It is a simple aquatic ecosystem. The location, size, depth and the substratum of a pond influence the pond ecosystem. The components of the pond ecosystem can be divided into two categories. They are:

1. Abiotic Components.

2. Biotic Components.

1. Abiotic Components: The chief abiotic components or substratum are temperature, water, light and several inorganic and organic substances. Water provides the medium for the survival of aquatic organisms. Water also provides dissolved gases and nutrients for plants and animals. The bottom soil provides substrata for the microbes and decomposers. Sunlight penetrates fairly deep into the pond water, depending upon the turbidity, and provides energy for photosynthesis. Organisms of the pond depend on the dissolved oxygen in water for respiration.PH of the water is a crucial factor for the survival of the aquatic organisms. Some proportions of nutrients are in solution state. But most of them are present stored in particulate matter as well as in living organisms.

2. Biotic Components: The biotic components of a pond comprise the various organisms of the pond. The biotic components of a pond are ecologically classified into three groups. They are:

a. Producers

b. Consumers

c. Decomposers

a. Producers or Autotrophs: Producers are the green plants categorized into two types. Viz, Macrophytes and Phytoplankton.

i. Macrophytes: Macrophytes are rooted larger plants, submerged, free floating and amphibious plants.

ii. Phytoplankton: Phytoplankton's are minute floating or suspended lower plants which belong to algae and flagellates.

b. Consumers: The consumers are of three types. They are:

i. Primary Consumers

ii. Secondary Consumers

iii. Tertiary Consumers

i. Primary Consumers: Primary consumers are zooplanktons and benthos or bottom forms. Zooplanktons are animals that drift with water currents and are found along with phytoplankton. They feed on phytoplankton. Benthos or bottom forms comprise the bottom-dwelling animals which feed on plants directly or on plant remains at the bottom.

ii. Secondary Consumers: Secondary consumers are the carnivores which feed on the herbivores. They include insects, fish and frogs.

iii. Tertiary Consumers or Top Consumers: Tertiary consumers or top consumers are some large fish, such as game fish which feed on smaller fish.

c. Decomposers: Decomposers are the several aquatic bacteria, fungi, etc. that are distributed throughout the pond. They decompose plants and animals. They play an important role in the return of mineral elements, i.e., the nutrients, back into the ecosystem.

Estuarine Ecosystem:

An estuary is a semi-enclosed coastal body of water connected on the one side with open sea and with freshwater river on the other side. It is transition zone which is strongly affected by tidal action, and within this zone, sea water is mixed with fresh water from river. An estuary is highly productive and offer high food potential for human beings due to the nutrient and energy inputs from both sea water and river water.The components of an estuarine ecosystem are:

1. Abiotic Components
2. Biotic Components

1. Abiotic Components: These are Inorganic and Organic substances in the soil and water.

2. Biotic Components: The biotic components of an estuarine ecosystem are:

a. Producers

b. Consumers

c. Decomposers

a. Producers: The producers are macrophytes (i.e., maish, grasses, sea, webs, sea grasses, benthic algae and phytoplankton)

b. Consumers: The consumers are oysters, crabs, several kinds of shrimp and many commercial sport fish.

c. Decomposers: The decomposers are micro-organisms like bacteria, virus and fungi.

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UNIT-III

NATURAL RESOURCES

3.1 Introduction

3.2 Land Resources

3.3 Land degradation

3.4 Soil Erosion

3.5 Desertification

3.6 Forest Resources

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3.13 Conflicts over Water

3.14 Energy Resources

3.15 Renewable Energy Resources

3.16 Non - Renewable Energy Resources

3.17 Use of alternate Energy Resources

3.18 Growing Energy Needs

3.1 Introduction:

Life on this planet earth depends up on a variety of goods and services provided by the mother earth, which are known as Natural resources. There are two parts of the word 'Resource' – Re and source. Re means certain duration or again and again while the meaning of source is means. Thus, 'Resource' means such source on which we can keep ourselves dependent. Thus water, air, soil, minerals, coal, forests,

crops and wildlife are all examples of natural resources. Any stock or reserve that can be drawn from nature is a natural resource. Anything that can be useful for the development of mankind is said to be a resource and which can be acquired from the nature itself is known as natural resource.

According to P. E. Macnall *"Natural resources may be defined as those resources which are provided by nature and which are useful to men".*

Natural resources are classified in to two (2) types. They are

- Renewable resources.
- Non-Renewable resources.

Renewable Resources: Which are inexhaustible and can be restored within a given period of time e.g. forests, wildlife, wind energy, biomass energy, tidal energy, hydro power, solar energy, geothermal energy, biogas etc. In spite of continuous utilization they can regenerate again and again, such type of resources is called renewable resources.

Non- Renewable Resources: Those resources cannot be regenerated e.g. fossil fuels like coal, petroleum, mineral resources etc. On continuous utilization these resources will not replenish and will diminish at a faster rate while our utilization rate is increases, such type of resources is called non- renewable resources.

3.2 Land Resources: Land resources are very important renewable natural resources.

Land as a Resource:

We depend upon land for our food, fibre, and fuel wood. About 200-1000 years are needed for the formation of one inch or 2.5 cm soil, depending upon the climate and the soil type. But, when rate

of erosion is faster than rate of renewal, then the soil becomes a non-renewable resource.

3.3 Land degradation:

- With increasing population growth the demands for land for producing food, fibre and fuel wood is also increasing.
- Hence there is more and more pressure on limited land resources which are getting degraded due to over-exploitation.
- Soil erosion, water-logging, salinization and contamination of the soil with industrial wastes like fly-ash, press-mud or heavy metals all cause degradation of land.

Land use Change

Various anthropogenic activities like hydroelectric projects, large dams, reservoirs, construction of roads and railway lines, construction of buildings, mining etc are responsible for clearing of large forested areas. Earlier there were few reports of landslides between Rishikesh and Byasi on Badrinath Highway area. But, after the highway was constructed, 15 landslides occurred in a single year.

3.4 Soil Erosion:

Soil erosion is defined as the movement of soil components, especially surface litter and top soil from one place to another.

Soil erosion results in the loss of fertility because it is the top soil layer which is fertile. Soil erosion is basically of two types based upon the cause of erosion:

Normal Erosion or Geological Erosion: This is caused by the gradual removal of top soil by natural processes which bring equilibrium between physical, biological and hydrological activities and maintain a natural balance between erosion and renewal?

Accelerated Erosion or Man-Made Erosion: This is mainly caused by man-made activities and the rate of erosion is much faster than the rate of formation of soil. Overgrazing, deforestation and mining are some important activities causing accelerated erosion

3.5 Desertification:

Desertification is characterized by devegitation and loss of vegetal over, depletion of groundwater, salinization and severe soil erosion. Desertification leads to the conversion of irrigated croplands to desert like conditions in which agricultural productivity falls. Moderate desertification produce 10-25% drop in productivity. Severe desertification cause 25-50% drop while very severe desertification results in 50% drop in productivity.

Causes of Desertification: The major man made activities responsible for desertification are as follows.

Deforestation

- Deforestation means destruction of forests.
- The total forests area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.
- Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.

Overgrazing

- Overgrazing can limit livestock production.
- Over grazing occurs when too many animals graze for too long and exceed the carrying capacity of a grass land area.
- Overgrazing removes the grass cover.

- The humus content of the soil is decreased and it leads to poor, dry, compacted soil.
- The soil roots are very good binders of soil.
- When the grasses are removed, the soil becomes loose and susceptible to the action of wind and water.
- The dry barren land reflects more of the suns heat, changing wind patterns leading to further desertification.

Mining and Quarrying:

- Mining operation requires removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.

3.6 Forest Resources:

- The word forest is derived from the Latin word " Foris" means Outside
- Forests are one of the most important natural resources of the earth.
- Approximately 1/3rd of the earth's total area is covered by forests
- Forest resources play an important role in the economy of any country. It is highly complex, changing environment made up of living and non living things.
- Forest is important to humans and the natural world.

Uses of Forests

Economical Uses (Commercial Uses)

- Man depends heavily on a larger number of plant and animal products from forests for his daily needs.
- The chief product that forests supply is wood, which is used as fuel, raw material for various industries as pulp, paper,

newsprint, board, timber for furniture items, other uses as in packing articles, matches, sports goods etc.

- Indian forests also supply minor products like gums, resins, dyes, tannins, fibers, etc.
- Many of the plants are utilized in preparing medicines and drugs; Total worth of which is estimated to be more than $300 billion per year.
- Many forests lands are used for mining, agriculture, grazing, and recreation and for development of dams.

Ecological Uses:

The ecological services provided by our forests may be summed up as follows:

- **Production of Oxygen**: The main green house gas carbon dioxide is absorbed by the forests as a raw material for photo synthesis. Thus forest canopy acts as a sink for carbon dioxide thereby reducing the problem of global warming caused by green house gas CO2
- **Wildlife Habitat**: Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone.
- **Regulation of Hydrological Cycle**: Forested watersheds act like giant sponges, absorbing the rainfall, slowing down the runoff. They control climate through transpiration of water and seed clouding.
- **Soil Conservation:** Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as wind breakers.

- **Pollution Moderators**: Forests can absorb many toxic gases and can help in keeping the air pure and in preventing noise pollution.

3.7 Deforestation:

- Deforestation means destruction of forests.
- The total forests area of the world in 1900 was estimated to be 7,000 million hectares which was reduced to 2890 million ha in 1975 fell down to just 2,300 million ha by 2000.
- Deforestation rate is relatively less in temperature countries, but it is very alarming in tropical countries.
- Deforestation is a continuous process in India where about 1.3 hectares of forest land has been lost.
- The per capita availability of forest in India is 0.08 hectares per person which is much lower than the world average of 0.8 hectares.
- The presence of waste land is a sign of deforestation in India.

Causes of Deforestation:

Major causes of deforestation are listed below:

- Development projects
- Shifting cultivation
- Fuel requirements
- Construction of dams
- Growing food needs

Consequences of Deforestation:

Some of the effects of deforestation are listed below:

Effect on Climate

- Global warming
- Less rainfall
- Hot climate and others.

Effect on Biodiversity

- Loss of medicinal plants.
- Loss of timber, fuel wood and others.

Effect on Resources

- Loss of land resource
- Loss of soil fertility
- Soil erosion
- Drastic changes in biogeochemical cycles

Effect on Economy

- Increase in medicinal values
- Demand of industrial products and others

Effect on Food

- Loss of fruit production
- Loss of root based foods

3.8 Causes and Impacts of Mining:

- Mining is the process of removing deposits of ores from substantially very well below the ground level.
- Mining is carried out to remove several minerals including coal.
- These mineral deposits invariably found in the forest region, and any operation of mining will naturally affect the forests.
- Mining from shallow deposits is done by surface mining while that from deep deposits is done by sub-surface mining.

- More than 80,000 ha of land of the country is presently under the stress of mining activities.

Impacts of Mining Activity

- Mining operation require removal of vegetation along with underlying soil mantle and overlying rock masses. This results in destruction of landscape in the area.
- Large scale of deforestation has been reported in Mussorie and Dehradun valley due to mining of various areas.
- Indiscriminate mining in Goa since 1961 has destroyed more than 50,000 ha of forest land.
- Mining of radioactive mineral in Kerala, TamilNadu and Karnataka are posing similar threats of deforestation.

3.9 Dams and their Effects on Forests and Tribal People:

- Big dams and river valley projects have multi-purpose uses and have been referred to as "Temples of modern India".
- India has more than 1550 large dams, the maximum being in the state of Maharashtra (more than 600) followed by Gujarat (more than 250) and Madhya Pradesh (130).
- The highest one is Tehri dam, on river Bhagirathi in Uttaranchal and the largest in terms of capacity is Bhakra dam on river Sutlej.

Effects on Tribal people

The greatest social cost of big dam is the widespread displacement of local people. It is estimated that the number of people affected directly or indirectly by all big irrigation projects in India over the past 50 years can be as high as 20 millions. The Hirakud dam, one of the largest

dams executed in fifties, has displaced more than 20,000 people residing in 250 villages.

3.10 Water Resources:

The water is very important for life, because it is vital. The animals or humans drink water because the body needs 75% water to do exercise for example: walk. Water covers 70% of the Earth. Like two thirds parts of the earth. 97.5% of the water on the Earth is salt water, and only 2.5% is fresh water of which slightly over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen fresh water is mainly found as groundwater, with only a small fraction present above ground or in the air.

Uses of Water

- Due to its unique properties, water is of multiple uses for all living organisms.
- Water is absolutely essential for life.
- Most of the life processes take place in water contained in the body.
- Uptake of nutrients, their distribution in the body, regulation of temperature, and removal of wastes are all mediated through water.
- Human beings depend on water for almost every developmental activity.
- Water is used for drinking, irrigation, and transportation, washing and waste disposal for industries and used as a coolant for thermal power plants.
- Water shaped the earth's surface and regulates our climate.

3.11 Over Exploitation of Surface and Groundwater:

- With increasing human population and rapid development, the world water withdrawal demands have increased many folds and a large proportion of the water withdrawn is polluted due to anthropogenic activities.
- Out of the total water reserves of the world, about 97% is salty water and only 3% is fresh water.
- Even this small fraction of fresh water is not available to us as most of it is locked up in polar ice caps and just 0.003% is readily available to us in the form of ground water and surface water.
- When ground water withdrawal is more than its recharge rate, the sediments in the aquifer (a layer of rock that is highly permeable and contains water) get compacted, a phenomenon known as ground subsidence. It results in sinking of overlying land surface. Due to this structural damage in buildings, fracture in pipes etc., occurs.
- Mining of ground water is done extensively for irrigating crop fields. However, excessive mining would cause lowering of water table.
- When excessive irrigation is done with brackish water it raises the water table gradually leading to water-logging and salinity problems.

3.12 Floods and Droughts:

- Heavy rainfall often causes floods in the low-lying coastal areas.
- Prolonged downpour can also cause the over-flowing of lakes and rivers resulting into floods.

- When annual rainfall is below normal and less than evaporation, drought conditions are created.

Causes of Floods and Droughts

- Deforestation, overgrazing, mining, rapid industrialization, global warming etc., have contributed largely to a sharp rise in the incidence of floods.
- Deforestation leads to desertification and drought too. When the trees are cut, the soil is subject to erosion by heavy rains, winds and sun.
- The removal of thin top layer of soil takes away the nutrients and the soil becomes useless.
- The eroded soils exhibit droughty tendency.

Preventive Measures:

- Clear knowledge in control of drought and desertification can be very useful for dealing with the problem.
- Carefully selected mixed cropping helps to optimize production and minimize the risks of crop failures.
- Social forestry and Wasteland development can prove quite effective to fight the problem, but it should be based on proper understanding of ecological requirement and natural process.

3.13 Conflicts over Water:

Indispensability of water and its unequal distribution has often led to inter-state or disputes. Issues related to sharing of river water have been largely affecting our farmers and also shaking our governments. Many countries are engaged in bitter rivalries over this precious resource.In India, water conflicts are still being continues between the states. For Eg.,

- Sharing of Krishna water between Karnataka and Andhra Pradesh.
- Sharing of Siruvani water between Tamil Nadu and Kerala, and others.
- Sharing of Cauvery between Karnataka and Tamil Nadu.

In 1991-1992 due to good monsoon, there was no dispute. In 1995, the situation turned into a crisis due to delayed rains and an expert Committee was set up to look into the matter which found that there was a complex cropping pattern in Cauvery basin. Samba paddy in winter, Kuravai paddy in summer and some cash crops demanded intensive water; thus aggravating the water crisis. Proper selection of crop varieties, optimum use of water, better rationing are suggested as some measures to solve the problem.

3.14 Energy Resources:

An energy resource that is not replaced or is replaced only very slowly by natural processes Fossil fuels are continually produced by the decay of plant and animal matter, but the rate of their production is extremely slow, very much slower than the rate at which we use them. Life on earth depends upon a large number of things and services provided by nature, which are knows as energy resources. Energy Resources are two kinds.

3.15 Renewable Energy Resources:

Which are in-exhaustive and can be regenerated within a given span of time eg. Solar energy, wind energy, tidal energy, hydro energy, biomass energy etc. Solar energy is also a renewable form of energy as it is an inexhaustible source of energy.

Solar Energy:

- Sun releases enormous quantity of energy in the form of heat and light.
- The solar energy received by the near earth space is approximately1.4 kJ/s/m2 known as solar constant.
- Now we have several techniques for harnessing solar energy.
- Solar heat collectors, solar cells, solar cooker, solar water heater, solar furnace and solar power plant are some important solar energy harvesting devices.

Wind Energy:

- The high speed winds have a lot of energy in them as kinetic energy due to their motion.
- Wind energy is very useful as it does not cause any air pollution.
- After the installation cost, the wind energy is very cheap.

Hydro Power:

- The water flowing in a river is collected by constructing a big dam where the water is stored and allowed to fall from a height.
- The blades of turbine located at the bottom of the dam move with the fast moving water which in turn rotates the generator and produces electricity.
- Hydro power does not cause any pollution.
- Hydro power projects help in controlling floods, used for irrigation, navigation etc.

Tidal Energy:

- Ocean tides produced by gravitational forces of sun and moon contain enormous amounts of energy.
- The tidal energy is harnessed by constructing a tidal barrage.

- During high tide, the water flows into the reservoir of the barrage and turns the turbine, which in turn produces electricity by rotating the generators.
- During low tide, when the sea-level is low, the sea water stored in the barrage reservoir flows out into the sea and again turns the turbines.

Geothermal Energy:

- The energy harnessed from hot rocks present inside the earth is called geothermal energy.
- Sometimes the steam or boiling water underneath the earth does not find any place to come out.
- We can drill a hole up to the hot rocks and by putting a pipe in it make the steam or hot water gush out through the pipe at high pressure which turns the turbine of a generator to produce electricity.

3.16 Non - Renewable Energy Resources:

Once we exhaust these reserves, the same cannot be replenished. Even our renewable resources can become non-renewable if we exploit them to such extent their rate of consumption exceeds their rate of regeneration.

Coal:

- Coal was formed 255-250 million years ago in the hot, damp regions of the earth during the carboniferous age.
- The ancient plants along the banks of rivers were buried after death into the soil and due to the heat and pressures gradually got converted into peat and coal over million years of time.

- When coal burnt it produces carbon dioxide, which is a green house gas responsible for causing enhanced global warming.

Petroleum:

- It is the life line of global economy.
- Petroleum is a cleaner fuel as compared to coal as it burns completely and leaves no residue.
- It is also easy to transport and use.
- Crude petroleum is a complex mixture of alkane hydrocarbons.
- Hence it has to be refined by the process of fractional distillation, during which we get large variety of products namely, petroleum gas, kerosene, petrol, diesel, fuel oil, lubricating oil, paraffin wax etc.
- The petroleum gas is easily converted to liquid form under pressure as LPG.

Natural Gas:

- It is mainly composed of methane with small amounts of propane and ethane.
- It is used as a domestic and industrial fuel in thermal power plants for generating electricity.
- It is used as a source of hydrogen gas in fertilizer industry and as a source of carbon in tier industry.
- Natural gas available in three forms: liquefied petroleum gas, compressed natural gas and synthetic natural gas.

Nuclear Energy:

- Nuclear energy is known for its high destructive power.
- Nuclear energy can be generated by two types of reactions:

- Nuclear power is generated using Uranium, which is a metal mined in various parts of the world.
- Nuclear power produces around 11% of the world's energy needs, and produces huge amounts of energy from small amounts of fuel, without the pollution that you'd get from burning fossil fuels.
- Nuclear energy has tremendous potential but any leakage from the reactor may cause devastating nuclear pollution. Disposal of the nuclear waste is also a big problem.

3.17 Use of alternate Energy Resources:

Biomass Energy:

- Biomass is the organic matter produced by the plants or animals which include wood, crop, residues, cattle dung agricultural wastes etc.
- The burning of biogas cause air pollution and produce a lot of ash.
- It is therefore more useful to convert biomass into biogas or bio fuels.

Biogas:

- Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide.
- Biogas is produced by anaerobic degradation of animal wastes in the presence of water.
- Anaerobic degradation means break down of organic matter by bacteria in the absence of oxygen.
- Biogas has many advantages. It is clean, non-polluting and cheap.

- There is direct supply of gas from the plant and there is no storage problem

Bio Fuels:

- Biomass can be fermented to alcohols like ethanol and methanol which can be used as fuels.
- Gasohol is common fuel in Brazil and Zimbabwe for running cars and buses.
- Methanol is very useful since it burns at a lower temperature than gasoline or diesel.
- Due to its high calorific value, hydrogen can serve as an excellent fuel.
- Moreover it is non-polluting and can be easily produced.

3.18 Growing Energy Needs:

Development in different sectors relies largely upon energy. Agriculture, industry, mining, transportation, lighting, cooling and heating in buildings all need energy. With the demands of growing population the world is facing further energy deficit. In developed countries like U.S.A and Canada an average person consumes 300 GJ per year. By contrast, an average man in a poor country like Bhutan, Nepal or Ethiopia consumes less than 1 Giga Jowl (GJ) per year. This clearly shows that our life-style and standard of living are closely related to energy needs.

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UNIT-IV

BIO DIVERSITY AND ITS CONSERVATION

1.1 Introduction:

The word bio diversity was first used by Walter Rosen in 1986. Biodiversity is a compound word derived from 'biological diversity' and therefore is considered to have the same meaning. Biodiversity refers to the variety and variability among all groups of living organisms and the ecosystem complexes in which they occur. Biodiversity is generally described in terms of its 3 fundamental and hierarchically related levels of biological organisms. In the convention of Biological diversity (1992) biodiversity has been defined as the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part.

1.2 Levels / Types of Bio-Diversity:

Bio-Diversity has been classified in to three (3) types they are: Genetic Diversity, Species Diversity and Ecosystem Diversity

Genetic Diversity: Genetic Diversity is the basic source of biodiversity. The genes found in organisms can form enormous number of combinations each of which gives rise to some variability. Genes are the basic units of hereditary information transmitted from one generation to other. When the genes within the same species show different versions due to new combinations it is called genetic variability. For example, all rice varieties belong to the species oryza sativa, but there are thousands of wild and cultivated varities of rice which show variations at the genetic level and differ in their color, size, shape, and nutrient content of the grain.

Species Diversity: Species Diversity is the variability found within the population of a species or between different species of a community. It represents broadly the specie's richness and their abundance in a community.Eg... single celled viruses and bacteria etc. and multi-cellular plants & animals.

Ecosystem Diversity: This is the diversity of ecological complexity showing variations in ecological niches, trophic structure, food-webs, and nutrient cycling etc.E.g... Forest Ecosystem, Grassland Ecosystem and Pond Ecosystem.

1.3 Biogeographical Classification of India:

Biogeography comprising of phytogeography and zoogeography, which deals with the aspects of plants and animals. There are around ten (10) bio geographical regions in India.

1. Trans- Himalayan (2 Parts)

- Ladakh Mountains, Tibetans plateau.
- Total area: 1,86,200 Sq.Km
- Flora: Pine, Deodar.

- Fauna: Wild Sheep, Snow Leopard, Wolf and Black Necked Crane.

2. Himalayan (4 Parts)

- North-West Himalayas- 6900 Sq.Km
- West Himalayas- 7,20,000 Sq.Km
- Central Himalayas-1,23,000 Sq.Km
- East Himalayas - 83,000 Sq.Km
- Flora: Pine, Castor, Sal.
- Fauna: Wild Bear, Yak, Sambar, Leopard and Musk Deer.

3. Indian Desert (3 Parts)

- Kutch- 45,000 Sq.Km
- Thar-1,80,000 Sq.Km
- Ladakh -86,904 Sq.Km
- Flora: Acacia, Zizyphus, Date Palm.
- Fauna: Camel, Wild Ass, Desert Cat and Fox.

4. Semi-Arid Region (2 Parts)

- Central India – 10,7,600 Sq.Km
- Gujarat Rajwara – 4,00400 Sq.Km
- Flora: Acacia, Date Palm and Peepal
- Fauna: Gir Lion, Tiger,

5. Western Ghats (2 Parts)

- Malabar Coast – 59,700 Sq.Km
- Western Ghat Mountains – 99,300 Sq.Km
- Flora: Sheesham Tree, Peepal Tree.
- Fauna: Tortoise, Frog, Lizards and Snakes.

6. Deccan Plateau (4 Parts)

- South Plateau – 3,78,000 Sq.Km

- Central Plateau – 3,41,000 Sq.Km
- Eastern Plateau – 1,98,000 Sq.Km
- Central Highlands – 2,87,000 Sq.Km
- Flora: Acacia, Pine, Castor.
- Fauna: Sambar, Sloth Bear, Tiger, Cheetal, Elephant and Buffalo.

7. Gangetic Plain (2 Parts)

- Upper Gangetic Plain – 2,06,400 Sq.Km
- Lower Gangetic Plain – 1,53,000 Sq.Km
- Flora: Sal, Acacia and Mango.
- Fauna: Black Chinkara, Stag and Rhinoceros.

8. North East India (2 Parts)

- Brahmaputra Valley – 65,200 Sq.Km
- North Eastern Hills – 10,6,200 Sq.Km
- Flora: Bamboo, Sal, Jack Fruit, Castor and Chest Nut.
- Fauna: Elephant, Rhinoceros, Yak, Deer and Porcupine.

9. Indian Islands (3 Parts)

- Andaman Islands – 6,397 Sq.Km
- Nicobar Islands – 1,930 Sq.Km
- Lakshadweep Islands – 180 Sq.Km
- Flora: Jack Fruit, Cardamom, Cloves and Coconut.
- Fauna: Dolphins, Alligator and Molluscans.

10. Indian Coasts (2 Parts)

- West Coast – 6,500 Sq.Km
- East Coast – 6,600 Sq.Km
- Flora: Coconut, Banana, and Cashew Nut.
- Fauna: Dolphins, Turtles, Alligators and Molluscans.

1.4 Global Bio-Diversity Hotspots:

The term was introduced by Norman Myers (1988).Areas, which exhibit high species richness as well as high species endemism, are termed as hot spots of biodiversity. Earlier 12 hot spots were identified on a global level. Later Myers et al (2000) recognized 34 hot spots. There are 34 hot spots of biodiversity on a global level out of which two are present in India, namely the Eastern Himalayas and Western Ghats. These hot spots covering less than 2% of the world's land, and are found to have about 50% of the terrestrial biodiversity. About 40% of terrestrial plants and 25% of vertebrate species are endemic and found in these hotspots. The Indian hot spots are not only rich in floral wealth and endemic species of plants but also in reptiles, amphibians, swallow tailed butterflies and some mammals.

1.5 Global and National Bio-Diversity:

About 8.7 million is the new, estimated total number of species on earth. The most precise calculation ever offered -- with 6.5 million species on land. 2.2 million Species in oceans, as announced by the census of marine life. All types of plant species that are present in a particular area or given area is also known as flora. All types of animal species present in a particular area or given area is also known as fauna.

Flora: Angiosperms - 1,72,000, Gymnosperms – 1,500, Ferns – 15,000, Mosses – 22,750

Fauna: Insects – 5,00,000, Molluscans – 2,00,000, Crustaceans – 1,50,000, Other Species -7,91,800, Fishes – 40,000, Amphibians – 15,000, Reptiles –10,500, Aves – 10,000, Mammals – 5,500.

India as Mega Diversity Nation

India is one of the 12 mega diversity countries in the world. Brazil,

Columbia, Ecuador, Peru, Mexico, Madagascar, Zaire, Australia, China, Indonesia Malaysia and India, are the mega diversity countries.

Indian Bio-Diversity: According to Botanical Survey of India, Zoological Survey of India Approximately 47- 48,000 plant species and 89-90,000 animal species present in India.

Flora: Algae – 6,500, Fungi – 14,500, Lichens – 2,000, Bryophytes – 2,850, Pteridophytes – 1,100, Gymnosperms – 64, Angiosperms – 17,500

Fauna : Protozoans – 2,577, Arthropods – 68,300, Molluscans – 5,070, Amphibians – 209, Fishes – 2,540, Reptiles – 456, Birds – 1,250, Mammals – 410 species are present.

1.6 Endangered and Endemic Species of India:

Endangered Species of India

The International Union for Conservation of Nature and Natural Resources (IUCN) publishes the Red Data Book which includes the list of endangered species of plants and animals. In India, nearly 450 plant species have been identified in the categories of endangered, threatened or rare. Existence of about 150 mammals and 150 species of birds is estimated to be threatened while an unknown number of species of insects are endangered. A few species of endangered reptiles, birds, mammals and plants are given below:

Reptiles: Green sea turtle, tortoise, python

Birds: Great Indian bustard, Peacock, Pelican, Great Indian Hornbill, Siberian crane

Carnivorous Mammals: Indian wolf, red fox, red panda, tiger, leopard, Indian lion, golden cat, desert cat.

Primates: Hoolock gibbon, capped monkey, golden monkey. The Zoological Survey of India reported that Cheetah, Pink headed duck and mountain squaril have already become extinct from India.

Plants: A large number of species of orchids, Rododendrons, medicinal plants like Rauvolfia serpentina, the sandal, wood tree santalum, cycas beddomeii etc.

Endemic Species of India:

The species are only found in a particular place or in a particular region are knows as endemic species. In our country 7,000 plant species are endemic. Some of the important endemic flora includes orchids and species like sapria himalayana, Uvaria lureda, Nepenthes khasiana etc. A large number of animal species in our country is endemic. The Western Ghats are particularly rich in amphibians and reptiles. About 62% amphibians and 50% lizards are endemic to Western Ghats. Different species of monitor lizard, reticulated python are some important endemic species of our country.

Endemism:

Species, which are restricted only to a particular area, are known as endemic. India shows a good number of endemic species. Center of origin: A large number of species are known to have originated in India. Nearly 5,000 species of flowering plants had their origin in India. Marine diversity: Along 7,500 km long coastline of our country in the mangroves, estuaries, coral reefs, back waters etc. there exists a rich biodiversity. More than 340 species of corals of the world are found

here. A large proportion of the Indian Biodiversity is still unexplored. There are about 93 major wet lands, coral reefs and mangroves.

1.7 Threats to Bio-Diversity:

Some of the major causes and issues related to threats to biodiversity. They are Loss of Habitat, Poaching of wildlife, and Man-Wildlife conflicts

Loss of Habitat:

Destruction and loss of natural habitat is the single largest cause of biodiversity loss. Billions of hectares of forests and grasslands have been cleared over the past 10,000 years for conversion into agriculture lands, pastures, settlement areas or development projects. Marine biodiversity is also under serious threat due to large scale destruction of the fragile breeding and feeding grounds of our oceanic fish and other species, as a result of human intervention.

Poaching of Wild Life:

Illegal trade of wildlife products by killing endangered animals i.e. poaching is another threat to wildlife. Despite international ban on trade in products from endangered species, smuggling of wild life items like furs, hides, horns, tusks, live specimens and herbal products worth millions of dollars per year continues. The cost of elephant tusks can go up to $100 per kg. The leopard fur coat is sold at $ 100,000.In Japan while bird catchers can fetch up to $ 10,000 for a rare hyacinth macaw, a beautiful coloured bird, from Brazil.

Man-Wildlife Conflicts:

Instances of man - animal conflicts keep on coming to lime light from several states in our country. In Sambalpur, Orissa 195 humans were killed in the last 5 years by elephants. In retaliation the

villagers killed 98 elephants and badly injured 30 elephants there are several instances of killing of elephants in the border regions of Mysore and Karnataka. The man-elephant conflict in this region has arisen because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops. In June, 2004 two men were killed by leopards in Powai, Mumbai.

1.8 Conservation of Bio-Diversity:

There are two approaches of biodiversity conservation:

1. **In situ conservation**
2. **Ex situ conservation**

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

Biosphere Reserves: The Biosphere Reserve conserves some representatives of ecosystems as a whole for long term In-situ conservation. In India we have 7 (Seven) Major and 11 (Eleven) Minor, total 18 (Eighteen) Biosphere Reserves total area =1,19,712 Km^2.

Biosphere Reserves in India

S.No.	Biosphere Reserve Name	Estd. Year	Located States
1.	Nilgiri Biosphere Reserve	1986	Tamil Nadu, Kerala and Karnataka.
2.	Nanda Devi "	1988	Uttarkhand (Uttar Pradesh).
3.	Nokrek "	1988	Meghalaya
4.	Gulf of Mannar "	1989	Tamil Nadu.
5.	Sundarbans "	1989	West Bengal.
6.	Manas "	1989	Assam.
7.	Great Nicobar "	1989	Andaman and Nicobar.

8.	Simlipal "	1994	Odisha.
9.	Dibru Saikhowa "	1997	Assam
10.	Dehang-Deibang "	1998	Arunachal Pradesh.
11.	Pachmarhi "	1999	Madhya Pradesh.
12.	Khangchendzonga "	2000	Sikkim
13.	Agasthyamalai "	2001	Kerala, Tamil Nadu.
14.	Achanakamar- Amarkantak "	2005	Madhya Pradesh, Chhattisgarh
15.	Cold Desert "	2009	Himachal Pradesh
16.	Great Rann of Kutchh "	2010	Gujarat
17.	Seshachalam "	2010	Andhra Pradesh
18.	Panna "	2011	Madhya Pradesh

National Parks: A National Park is an area dedicated for the conservation of wildlife along with its environment. It is also meant for enjoyment through tourism but without impairing the environment. In India we have 102 National Parks at present.

Some important National Parks in India

S.No.	Park Name	Estd.Year	Located States
1.	Jim Corbett National Park	1936	Uttarkhand
2.	Mudumalai National Park	1940	Tamilnadu
3.	Kanha National Park	1955	Madhya Pradesh
4.	Gir National Park	1965	Gujarat
5.	Nandapha National Park	1974	Arunachal Pradesh
6.	Kaziranga National Park	1974	Assam
7.	Bandhipur National Park	1974	Karnataka
8.	Indravathi National Park	1981	Chhattisgarh

9.	Periyar National Park	1982	Kerala
10.	Sri Venkateswara National Park	1989	Andhra Pradesh

Wildlife Sanctuaries: Wildlife Sanctuaries are also protected areas where killing, hunting, shooting or capturing of wildlife is prohibited except under the control of highest authority. In India 515 Wildlife Sanctuaries are present. Out of which 39 Tiger Reserves and 21 Bird Sanctuaries.

Some important Wildlife Sanctuaries in India

S.No.	Wildlife Sanctuary Name	Estd.Year	Located States
1.	Parimbikulam Wildlife Sanctuary	1973	Kerala
2.	Bhadra Wildlife Sanctuary	1974	Karnataka
3.	Mudumalai Wildlife Sanctuary	1940	Tamilnadu
4.	Jaldapara Wildlife Sanctuary	1943	West Bengal
5.	Nandini Wildlife Sanctuary	1981	Jammu & Kashmir
6.	Palkot Wildlife Sanctuary	1990	Jharkhand
7.	Lakhari Valley Wildlife Sanctuary	1985	Odisha
8.	Naina Devi Wildlife Sanctuary	1962	Himachal Pradesh
9.	Sri Venkateswara W.L. Sanctuary	1985	Andhra Pradesh
10.	Kawal Wildlife Sanctuary	1977	Telangana

2. Ex situ conservation (outside habitats) this is done by establishment of gene banks, seed banks, zoological parks and botanical gardens etc.

Zoological Parks: A park or an institution in which living animals are k ept and usually exhibited to the public.It is the best example of Ex-situ conservation. In India total 240 Zoological Parks are present.

Some important Zoological Parks in India

S.No.	Zoological Park	Estd.Year	Location
1.	Arignar Anna Z. P.	1855	Chennai (Tamil Nadu)
2.	Sakkarbaug "	1863	Junagadh (Gujarat)
3.	Jaipur "	1876	Jaipur (Rajasthan)
4.	Alipore "	1876	Kolkata (West Bengal)
5.	Mysore "	1892	Mysore (Karnataka)
6.	Lucknow "	1921	Lucknow (Uttar Pradesh)
7.	Padmaja Naidu "	1958	Darjeeling (West Bengal)
8.	Delhi or National "	1959	New Delhi
9.	Nandankanan "	1960	Bhubaneswar (Odisha)
10.	Sri Venkateswara "	1989	Tirupathi (Andhra Pradesh)

Botanical Gardens: Botanical garden is a garden dedicated to the collection, cultivation and display of a wide range of plants labeled with their botanical names. Total numbers of Botanical Gardens present in India is 122.s

Some important Botanical Gardens in India

S.No.	Botanical Garden	Estd.Year	Location
1.	Government B.G.	1874	Ooty (Tamil Nadu)
2.	Calcutta "	1918	Howrah (West Bengal)
3.	Roxburg "	1923	Allahabad (Uttar Pradesh)
4.	Agra "	1930	Agra (Uttar Pradesh)
5.	Mumbai "	1930	Mumbai (Maharashtra)
6.	Delhi "	1947	New Delhi
7.	Darjeeling "	1948	West Bengal
8.	Padmapuram "	1955	Araku (Andhra Pradesh)
9.	Dharwad "	1963	Karnataka
10.	KVB Reddy "	2001	Hyderabad (Telangana)

1.9 Bio-Diversity Services / Values:

The services or values of biodiversity in terms of its commercial utility, ecological services, social and aesthetic value is enormous. The multiple uses of biodiversity value have been classified as follows:

1. Consumptive use value
2. Productive use value
3. Social value
4. Ethical value
5. Aesthetic value
6. Option value
7. Ecosystem service value

1. Consumptive Use Value

These are direct use values where the biodiversity product can be harvested

and consumed directly e.g. fuel, food, drugs, fibre etc.

a. Food: A large number of wild plants are consumed by human beings as food. About 80,000 edible plant species have been reported from wild. About 90% of present day food crops have been domesticated from wild tropical plants. A large number of wild animals and marine organisms are also our sources of food.

b. Drugs and medicines: About 75% of the world's population depends upon plants or plant extracts for medicines. The wonder drug penicillin used as an antibiotic is derived from a fungus called penicillium notetum. Quinine, the cure for malaria is obtained from the bark of Cinchona officinalis tree. Digitalin is obtained from foxglove (Digitalis purpurea) which is an effective cure for heart ailments.

2. Productive Use Value

These are the commercially usable values where the product is marketed and sold. These may include the animal products like tusks of elephants, musk from musk deer, silk from silk-worm, wool from sheep, lac from lac insects etc.Many industries are dependent upon the productive use values of biodiversity like the paper and pulp industry, plywood industry, railway sleeper industry, silk industry, leather industry, pearl industry etc.

3. Social Value

These are the values associated with the social life, customs, and religion of the people. Many of the plants are considered holy and sacred in our country like Tulasi, peepul, Mango, and Lotus etc. The leaves, fruits or flowers of these plants are used for worship or the plant itself is worshipped. Many animals like Cow, Snake, and Peacock also have significant place in our psycho-spiritual arena.

4. Ethical Value

It is also sometimes known as existence value. It involves ethical issues like "all life must be preserved". The ethical value means that we may or may not use a species, but knowing the very fact that this species exists in nature gives us pleasure.

5. Aesthetic Value

No one of us would like to visit vast stretches of barren lands with no signs of visible life. People from far and wide spend a lot of time and money to visit wilderness areas where they can enjoy the aesthetic value of biodiversity.

6. Option Value

These values include the potentials of biodiversity that are presently unknown and need to be explored. There is a possibility that we may have some potential cure for AIDS or cancer existing within the depths of a marine ecosystem, or a tropical rain forest.

7. Ecosystem Service Value

It refers to the services provided by ecosystems like prevention of soil erosion, prevention of floods, maintenance of soil fertility, cycling of nutrients, prevention floods, cycling of water, their role as carbon sinks, pollutant absorption and reduction of the threat of global warming etc.

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UNIT –V

ENVIRONMENTAL POLLUTION

4.1 Introduction

4.2 Types of Environmental Pollution

4.3 Air Pollution

4.4 Causes / Sources of Air Pollution

4.5 Effects of Air Pollution

4.6 Control measures of Air Pollution

4.7 Water Pollution

4.8 Causes / Sources of Water Pollution

4.9 Effects of Water Pollution

4.10 Control of Water Pollution

4.11 Soil Pollution

4.12 Sources and Effects of Soil Pollution

4.13 Control of Soil Pollution

4.14 Noise Pollution

4.15 Sources of Noise Pollution

4.16 Effects of Noise Pollution

4.17 Control of Noise Pollution

4.18 Nuclear Hazards and Human Health Risks

4.19 Sources of Nuclear Hazards

4.20 Effects of Nuclear Hazards

4.21 Solid Waste Management

4.22 Control Measures of Urban and Industrial Waste

4.1 Introduction:

The word pollution is derived from the Latin word polluere or pollutonium, which means defilement and contaminant.

For normal and healthy living a conducive environment is required by all the living beings, including humans, livestock, plants, micro-organisms and the wildlife. In 1986 Environmental protection agency given to one definition for environmental pollution. Environmental pollution can be defined as any undesirable change in the physical, chemical and biological characteristics of any component of the environment (air, water, soil), which can cause harmful effects on various forms of life or property. Environmental pollution could be of various types:

4.2 Types of Environmental Pollution:

There are different types of pollutions are there:

1. Air pollution
2. Water pollution
3. Soil pollution
4. Noise pollution

4.3 Air Pollution:

Air pollution can be defined as any undesirable change in the physical, chemical and biological characteristics of the air which can cause harmful effects on various forms of life or property.

Classification of Air Pollutants: Air pollutants are classified in to two types—

1. Primary Pollutants – These are emitted directly from the point source in the atmosphere in harmful form like Oxides of Carbon (Cox), Oxides of Nitrogen (NOx) and Oxides of Sulphur (Sox) etc.

2. Secondary Pollutants – These are formed by interactions of primary pollutants with other primary pollutants. Ex: Smog, Ozone Peroxyacetylnitrate (PAN).

4.4 Causes / Sources of Air Pollution:

The sources of air pollution are natural and man-made (anthropogenic).

Natural Sources:

- The natural sources of air pollution are volcanic eruptions, forest fires, sea salt sprays, biological decay, photochemical oxidation of terpenes, marshes, extra terrestrial bodies, pollen grains of flowers, spores etc.
- Radioactive minerals present in the earth crust are the sources of radioactivity in the atmosphere.

Man-made Sources:

- Man made sources include thermal power plants, industrial units, vehicular emissions, fossil fuel burning, agricultural activities etc.
- Thermal power plants have become the major sources for generating electricity in India as the nuclear power plants couldn't be installed as planned.
- The main pollutants emitted are fly ash and SO_2. Metallurgical plants also consume coal and produce similar pollutants. Fertilizer plants, smelters, textile mills, tanneries, refineries, chemical industries, paper and pulp mills are other sources of air pollution.
- Automobile exhaust is another major source of air pollution. Automobiles release gases such as carbon monoxide (about 77%), oxides of nitrogen (about 8%) and hydrocarbons (about 14%).

- Heavy duty diesel vehicles spew more NOx and suspended particulate matter (SPM) than petrol vehicles which produce more carbon monoxide and hydrocarbons.

4.5 Effects of Air Pollution: Air pollution has adverse effects on living organisms and materials.

Effects on Human Health:

- Human respiratory system has a number of mechanisms for protection from air pollution.
- Years of exposure to air pollutants (including cigarette smoke) adversely affect these natural defenses and can result in lung cancer, asthma, chronic bronchitis and emphysema (damage to air sacs leading to loss of lung elasticity and acute shortness of breath).
- Suspended particulates can cause damage to lung tissues and diseases like asthma, bronchitis and cancer especially when they bring with them cancer causing or toxic pollutants attached on their surface. Sulphur dioxide (SO_2) causes constriction of respiratory passage and can cause bronchitis like conditions.
- In the presence of suspended particulates, SO_2 can form acid sulphate particles, which can go deep into the lungs and affect them severely. Oxides of nitrogen especially NO_2 can irritate the lungs and cause conditions like chronic bronchitis and emphysema.
- Carbon monoxide (CO) reaches lungs and combines with hemoglobin of blood to form carboxyhaemoglobin. CO has affinity for hemoglobin 210 times more than oxygen.

- Hemoglobin is, therefore, unable to transport oxygen to various parts of the body. This causes suffocation.
- Long exposure to CO may cause dizziness, unconsciousness and even death. Many other air pollutants like benzene (from unleaded petrol), formaldehyde and particulates like polychlorinated biphenyls (PCBs) toxic metals and dioxins (from burning of polythene) can cause mutations, reproductive problems or even cancer.

Effects on Plants:

- Air pollutants affect plants by entering through stomata (leaf pores through which gases diffuse), destroy chlorophyll and affect photosynthesis.
- Pollutants also erode waxy coating of the leaves called cuticle. Cuticle prevents excessive water loss and damage from diseases, pests, drought and frost.
- Damage to leaf structure causes necrosis (dead areas of leaf), chlorosis (loss or reduction of chlorophyll causing yellowing of leaf) or epinasty (downward curling of leaf), and abscission (dropping of leaves). Particulates deposited on leaves can form encrustations and plug the stomata. The damage can result in death of the plant.

Effects on Aquatic Life:

- Air pollutants mixing up with rain can cause high acidity (lower pH) in fresh water lakes.
- This affects aquatic life especially fish population.. Some of the freshwater lakes have experienced total fish death.

Effects on Materials:

- Because of their corrosiveness, particulates can cause damage to exposed surfaces.
- Presence of SO_2 and moisture can accelerate corrosion of metallic surfaces. SO_2 can affect fabric, leather, paint, paper, marble and limestone.
- Ozone in the atmosphere can cause cracking of rubber. Oxides of nitrogen can also cause fading of cotton and rayon fibres.

4.6 Control measures of Air Pollution:

Air pollution can be minimized by the following methods:

- Sitting of industries after proper Environmental Impact Assessment studies.
- Using low sulphur coal in industries
- Removing sulphur from coal (by washing or with the help of bacteria)
- Removing NOx during the combustion process.
- Removing particulate from stack exhaust gases by employing electrostatic precipitators, bag-house filters, cyclone separators, scrubbers etc.
- Vehicular pollution can be checked by regular tune-up of engines ; replacement of more polluting old vehicles; installing catalytic converters by engine modification to have fuel efficient (lean) mixtures to reduce CO and hydrocarbon emissions; Using mass transport system, bicycles etc.
- Shifting to less polluting fuels (hydrogen gas).
- Using non-conventional sources of energy
- Using biological filters and bio-scrubbers.
- Planting more trees.

4.7 Water Pollution:

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

4.8 Causes / Sources of Water Pollution:

- Water is an essential commodity for survival.
- We need water for drinking, cooking, bathing, washing, irrigation, and for industrial operations. Most of water for such uses comes from rivers, lakes or groundwater sources.
- Water has the property to dissolve many substances in it, therefore, it can easily get polluted.
- Pollution of water can be caused by point sources or non-point sources.
- Major point sources of water pollution are industries, power plants, underground coal mines, offshore oil wells etc.
- Surface run-off from agricultural fields, overflowing small drains, rain water sweeping roads and fields, atmospheric deposition etc. are the non-point sources of water pollution.

Ground Water Pollution:

- Ground water forms about 6.2% of the total water available on planet earth and is about 30 times more than surface water (streams, lakes and estuaries).
- Ground water seems to be less prone to pollution as the soil mantle through which water passes helps to retain various contaminants due to its cation exchange capacity.
- However, there are a number of potential sources of ground water pollution. Septic tanks, industry (textile, chemical, and

tanneries), deep well injection, mining etc. are mainly responsible for ground water pollution, which is irreversible.

- Ground water pollution with arsenic, fluoride and nitrate are posing serious health hazards.

Surface Water Pollution: The major sources of surface water pollution are:

1. Sewage: Pouring the drains and sewers in fresh water bodies causes water pollution. The problem is severe in cities.

2. Industrial Effluents: Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances, etc. are sources of water pollution. They also cause thermal (heat) pollution of water.

3. Synthetic Detergents: Synthetic detergents used in washing and cleaning produce foam and pollute water.

4. Agro-Chemicals: Agrochemicals like fertilizers (containing nitrates and phosphates) and pesticides (insecticides, fungicides, herbicides etc.) washed by rain-water and surface

Run-off pollutes water.

5. Oil: Oil spillage into sea-water during drilling and shipment pollute it.

6. Waste Heat: Waste heat from industrial discharges increases the temperature of water bodies and affects distribution and survival of sensitive species.

4.9 Effects of Water Pollution:

Following are some important effects of various types of water pollutants:

Effects of Water Pollution on Plants

Aquatic plants get severely affected due to water pollution. Due to plethora of moss in the polluted water of the rivers, the sun light fails to reach to the depths of the river which affects the growth of aquatic plants in the lack of photosynthesis. In the polluted water of the rivers, some aquatic weed as aquatic ferns and water hyacinth start increasing. Similarly, the sewage water getting mixed into the water of the rivers, helps in the increase of fungus, algae, bacteria, etc which start to erupt faster.

Effects of Water Pollution on Animals

Increasing pollution in the sea and oceanic areas has become a threat. Polluted water makes the life of aquatic organism miserable. Water pollution reduces the level of oxygen in it. According to a survey in most of the rivers, the amount of oxygen in a litre of water has decreased to 0.1 cubic centimetre only, while this average in 1940 was around 2.5 cubic centimetres.

Different varieties of fish are the most affected creatures due to water pollution. Fish and other aquatic organisms start dying due to lack of oxygen in the polluted water. Hydrocarbons in the oil spread on the surface of the oceans due to which marine and aquatic organisms do not get the oxygen and they die consequently. Things have become so alarming that many aquatic species are on the brink of extinction.

Polluted water also negatively impacts the breeding power of aquatic life. It makes fish and plants deficient in their ability to regenerate and reproduce. Also, animals fall prey to a variety of diseases due to drinking polluted water.

Effects of Water Pollution on Human Health

Polluted water leads to the worst effect on human health. According to the World Health Organization (WHO), every year due to contaminated water 50 million persons become the victims of death. About 360 persons per one lakh die in India and over 50 per cent patients getting admitted in hospitals are the patients of water borne diseases. The situation in underdeveloped countries is even worse where over 80 per cent of the patients are suffering from the diseases born out of polluted water.

Microbes, toxins and water containing unnecessary amounts of salts give rise to many diseases. Around the globe more than 80 per cent of diseases are due directly or indirectly to polluted water. As per an estimate, almost 2.5 million people in over 34000 villages of India are suffering from cholera. Millions of tribal villagers in Rajasthan are suffering from various diseases due to drinking dirty water from the ponds. Contaminated water contains a variety of disease-causing bacteria that results in several types of diseases.

4.10 Control of Water Pollution:

It is easy to reduce water pollution from point sources by legislation. However, due to absence of defined strategies it becomes difficult to prevent water pollution from non-point sources.

The following points may help in reducing water pollution from non-point sources.

(i) Judicious use of agrochemicals like pesticides and fertilizers which will reduce their surface run-off and leaching. Avoid use of these on sloped lands.

(ii) Use of nitrogen fixing plants to supplement the use of fertilizers.

(iii) Adopting integrated pest management to reduce reliance on pesticides.

(iv) Prevent run-off of manure. Divert such run-off to basin for settlement. The nutrient rich water can be used as fertilizer in the fields.

(v) Separate drainage of sewage and rain water should be provided to prevent overflow of sewage with rainwater.

(vi) Planting trees would reduce pollution by sediments and will also prevent soil erosion.

Advanced treatment for removal of nitrates and phosphates will prevent eutrophication. Before the discharge of wastewater, it should be disinfected to kill the disease-causing organisms like bacteria. Proper chlorination should be done to prevent the formation of chlorinated hydrocarbons or disinfection should be done by ozone or ultraviolet radiations.

4.11 Soil Pollution:

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

4.12 Sources and Effects of Soil Pollution:

1. Industrial Wastes

Pulp and paper mills, chemical industries, oil refineries, sugar factories etc., these pollutants affect and alter the chemical and biological properties of soil. As a result, hazardous chemicals can enter into human food chain from the soil; disturb the bio chemical process and finally lead to serious effects.

2. Urban Wastes

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

3. Agricultural Practices

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

4. Radioactive Pollutants

These are resulting from explosions of nuclear dust and radioactive wastes penetrate the soil and accumulate there by creating land pollution.

5. Biological Agents:

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

4.13 Control of Soil Pollution:

The pressure on intensification of farm activities increases for two reasons

1. Population growth
2. Decrease of the available farm land due to urbanization

The soil pollution can be controlled by

1. Forestry and farm practices
2. Proper dumping of unwanted materials
3. Production of natural fertilizers, Proper Hygienic condition, Public awareness recycling and Reuse of wastes and Ban on Toxic chemicals.

4.14 Noise Pollution:

It may be defined as "the unwanted, unpleasant or disagreeable sound that causes discomfort for all living beings"

Types of Noise:

1. Industrial noise
2. Transport noise
3. Neighborhood noise

4.15 Sources of Noise Pollution:

Transportation systems are the main source of noise pollution in urban areas.

Construction of buildings, highways, and streets cause a lot of noise, due to the usage of air compressors, bulldozers, loaders, dump trucks, and pavement breakers.

Industrial noise also adds to the already unfavorable state of noise pollution.

Loud speakers, plumbing, boilers, generators, air conditioners, fans, and vacuum cleaners add to the existing noise pollution.

4.16 Effects of Noise Pollution:

1. This affects human health, comfort and efficiency.
2. It causes muscles to contract leading to nervous breakdown, tension
3. It affects health efficiency and behavior.
4. In addition to serious loss of hearing due to excessive noise, impulsive noise also causes psychological and pathological disorders.
5. Brain is also adversely affected by loud and sudden noise as that of jet and aero plane noise etc.

4.17 Control of Noise Pollution:

1. Source control – acoustic treatment to machine surface, design changes, limiting the operational timings

2. Transmission path intervention- the source inside a sound insulating enclosure, construction of a noise barrier or provision of sound absorbing materials

3. Oiling – Proper oiling will reduce the noise from the machines.

4.18 Nuclear Hazards and Human Health Risks:

The nuclear or radiation hazard in the environment comes from ultraviolet, visible, cosmic rays and micro wave radiation which produces genetic mutation in man.

4.19 Sources of Nuclear Hazards:

1. Natural Sources: which is in space which emits cosmic rays.

2. Man made sources (Anthropogenic sources): these are nuclear power plants, X-rays, nuclear accidents, nuclear bombs, diagnostic kits etc.

4.20 Effects of Nuclear Hazards:

1. Exposure of the brain and central nervous system to high doses of radiation causes delirium, convulsions and death within hours or days.

2. The use of eye is vulnerable to radiation. As its cell die, they become opaque forming cataracts that impair sight.

3. Acute radiation sickness is marked by vomiting; bleeding of gums and in severe cases mouth ulcers.

4. Nausea and vomiting often begin a few hours after the gastrointestinal tract is exposed Infection of the intestinal wall can kill weeks afterwards.

5. Unborn children are vulnerable to brain damage or mental retardation, especially if irradiation occurs during formation of the central nervous system in early pregnancy.

4.21 Solid Waste Management:

A higher standard of living of ever increasing population has resulted in an increase in the quantity and variety of waste generated. It is now realized that if waste generation continues indiscriminately then very soon it would be beyond rectification. Management of solid waste has, therefore, become very important in order to minimize the adverse effects of solid wastes. Solid waste (waste other than liquid or gaseous) can be classified as municipal, industrial agricultural, medical, mining waste and sewage sludge.

Sources of Urban Waste:

Urban waste consists of medical waste from hospitals. Municipal solid wastes from homes, offices, markets (commercial waste) small cottage units. Waste from homes (Domestic waste) contains a variety of discarded materials like polyethylene bags, empty metal and aluminium cans, scrap metals, glass bottles, waste paper, diapers, cloth/rags, food waste etc. Waste from shops mainly consists of waste paper, packaging material, cans, bottles, polyethylene bags, peanut shells, eggshells, tea leaves etc. Biomedical waste includes anatomical wastes, pathological wastes, infectious wastes etc. The urban solid waste materials that can be degraded by microorganisms are called biodegradable wastes. Examples of the biodegradable waste are

vegetable wastes, stale food, tea leaves, egg shells, peanut shells, dry leaves etc. Wastes that cannot be degraded by microorganisms are called non-biodegradable wastes. For example, polyethylene bags, scrap metal, glass bottles etc.

Sources of Industrial Waste:

Industrial waste consists of a large number of materials including factory rubbish, packaging material, organic wastes, acids, alkalis and metals etc. During some industrial processing large quantities of hazardous and toxic materials are also produced. The main sources of industrial wastes are chemical industries, metal and mineral processing industries. Radioactive wastes are generated by nuclear power plants. Thermal power plants produce fly ash in large quantities. Solid wastes from other types of industries include scrap metal, rubber, plastic, paper, glass, wood, oils, paints, asphalt, tars, dyes, scrap leather, ceramics, abrasives, slag, heavy metals, asbestos, and batteries.

4.22 Control Measures of Urban and Industrial Waste:

For waste management we stress on three R.s.-Reduce, Reuse and Recycle before destruction and safe storage of wastes.

(i) Reduction in use of Raw Materials: Reduction in the use of raw materials will correspondingly decrease the production of waste. Reduced demand for any metallic product will decrease the mining of their metal and cause less production of waste.

(ii) Reuse of Waste Materials: The refillable containers which are discarded after use can be reused. Making rubber rings from the discarded cycle tubes which are used by the newspaper vendors, instead of rubber bands, reduces the waste generation during manufacturing of

rubber bands. Because of financial constraints poor people reuse their materials to the maximum.

(iii) Recycling of Materials: Recycling is the reprocessing of discarded materials into new useful products. Formation of some old type products e.g. old aluminium cans and glass bottles are melted and recast into new cans and bottles.

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UNIT-VI

ENVIRONMENTAL POLICIES & PRACTICES

2.1 Climate Change

2.2 Global Warming

2.3 Acid Rains

2.4 Ozone Layer Depletion

2.5 Environmental Laws

2.6 International Agreements

2.7 Nature Reserves

2.8 Tribal Populations and Rights

2.9 Human and Wildlife Conflicts

2.1 Climate Change:

Climate change is a newcomer to the international political and environmental agenda, having emerged as a major policy issue only in the late 1980s and thereafter. It has emerged since the 19th century that CO_2 in the atmosphere is a greenhouse gase, that is, its presence in the atmosphere helps to retain the incoming heat energy from the sun, thereby increasing the earth's surface temperature. Of course, CO_2 is only one of several such greenhouse gases in the atmosphere. Others include methane, nitrous oxide and water vapour. However, CO_2 is the most important greenhouse gas that is being affected by human activities. CO_2 is generated by a multitude of processes. Since the Industrial Revolution, when our usage of fossil fuels increased dramatically, the contribution of CO_2 from human activities has grown large enough to constitute a significant perturbation to the natural carbon cycle. The concentration of CO_2 in the Earth's atmosphere was about 280 parts per million by volume

(ppmv) in 1750, before the Industrial Revolution began. By 1994 it was 358 ppmv and rising by about 1.5 ppmv per year. If emissions continue at the 1994 rate, the concentration will be around 500 ppmv, nearly double the pre-industrial level, by the end of the 21st century.

Rising Concentrations

The effect is that the atmosphere retains more of the Sun's heat, warming the Earth's surface. While the pattern of future warming is very much open to debate, it is indisputable that the surface of the Earth has warmed, on average, 0.3 to 0.6 ˚C since the late 19th century when reliable temperature measurements began. The existing scenarios of economic growth and development will lead to greenhouse gas emissions, on a worldwide average, temperatures would rise by 1 to 3.5 ˚C by the year 2100, and global mean sea level about 15 to 95 cm. It is likely that changes of this magnitude and rapidity could pose severe problems for many natural and managed ecosystems.

2.2 Global Warming / Green House Effect:

The process of heating up of globe is called 'Global Warming'. This phenomenon is similar to that of greenhouse or glass – house in which glass roof allows solar radiation inside but prevents the escape of the terrestrial radiation (heat) generated inside the greenhouse. As a result, inside temperature of the greenhouse will rise and allow tropical plants to grow on temperature of the greenhouse will rise and allow tropical plants to grow on temperate soils without any discomfort. Hence, it takes the name of "Greenhouse effect." J. Fourier – French scientist first recognized it in 1827. But Anthes et al differed to use the name 'greenhouse effect' as there is no perfect analogy between Co_2

and glass. They preferred to call 'Atmosphere effect' to Greenhouse effect.'

Green House Effect

The troposphere has thick layer of carbon dioxide above us spreading like an umbrella, increasing thickness as the evolution of carbon dioxide from the vehicular traffic is the roof of a greenhouse described above. The layer of carbon dioxide permits the sun's rays to pass through it but prevents the infrared radiation returning from the soil and the plants to go back into the atmosphere In a manner very similar to what is happening In the green house. Consequently the earth gets warmed up due to the infrared radiation falling on it. The phenomenon is also known as global warming. This is the greenhouse effect.

Causes of Green House Effect

Carbon dioxide (CO_2) in harmless if it's present around 0.03% in the atmosphere. The excess carbon dioxide produced in the atmosphere is absorbed during the photosynthesis by green plants. Unfortunately green plants and forest are being cut off by human beings in the process of urbanization and building concrete jungles in the place of natural forests. The use of petroleum fuels in automobiles is increasing every day with increased use of vehicles. No other possible sinks are developed to absorb the emission of carbon dioxide. Carbon dioxide CO_2, nitrogen oxides, sulphur oxide and other gaseous oxides are called the greenhouse gases.

Effects of Global Warming

The temperature of the earth s' surface is increasing slowly day by day. Increase in temperature all over the earth shifts the fertile

areas of the earth. Along with the shifting of fertile areas, the ecosystems also are shifted causing imbalance to the ecology. Due to a rise in temperature at the Polar Regions also, the ice at these regions melts and flows into the oceans. The oceans are flooded and inundate the low lying areas of seashore. It is estimated that several low lying countries of the world, are withdrawn under the rising sea levels.

Control Measures of Global Warming:

Reducing the production of CO_2 by reducing the use of fossil fuels and watch over the alternate fuels. Grow green plants wherever possible. They will serve as sinks for carbon dioxide. Reduce vehicular traffic as far as possible. Educate people about the evil consequences of the greenhouse effect. Reduce the use of vehicles. Reduce the emissions of fossil fuels exhaust to atmosphere. Promote or develop the forestation. Reduce the rate of deforestation. Reduce the over exploitation of natural resources. Reduce the burning of plastic materials. Reduce the use of non conventional energy resources, Use of bio-gas plants. Use of nuclear power plants. Use of unleaded petrol in automobiles. Installation of pollution controlling devices in industries and automobiles like electrostatic precipitator, wet scrubber and bag house filters.

2.3 Acid Rains:

Acid rain literally means 'the presence of excessive acids in rain waters'. Acid precipitation is a mixture of strong mineral acids sulphuric acid (H2SO4), nitric acid (HNO3) and in some locations, hydrochloric acid (HCl). It usually has a ph of less than 5.6, the value of distilled water in equilibrium with atmospheric carbon dioxide. Acid rain is an environmental hazard that is transponder in nature. North-

eastern America, North Western Europe and India are facing an acute problem of acid rain. Acid rain has affected certain rivers, lakes, streams and forests in United Kingdom (UK), United States of America (USA), Germany and many other countries.

Sources of Acid Rains

The thermal power plants, Industries and vehicles releases nitrous oxides and sulphur dioxide into atmosphere due to the burning of coal and oil. These gases produce acid rain. When these gases react with water vapour in the atmosphere they form acids and descend on to earth as" acid rain" through rain water. The acid rain causes severe damage to the plant and animal life. Due to the drifting of these gases in the atmosphere by the wind, their presence is felt as far as 2000 kilometres. The air pollution of one nation could cause acid rain for another nation. Population growth too aggravates acid rain problem. With more people, the development activities and the transport facility are increased resulting in greater emission of nitrous and sulphurous oxides.

Effects of Acid Rains

Many nations are affected by acid rain. Nations in central and Eastern Europe, eastern North America, scandinaria face very serious problems. Africa, burning of grass lands creates acid rain. Reduced crop yields and fish caches and damaged forests are the common adverse effects observed. The drinking water and fresh water lakes are poisoned. The acid rain causes corrosion to buildings and monuments, as it happened in India, Italy and many European countries. It affects respiratory system in humans. The phenomenon of "Acid rain" was first observed during the fifties in Europe where some fossil fuels (coal)

were burnt in the industrial furnaces. The pH of the acid rain ranged from 5 to 4.5 which iss sufficient to destroy plant life. During a period of about 2 decades acid rains caused sufficient damage to the plants, forests and aquatic life as the lakes become acidic. This severity of acid rain called for a high level conference in Sweden during July 1982.

Control Measures of Acid Rain

Improvement in technologies and switching to clear combustion technologies are highly essential. Coal with lower sulphur content is desirable to use in thermal plants. Replacement of coal by natural gas would also reduce the problem substantially. Installing scrubbers to reduce smoke stack emissions, though expensive, would be economical compared to the losses due to damage done to lakes, forests, monuments, food production and so on. A building in Europe annually. Use of alkali sinks; pos containing alkalis lines and potassium hydroxide are hung in the windows of buildings in the industrial areas.

2.4 Ozone Layer Depletion:

Ozone layer is a protective thin band in the stratosphere (above troposphere) that shields the earth from the harmful ultra violet rays coming from the sun. In 1970, it was found that this ozone layer was attacked by chlorofluoro carbons (CFCs) which are released into atmosphere by refrigeration units, air conditioning systems, aerosol sprays and cleaning solvents. The first observation of the ozone layer depletion was in the early 1980's observed from Antarctica. Since then constant monitoring by the scientists revealed continuous broadening of the ozone holes poring great threat to the very existence of life on earth. The process of ozone destruction happens as follows, chlorofluorocarbons release chlorine which breaks ozone into oxygen.

Since chlorine is not affected by its interaction with ozone, chlorine continues to destroy ozone. Over a period of time Ozone levels declined by about 2% world-wide, with larger declines over parts of north and South America, Europe, Australia and New Zealand. A study undertaken in 1992 indicates ozone layer is thinning even more than previously thought.

Effects of Ozone Layer Depletion

Thinning of ozone layer allows more ultra violet radiation to reach the earth. As a result, change in climate, reduction in crop yields, disrupting marine food chains and obstructing photo synthesis is noticed. Ultra violet radiation affects health of people growing number of skin cancers, cataracts, genetic changes and inability of human systems to respond to infection are some of the diseases that afflict people.

Control Measures of Ozone Layer Depletion

The studies have shown that CFCs already released persist in the atmosphere for very long periods, nearly 100 years, and continue to damage ozone layer, even if their usages is stopped forth with. Studies also reveal that global warming may also contribute to ozone depletion. Use of gases such as methyl bromide which is a crop fumigant also to be controlled. Small traces of ozone are present in troposphere too. This ozone behaves as a greenhouse gas and contributes to global warming. Ozone in the atmosphere plays a dual role. Its presence in the stratosphere protects life on earth by arresting ultra-violet radiation and its presence in troposphere affects life earth as a greenhouse gas.

Global Warming Impact on Human Communities and Agriculture:

The first major health impact of global warming is the rise in rates of mortality and diseases caused by extreme weather events. These include floods, droughts, tsunamis, heat-waves and other disasters which kill thousands of people in both the developed and developing worlds.

Global warming affects agriculture in a number of ways, through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some food crops.

Acid Rains Impact on Human Communities and Agriculture:

The pollutants that cause acid rain (sulphur dioxide (SO_2) and nitrogen oxides (NOx)) also damage human health. These gases interact in the atmosphere to form fine sulphate and nitrate particles that can be transported long distances by winds and inhaled deep into people's lungs.

Acid rain affects plants directly and decreases soil quality, which reduces yields from agriculture. Its effects are particularly severe in locations near sources of sulphur dioxide and nitrogen oxides. In the United States, about two-thirds of sulphur dioxide and one-quarter of nitrogen oxides come from power generation plants, burning fossil fuels, while the rest is from industrial and transportation sources.

Ozone layer depletion Impact on Human Communities and Agriculture:

If the ozone layer is depleted, it means humans will be overly exposed to strong UV light. Over exposure to strong UV light causes skin cancer, cataracts, sunburns, weakening of immune system and quick aging. Ozone layer depletion increases the amount of UVB that reaches the Earth's surface. UVB causes non-melanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to the development of cataracts, a clouding of the eye's lens.

One of the primary concerns of future increases in solar UV-B radiation is its potential effect on global agriculture. Despite the obvious potential consequences of the issue, we cannot make quantitative predictions of anticipated effects resulting from stratospheric ozone depletion. Common finding is that different varieties of the same crop species often react differently to elevated UV-B radiation.

2.5 Environmental Laws / Acts:

India is the first country in the world to have made provisions for the protection and conservation of environment in its constitution. On 5th June, 1972 U.N. Conference on Human Environment held in Stockholm and there after 5th June is celebrated all over the world as World Environment Day. Soon after the Stockholm Conference our country took substantive legislative steps for environmental protection.

Constitutional Provisions

Article 48-A of the constitution provides: The state shall endeavour to protect and improve the environment and to safeguard forests and wildlife of the country. Article 51A (g) provides: .It shall be

the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures. Thus our constitution includes environmental protection and conservation as one of our fundamental duties. Some of the important Acts passed by the Government of India are ----

The Wildlife Protection Act in 1972.

Water Pollution (Prevention and Control) Act 1974.

Forest Conservation Act 1980.

Air Pollution (Prevention and Control) Act 1981.

Environmental Protection Act 1986.

Wildlife Protection Act 1972

The act came into force on 9th September 1972. The major activities and provisions in the act are---It provides for the appointment of wildlife advisory Board, Wildlife warden, their powers, duties etc. Protection to some endangered plants like Beddomee cycad, Blue Vanda, Ladies Slipper Orchid, Pitcher plant etc. The Act provides for setting up of National Parks, Wildlife Sanctuaries etc. The Act provides for the constitution of Central Zoo Authority. It provides for captive breeding programme for endangered species. Several Conservation Projects for individual endangered species like ---Lion Project (1972), Tiger Project (1973) Crocodile Project (1974) Brown Deer Project (1981) were started under this Act. The Act is adopted by all states in India except J & K, which has itss own Act.

Water Pollution (Prevention & Control) Act 1974

The act came into force on 23rd March 1974. It provides for maintenance and restoration of quality of all types of surface and

ground water. It provides for the establishment of Central and State Boards for pollution control. It confers them with powers and functions to control pollution. It provides for maintenance and restoration of quality of all types of surface and ground water.

Central Pollution Control Board (CPCB)

It advises the central govt. in matters related to prevention and control of water pollution. Coordinates the activities of State Pollution Control Boards and provides them technical assistance and guidance. Organizes training programs for prevention and control of pollution. Organizes comprehensive programs on pollution related issues through mass media. Establishes and recognizes laboratories for analysis of water, sewage or trade effluent sample.

State Pollution Control Board (SPCB)

The State Pollution Control Boards also have similar functions to be executed at state level and are governed by the directions of CPCB. The Board advises the state govt. with respect to the location of any industry that might pollute a stream or a well. It lays down standards for effluents and is empowered to take samples from any stream, well or trade effluent or sewage passing through an industry. The Board suggests efficient methods for utilization, treatment and disposal of trade effluents.

Forest Conservation Act 1980

The act came into force on 27th December 1980. This act deals with the conservation of forests and related aspects. The Act covers under it all types of forests including reserved forests, protected forests or any forested land. The State Govt. has been empowered under this

Act to use the forests only for forestry purposes. Any illegal non-forest activity within a forest area can be immediately stopped under this Act.

Air Pollution (Prevention & Control) Act 1981

The act came into force on 29th March 1981. The Act provides for prevention, control and abatement of air pollution. Noise pollution has been inserted as pollution in the Act in 1987.Pollution control boards at the central or state level have the regulatory authority to implement the Air Act. Just parallel to the functions related to Water (Prevention and Control of Pollution) Act, the boards perform similar functions related to improvement of air quality. Section 20 of the Act has provision for ensuring emission standards from automobiles.

Environmental Protection Act 1986

The act came into force on 23rd May 1986. The birth anniversary of our Late Prime Minister Indira Gandhi, who was a pioneer of environmental protection issues in our country. The most important functions of this Act include ---The standards of quality of air, water or soil for various areas and purposes. The maximum permissible limits of concentration of various environmental pollutants (including noise) for different areas. The prohibition and restrictions on the handling of hazardous substances in different areas. The prohibition and restriction on the location of industries and to carry on process and operations in different areas. The procedures and safeguards for the prevention of accidents which may cause environmental pollution and providing for remedial measures for such accidents.

2.6 International Agreements:

Montreal Protocols:

Montreal Protocol on substances that deplete the Ozone Layer (Montreal, Canada, September 16, 1987). This protocol signed by 24 of the 46 countries including Canada, the United States Japan, and many nations in Europe, attending a Conference in Montreal seeks to inhibit the production, consumption and trade of ozone-depleting compounds. The compounds are divided into groups: Group I (certain CFSs) and Group II (specific halons) each subject to different limitations. The protocol also distinguishes between two groups of countries, the more developed with relatively high levels of consumption of the contoured ozone depleting substances and the developing countries with relatively low levels of consumption.

Kyoto Protocols:

The Kyoto Conference held, in December 1-12, 1997, in Kyoto, Japan. The Kyoto Protocol to the United Nations Framework Convention on Climate Change commits industrialized nations to specific, legally binding emission reduction targets for six greenhouse gases: carbon dioxide, methane, nitrous oxide, hydro fluorocarbons, per-fluorinated compounds and sulphur hexa fluoride. The Kyoto agreement outlined emission targets. Implementation required participating members to create policies and measures to reduce and offset domestic emissions and increase absorption of greenhouse gases. Other specifications included requirements for accountability, compliance and reporting. That agreement expired at the end of 2012. Members agreed upon an extension of the protocol, effective from 2013 to 2020.

Convention on Biological Diversity:

Earth Summit-United Nations Conference on Environment and Development (Rio de Janeiro 3-14 June, 1992)- The historic Earth Summit held from June 3-14, 1992 in Rio de Janeiro was attended by over 115 heads of states or governments. The major achievement was the adoption of UNCED conservation of flora and fauna in global level. The Convention calls on States to restore and preserve degraded ecosystems and develop guidelines to manage them or to take measures to promote the recovery of threatened species. The Convention also stresses the importance of assessing and precluding the environmental impacts of proposed projects, information exchange and State cooperation, and joint contingency plans to reduce imminent environmental damage. The objective of UNCBD and its additional Protocols of Nagoya and Cartagena is to maintain biological diversity, stop genetic erosion and ensure a just and equitable sharing of the benefits from the use of genetic resources.

2.7 Nature Reserves:

Nature reserves are areas selected to preserve and protect, in perpetuity, representative (typical) and special natural ecosystems, plant and animal species, features and natural processes. Scientific research and education are the primary uses of nature reserves and recreation is generally restricted. Biosphere reserves, National Parks and wildlife sanctuaries are examples of natural reserves.

The first ecological or natural reserve grew out of efforts associated with the International Biological Program (IBP), conducted in 58 countries from 1964 to 1974. These efforts aimed to identify and preserve representative examples of the world's ecosystems for present

and future biological research and education, for preservation of species, their genes, and habitats, and as benchmarks for comparison with ecosystems managed by humans.

In 1994, responsibility for protected areas, including nature reserves, was transferred to the Department of Natural Resources (DNR). Work continued towards the identification of new sites of ecological significance and the designation of additional nature reserves, and in 1998, responsibility for protected areas moved to the Department of the Environment.

Nature Reserves are established to: - provide areas suitable for scientific research and education; protect representative examples of natural ecosystems; provide examples of ecosystems that have been modified by humans and offer an opportunity to study the natural recovery of ecosystems from modification; protect rare or endangered native plants or animals in their natural habitats; and provide educational or research field areas for the long-term study of natural changes and balancing forces in undisturbed ecosystems.

2.8 Tribal Populations and Rights:

The word 'Tribe' denotes a group of people living in primitive and ruthless conditions. These tribes are a social group living in a fixed territory having no such Specialization of functions and the people living in these social groups are known as tribes or tribal people. Tribes also have several sub groups and collectively they are known as 'Tribal Society'. Tribes are the inhabitants of forests since pre history and even in this modern world this trend is followed by many people. Tribes constitute around 8.6 percent of the total Indian population and the

total tribal population around 80 percent are found in Central India. India has the second largest tribal population in the world.

In India, Scheduled Tribes are mainly spread across the forests and hilly regions of India. Tribes in India are mainly characterised by their geographical location and distinct culture. In India, tribes are treated very low, are execrated and are even treated as untouchables by the prevailing adherence to social norms and caste system.

Constitutional Rights to Tribal People:

The Constitution of India has provided special provisions to the tribal people to safeguard their interests.

1. Article 15 of the Indian Constitution states that the state shall not discriminate any citizen on grounds of religion, race, caste, sex, place of birth or any of them. This explains that every citizen of India is provided equal rights and opportunities without any discrimination.

2. Government of India has made reservation for the tribes in employment under Article 16(4) of the Constitution of India.

3. The Government of India has reserved seats in The House of People (Lok Sabha) and The State Legislative Assemblies under Article 330 and 332 of The Constitution of India.

4. Article 19(5) of the Constitution of India guarantees the tribal people right to own property and enjoy it in any part of the country.

5. Article 338 of The Constitution of India grants the right to appoint a Commissioner to look after welfare activities of tribes.

6. Article 46 of the Constitution of India states that, The State shall promote with special care the educational and economic interests of the weaker sections of the people and in particular, the Scheduled

Castes and the Scheduled Tribes, and shall protect them from social injustice and all forms of exploitation.

7. Under Article 275(i) of the Constitution of India the Central Government is required to give grants-in-aid to the State Government for approved Tribal Welfare Schemes.

2.9 Human and Wildlife Conflicts:

Man animal conflicts keep on coming to lime light from several states in our country. In Sambalpur, Orissa 195 humans were killed in the last 5 years by elephants. In retaliation the villagers killed 98 elephants and badly injured 30 elephants. Several instances of killing of elephants in the border regions of Kote-Chamarajanagar belt in Mysore have been reported recently. The man-elephant conflict in this region has arisen because of the massive damage done by the elephants to the farmer's cotton and sugarcane crops. The agonized villagers electrocute the elephants and sometimes hide explosives in the sugarcane fields, which explode as the elephants intrude into their fields. In fact, more killings are done by locals than by poachers.

Recently, in early 2004, a man-eating tiger was reported to kill 16 Nepalese people and one 4-year old child inside the Royal Chitwan National Park, 240 Km South-west of Kathmandu. The Park renowned for its wildlife conservation effort has become a zone of terror for the locals. At times, such conflicting situations have been reported from the border regions of Corbett, Dudhwa, Palamau and Ranthambore National Parks in our country as well. Very recently in June, 2004 two men were killed by leopards in Powai, Mumbai. A total of 14 persons were killed during 19 attacks since January by the leopards from the

Sanjay Gandhi National Park, Mumbai which has created a panic among the local residents.

Causes of Man-animal conflicts:

1. Dwindling habitats of tigers, elephants, rhinos and bears due to shrinking forest cover compels them to move outside the forest and attack the field or sometimes even humans. Human encroachment into the forest areas raises a conflict between man and the wildlife, perhaps because it is an issue of survival of both.

2. Usually the ill, weak and injured animals have a tendency to attack man. Also, the female tigress attacks the human if she feels that her newborn cubs are in danger. But the biggest problem is that if human-flesh is tasted once then the tiger does not eat any other animal. At the same time, it is very difficult to trace and cull the man-eating tiger and in the process many innocent tigers are also killed.

3. Earlier, forest departments used to cultivate paddy, sugarcane etc. within the sanctuaries when the favourite staple food of elephants i.e. bamboo leaves were not available. Now due to lack of such practices the animals move out of the forest in search of food. It may be noted that, one adult elephant needs 2 quintals of green fodder and 150 litres of clean water daily and if it is not available, the animal strays out.

4. Very often the villagers put electric wiring around their ripe crop fields. The elephants get injured, suffer in pain and turn violent.

5. Earlier there used to be wild-life corridors through which the wild animals used to migrate seasonally in groups to other areas. Due to development of human settlements in these corridors, the path of wildlife has been disrupted and the animals attack the settlements.

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Unit - VII

HUMAN COMMUNITIES AND THE ENVIRONMENT

3.1 Human Population Growth

3.2 Reasons / Causes of Population Growth

3.3 Effects of Population Growth on Environment

3.4 Human Health and Welfare

3.5 Resettlement and Rehabilitation of Project effected Persons

3.6 Disaster Management

3.7 Environmental Movements

3.8 Environmental Ethics

3.9 Environmental Communication and Public Awareness

3.1 Human Population Growth:

The rapid population growth and economic development in the country are degrading the environment through the uncontrolled growth of urbani zation and indu--strialization expansion and intensification of agriculture, and the destruction of natural habitats. One of the major causes of environmental degradation in India could be attributed to rapid growth of population, which is adversely affecting the natural resources and environment. The growing population and the environmental deterioration face the challenge of sustained development without environmental damage. The existence or the absence of favourable natural resources can facilitate or retard the process of economic development. The three fundamental demographic factors of births, deaths and migration produce changes in population size; composition, distribution and these changes raise a number of important questions of cause and effect.

3.2 Reasons / Causes of Population Growth:

Overpopulation is an undesirable condition where the number of existing human population exceeds the carrying capacity of Earth. Overpopulation is caused by number of factors. Reduced mortality rate, better medical facilities, depletion of precious resources are few of the causes which results in overpopulation. It is possible for a sparsely populated area to become densely populated if it is not able to sustain life.

1. High birth rate & Low death rate

At the root, overpopulation is the difference between the overall birth rate and death rate in populations. If the number of children born each year equals the number of adults that die, then the population will stabilize. Talking about overpopulation shows that while there are many factors that can increase the death rate for short periods of time, the ones that increase the birth rate do so over a long period of time. The discovery of agriculture by our ancestors was one factor that provided them with the ability to sustain their nutrition without hunting. This created the first imbalance between the two rates.

2. Early Marriages

Even though legally the marriageable age of a girl is 18 years, the concept of early marriage still prevails and getting married at an young age prolongs the child bearing age. Also, in India, marriage is a sacred obligation and a universal practice, where almost every woman is married at the reproductive age.

3. Joint Family System

Joint family system is still prevalent in the large part of the country which supports to population growth. Despite the fact, joint family system has started disintegrating in big cities; even then it still is the common feature. The joint family system induces young couples to have more children though they may not be in a position to support them. Thus, joint family system, to a greater extent, is responsible to increase population especially in rural areas of the country.

4. Social and Religious Beliefs

According to Hindu ideology, it is considered one's dharma to have children. In any case, they must have a son because certain religious duties will be performed only by him and none else. Similarly, they should also have a daughter as the giving of a daughter in marriage is also an act high religious spirit. In this way, such irrational attitudes are based on wrong religion and social norms laid down by man. The birth of child is considered to be a gift of god. On account of these religious and social superstitions there is no check on raised; population.

5. Ignorance of Family Planning Methods

Most developing nations have large number of people who are illiterate, living below the poverty line and have little or no knowledge about family planning. Getting their children married at an early age increase the chances of producing more kids. Those people are unable to understand the harmful effects of overpopulation and lack of quality education prompts them to avoid family planning measures.

3.3 Effects of Population Growth on Environment:

One of the factors responsible for environment degradation is population growth or population density. In particular, population density plays the most important role in shaping the socio-economic environment. Its effects are felt on the natural environment also.

Depletion of Natural Resources

The effects of overpopulation are quite severe. The first of these is the depletion of resources. The Earth can only produce a limited amount of water and food, which is falling short of the current needs. Most of the environmental damage being seen in the last fifty odd years is because of the growing number of people on the planet. They are cutting down forests, hunting wildlife in a reckless manner, causing pollution and creating a host of problems. Those engaged in talking about overpopulation have noticed that acts of violence and aggression outside of a war zone have increased tremendously while competing for resources.

Degradation of Environment

With the overuse of coal, oil and natural gas, it has started producing some serious effects on our environment. Rise in the number of vehicles and industries have badly affected the quality of air. Rise in amount of CO_2 emissions leads to global warming. Melting of polar ice caps, changing climate patterns, rise in sea level are few of the consequences that we might have to face due to environment pollution.

Generation of Waste

Due to his destructive activities, man has dumped more and more waste in environment. As the man-made waste is not

transformed, it causes degradation and the capacity of environment to absorb more waste is reduced. Further, waste leads to air and water pollution.

Threat to Biodiversity

Due to his destructive activities, man has extracted more and more minerals from the earth. Animals have been hunted and plants have disappeared. There has been loss of biodiversity. These have led to ecological imbalance.

Strain on Forests

Man has established new housing colonies. National highways and hydropower projects have been built and forests have been wiped out. These destructive activities have increased and led to ecological imbalance.

Urbanization

Rapid growth of population has led to urbanization which has adversely affected environment. Due to population pressure, natural resources in the cities are depleted at a fast rate. Moreover, population does not have proper sanitation facilities and pure drinking water. As a result, the health of the people is adversely affected. No doubt, urbanization reduces pressure on the rural environment, but it brings with if environmental damages through industrial growth, emissions and wastes.

3.4 Human Health and Welfare:

The state of health of the people does not depend on the number of doctors and hospitals only, but also on clean environment. The changes in the human environment have increased the incidence of many diseases. Such changes include socio-economic and cultural

changes leading to stresses of many kinds on human health. The increasing population and the expanding cities and industries have brought about changes in the human environment and have made it a paradise for infectious agents.

What is Health?

Health is a dynamic condition resulting from a body's constant adjustment and adaptation in response to stresses. The World Health Organization (WHO) defined health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."

What is Disease?

Any condition which interferes with the normal functioning of the body is called a disease. In other words, disease may be defined as a disorder in the physical, physiological, psychological or social state of a person caused due to nutritional deficiency, physiological disorder, genetic disorder, pathogen or any other reason.

Nearly 80 percent of the world's diseases, particularly in developing countries are considered to be water borne. About 15 lakh children die of water borne disease, like diarrhoea in pre-school age group. The incidence of malaria, filarial, encephalitis and kala azar is mainly due to the degradation of our environment.

Types of Diseases

The diseases may be classified into two broad categories.

1. Communicable Diseases: The diseases which can be transmitted from an infected person to a healthy person. Ex: Chicken pox, Measles, Poliomyelitis, Hepatitis, Malaria and Dengue etc.

2. Non - Communicable Diseases: These diseases do not spread from an affected person to a healthy person. Ex. Diabetes, Cardio vascular diseases, Cancer, Allergy etc.

Diseases Caused by Virus

Dengue Fever

1. Dengue fever caused by the Dengue Virus.

2. Dengue fever transmitted by the *Aedes aegypti* mosquito.

3. Incubation Period of the dengue virus time between the bite of a mosquito carrying the start of symptoms averages 4 to 6 days, with a range of 3 to 14 days.

Symptoms:

1. Sudden onset of high fever, generally 104-105 ˚F (40 ˚C), which may last 4- 5 days.

2. Severe headache mostly in the forehead.

3. Pain in the joints and muscles, body aches.

4. Pain behind the eyes which worsens with eye movement.

5. Nausea or vomiting.

Prevention: Following steps can be taken to prevent spread of dengue fever:

1. Avoid water stagnation for more than 72 hours so that the mosquitoes do not breed there.

2. Prevent mosquito breeding in stored water bodies, like ponds, wells etc.,

3. Destroy discarded objects like old tyres, bottles, etc. as they collect and store rain water.

4. Use mosquito repellents and wear long sleeved clothes to curtail exposure.

5. Use mosquito nets, also during daytime.

6. Patients suffering from dengue fever must be isolated for at least 5 days.

Malaria Fever

1. Malaria fever caused by the *Plasmodium vivax* parasite belongs to Protozoa family.

2. Malaria fever transmitted by the bite of female *Anopheles* mosquitoes.

3. Malaria virus Plasmodium vivax Incubation period approximately 12 days.

Symptoms:

1. Headache, nausea and muscular pain.

2. Feeling of chilliness and shivering followed by fever which becomes normal along with sweating after some time.

3. The patient becomes weak and anemic.

4. If not treated properly secondary complications may lead to death.

Prevention and cure:

1. Fitting of double door and windows (with "Jali" i.e. wire mesh) in the house to prevent entry of mosquitoes.

2. Use of mosquito net and mosquito repellents.

3. No water should be allowed to collect in ditches or other open spaces to prevent mosquito breeding.

Diseases Caused by Bacteria

Typhoid

1. Typhoid caused by the Bacillus rod-shaped bacterium (*Salmonella typhi*)

2. Typhoid transmitted through contaminated food and water

3. Incubation period of *salmonella typhi* bacteria about 1-3 weeks

Symptoms:

1. Continuous fever, headache, slow pulse rate.

2. Reddish rashes appear on the belly.

3. In extreme cases, ulcers may rupture resulting in death of the patient.

Prevention and Cure:

1. Anti-typhoid inoculation should be given.

2. Avoid taking exposed food and drinks.

3. Proper sanitation and cleanliness should be maintained.

4. Proper disposal of excreta of the patient.

5. Antibiotics should be administered.

Cholera

1. Cholera often breaks out among crowded and areas with poor sanitary conditions.

2. Cholera caused by the Comma shaped bacterium (*Vibrio cholerae*)

3. Cholera transmitted through contaminated food and water. House - fly is the carrier.

4. Incubation period of the *vibrio cholera* bacteria 6 hours to 2-3 days.

Symptoms:

1. Acute diarrohoea, rice watery stool.

2. Muscular cramps.

3. Loss of minerals through urine.

4. Dehydration leads to death.

Prevention and cure

1. Cholera vaccination should be given.

2. Electrolytes (Na, K, sugar, etc.) dissolved in water should be given to the patient.

3. Patient to check dehydration (In market it is available as ORS–oral rehydration solution).

4. Proper washing and cooking of food.

5. Proper disposal of vomit and human excreta.

6. Flies should not be allowed to sit on eatables and utensils.

3.5 Resettlement and Rehabilitation of Project effected Persons:

Though developmental projects like construction of dams, mining, creation of National Parks, etc., provide manifold benefits to the society and raise the quality and standard of life of the people. But quite often, the native people of the project sites are displaced from their homeland.

Causes of Displacement

The main causes of displacement of people are described below.

Displacement Due to Dams: Big river valley projects like Hirakund dam (Orissa), Bhakra Nangal dam (Punjab), Tehri dam (Uttarpradesh), Sardar Sarvovar project (Gujarat) and Damodar Valley project (West Bengal) etc. have caused large scale displacement of local people. In the last 50 years more than 20 million people have been displaced by dams.

Displacement Due to Mining: Mining operations cover thousands of hectares of land and cause displacement of native people. Jharia coal fields (Jharkhand) have been posing a big problem to the local

residents due to underground fires and they are asked to vacate the area.

Displacement Due to Creation of National Parks: When a forest area is converted into a National Park, it deprives the local dwellers of their ancestral rights of collection of forest products. As a result, the local people retaliate by starting destructive activities.

Displacement Due to Natural Disaster: Every year natural disasters like earthquake, landslides, droughts, floods etc., displace millions of people from their homeland.

Problems of Displacement

1. Displaced people lose their land homes, jobs and property, which often leads to social isolation and increased morbidity and mortality.
2. The joint families and tribal communities often face disintegration as the people are resettled at different places.
3. The social and cultural activities and kinship systems of tribal people vanish with their displacement.
4. The displaced people lose their identity and intimate link with the environment.
5. The inherited knowledge and experiences of the local people about the plants and animals of that area and their uses get lost with the displacement.
6. The well-known environmentalist, Sundarlal Bahuguna says," The big dams are being constructed everywhere in tribal or hilly areas.

7. The people of these regions are being uprooted to provide power to big cities, industries and irrigation water to comparatively more prosperous areas. This is unethical.
8. The locals are affected by sudden rise in prices of essential commodities. Their scare resources of water, fuel etc. are exploited leaving nothing for them."

Rehabilitation Policy

There is a need for a comprehensive National Rehabilitation Policy. 'Land for land' is a better policy than cash settlements of displaced people. Following objectives should be kept in mind for the rehabilitation programmes.

1. The displaced people should get an appropriate share in the fruits of development.
2. The displaced people should be rehabilitated within their own environment.
3. Removal of poverty should be an objective of the rehabilitation policy and therefore some land for all should be provided.
4. Even the landless ousters should be given assurance of employment.
5. While dealing with tribal, their traditions, culture and rights in land and forests should be preserved.
6. 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.
7. Special attention should be given to the rehabilitation of artisans and village crafts people.

8. Villagers should be taken into confidence at every stage of implementation and they should be educated, through open meetings and discussion, about the legalities of the Land Acquisition Act and other rehabilitation provisions.
9. The aid of voluntary agencies should be taken in the planning and implementation of the rehabilitation programme.

3.6 Disaster Management:

Hazard: It is a perceived natural event which threatens both life and property

Disaster: A disaster is the realization of this hazard. It is defined as the geological process and it is an event concentrated in time and space in which a society or subdivision of a society undergoes severe danger and causes loss of its members and physical property.

Types of Disasters

1. Natural disasters – refers to those disasters that are generated by natural phenomena.

2. Man-made disasters – refers to the disasters resulting from man-made hazards.

Floods:

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

Types of Floods

Floods may be classified in to four types. They are:

Flash Floods

Flash floods happen in a short time; they have a great volume of water, and are local floods. The runoff of intense rain results in high flood waves.

River Floods

Riverine floods are caused by melting of snow and precipitation over large areas. They take place in rivers. Floods in large rivers take hours to days.

Coastal Floods

Coastal floods are caused by tides, storms, tropical cyclones, or tsunamis.

They happen in the ocean and affect the general public and maritime interests along the coastline. They are caused by heavy surf, tidal piling, and storm surges, Other factors are tidal cycles, behaviours of the storm, river or stream runoff, no offshore reefs or other barriers, and high winds.

Urban Floods

Urban floods are when the land is turned from fields or woods into roads and parking lots. Since this happens it can't absorb the rainfall. During the urban floods all the streets become rivers and basements become full of water, they are death traps.

Causes of floods

Heavy rain, rainfall during cyclone causes floods, sudden snow melt also raises the quantity of water in streams and causes flood. Sudden and excess release of impounded water behind dams clearing of forests for agriculture has also increased severity of floods.

Effects of Floods

Floodwater can seriously disrupt public and personal transport by cutting off roads and railway lines, as well as communication links when telephone lines are damaged. Floods disrupt normal drainage systems in cities, and sewage spills are common, which represents a serious health hazard, along with standing water and wet materials in the home. Bacteria mould and viruses, cause disease, trigger allergic reactions, and continue to damage materials long after a flood.

Control Measures

Introduce better flood warning systems. Modify homes and businesses to help them withstand floods. Construct buildings above flood levels. Tackle climate change. Increase spending on flood defences. Restore rivers to their natural courses.

Earthquakes:

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

Types of Earthquakes: Earthquakes are two types they are natural and anthropogenic earthquakes.

(A) Natural Earthquakes

Natural earthquakes are those, which are caused by natural processes i.e. due to end genetic forces. These are further divided into four subcategories.

Volcanic Earthquakes

These 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.

Tectonic Earthquakes

These 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).

Isostatic Earthquakes

These are triggered due to sudden disturbance in the Isostatic balance at regional scale due to imbalance in the geological processes.

Plutonic Earthquakes

These are in fact, deep focus earthquakes, which occur at greater depths.

(B) Anthropogenic Earthquakes

These are caused by human activities such as pumping of water and mineral oil from underground aquifers. And oil reserves respectively, deep underground mining,

Causes of Earthquakes

Disequilibrium in any part of the earth crust. Underground nuclear testing. Decrease of underground water level.

Effects of Earthquakes

The Earthquakes are effect on Economy and Society. Damage the settlements and transport systems. Collapses houses and their structures Deformation of ground surface and Tsunami

Control Measures of Earthquakes

Constructing earthquake resistant building. Wooden houses are preferred. Seismic hazard map should give the information about the magnitude of intensity of anticipated earthquakes.

Cyclones

It is a meteorological process, intense depressions forming over the open oceans and moving towards the land.

Types of Cyclones

Cyclones are known by different names in different parts of the world:

Typhoons in the Northwest Pacific Ocean west of the dateline

Hurricanes in the North Atlantic Ocean, the Northeast Pacific Ocean east of the dateline, or the South Pacific Ocean.

Tropical cyclones - the Southwest Pacific Ocean and Southeast Indian Ocean.

Effects of Cyclones

The damage depends on the intensity of cyclone the damage to human life, crops, roads, transport, could be heavy rain.

First, in a sudden, brief onslaught, high winds cause major damage to infrastructure and housing, in particular to fragile constructions.

Physical damage

Structures will be damaged or destroyed by the wind force, flooding and storm surge. Light pitched roofs of most structures especially the ones fitted on to industrial buildings will suffer severe damage. Casualties and public health: Casualties and public heath caused by flooding and flying elements, contamination of water supplies may lead to viral outbreaks, diarrhea, and malaria. Water

supplies ground and pipe water supply may get contaminated by flood waters. Crops and food supplies: high winds and rains ruin the standing crop and food stock lying in low lying areas.

Control Measures of Cyclones

Coastal belt plantation. Green belt plantation along the coastal line in a scientific interweaving pattern can reduce the effect of the hazard. Providing a cover through green belt sustains less damage. Forests act as a wide buffer zone against strong winds and flash floods.

Land Slides:

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

Causes of Landslides

Erosion causing extremely steep slopes. Powerful earthquakes Excess weight on unstable soil. Volcanic eruptions – Ash Great force

Effects of Landslides

Destroys the slope/hill. Eliminates all vegetation. Buries houses and sometimes entire villages. Weakens the slope and makes it more susceptible to further landslides

Some Important Landslides in the Worldwide

1. Brazil, January 2003, 8 people killed
2. March 4, 2003 14 people killed, 400 buried in Bolivia
3. March 19th, 2003 7 people killed, 13 injured, and 20+ missing in Western Columbia
4. April 1st, 2003 400 homes buried,700people missing Bolivia landslide
5. April 2, 2003 34 people killed in Indonesian flood/landslide

3.7 Environmental Movements:

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. Environmental movements range from the highly organized and formally institutionalized ones to the radically informal activities. The spatial scope of various environmental movements ranges from being local to the almost global.

Chipko Movement

The Chipko movement was started in the year of 1973, In Chamoli district and later at Tehri-Garhwal district of Uttarakhand in the presence of Sundarlal Bahuguna, Gaura Devi, Sudesha Devi, Bachni Devi, Chandi Prasad Bhatt, Govind Singh Rawat, Dhoom Singh Negi, Shamsher Singh Bisht and Ghanasyam Raturi. The main objective of Chipko movement 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.

Silent Valley Movement

The Silent Valley Movement was started in the year of 1978, in Silent Valley, an evergreen tropical forest in the Palakkad district of Kerala, India, with the help of The Kerala Sastra Sahitya Parishad (KSSP) an NGO, and the poet-activist Sughathakumari played an important role in the Silent Valley protests. The main aim of the Silent Valley Movement is 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.

Bishnois Movement

The Bishnois movement was started in 1700s, in Khejarli, Marwar region, Rajasthan state, in the presence of Amrita Devi along with Bishnoi villagers in Khejarli and surrounding villages. The main aim of the Bishnois Movement was 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.

3.8 Environmental Ethics:

Ethical issues dealing with the environment are no different from other kinds of problems. The concept of an environmental ethics could encompass differing principles and beliefs. Ethics is one branch of philosophy, which fundamentally attempts to define what is right, and what is wrong, regardless of cultural differences. Environmental ethics are formulated on the basis that human beings are also a part of nature and nature has many interdependent components. In any natural ecosystem, the well-being of the individual and of each species is linked to the welbeing of the entire community. In a world

increasingly without environmental borders, nations, like individuals, should have a fundamental ethical responsibility to respect nature and to care for the Earth, protecting its life-support systems, biodiversity, and beauty, caring for the needs of other countries and future generations. Environmental ethicists argue that to consider environmental protection as a "right" of the planet is a natural extension of concepts of human rights. Although there are many different attitudes about the environment.

1. Three types of the ethics are identified as (a) the development ethic, (b) the preservation ethic, and (c) the conservation ethic. Each of these ethical positions has its own appropriate code of conduct against which ecological mortality may be measured.
2. The development ethic is based 011 actions. Development in any sector is inevitable. But the development should not crop up at the cost of environmental failure. This philosophy is strengthened by the idea that, "if it can be done, it should be done."
3. The preservation ethic considers nature special in itself. Some preservationists' have an almost religious outlook regarding nature. They believe that nature is beautiful place to live in and it should be maintained for feeding, breeding, enjoyment and peace.
4. The third environmental ethic is referred to as the conservation ethic, it recognizes the desirability of decent living standards, but it works towards a balance of resource use and resource availability.

3.9 Environmental Communication and Public Awareness:

Environmental communication refers to the study and practice of how individuals, institutions, societies, and cultures craft, distribute, receive, understand, and use messages about the environment and human interactions with the environment. Environmental Communications pertains to any profession which communicates an environmental or scientific message. This message can range from conservation of resources to promotion of products to education about community programs and anywhere in between, and environmental communications professionals are working in every sector of the economy from the largest corporations to the smallest newspapers. The field is becoming more and more important as the stakes have become greater and greater and the tools for communicating become more diverse. Corporations, government agencies, and conservation organizations all compete for public support, and the art of "spinning" complex and often conflicting environmental information for public consumption has become a sophisticated profession. Effective communication of an environmental message can determine the fate of an environmental campaign at any level - local, regional, national or global."

CNG (Compressed Natural Gas) Vehicles in Delhi:

Delhi, the capital city of India, is one of the 10 most polluted cities of the world and the third most populated city in India with 13.8 million inhabitants spread over 1483 km. The population density has increased in last 10 years from 6352 per km2 in 1991 to nearly 9500 per km2 in 2000. Its length of 51.9 km and width of 48.5 km gives it a circular structure. The transportation network in Delhi is

predominantly road based with 1284 km of road per 100 km^2. Its urban area has quadrupled from 182 km in 1970s to more than 750 km2 in 1999 with the number of industries from 26,000 in 1971 to 137,000 in 1997. The steep increase in vehicular population has resulted in corresponding increase in pollutants emitted by these vehicles. Presently, more than 1300 tonnes of pollutants are emitted by the vehicles plying in Delhi.

Implementation of CNG in Delhi

It was not easy to implement the Supreme Court orders and use CNG as a major fuel in vehicles. There were different people with different opinions. The claims that other cities of the world still do not have such a large fleet of vehicles are often made out of context. The reason why a large fleet of buses have not yet been made the target of mandatory alternative fuel regulations in European and US cities is because of lesser number of buses in those cities, lesser intensity of bus use and comparatively lesser relative contribution of buses to air pollution. It is also important to note that availability of CNG also varies from country to country but whenever it is available a move is being made to use it for transportation. The report of Centre for Science and Environment (CSE, 2001) concludes that in cities, facing severe air pollution problems, the use of heavy-duty natural gas engines in place of diesels offers numerous environmental benefits. This has led Tehran, Los Angles, Bangkok, Santiago, Cairo, Beijing and many other major cities to establish natural gas bus programme (Frank et al., 2001). Before starting the implementation of CNG as a fuel in transportation of Delhi, many earlier studies made by other countries have been reviewed.

Advantages of CNG

It is found to be one of the most environment friendly fuels as CNG powered vehicles emit 85% less NOX, 70% less reactive HC's, and 74% less CO than similar gasoline powered vehicles (http://daq.state.nc.us/motor/ cng/). The use of CNG-fuelled vehicles significantly reduces emissions of ozone precursors. While Gasoline powered vehicles produce (NOX) that when combined with volatile organic compounds (VOCs) which are produced by trees naturally, will react with sunlight in the lower atmosphere to form O3, a primary constituent of smog.

Some more advantages of CNG are as follows:

1. Lesser running cost;
2. Very easy on the engine, giving longer service life and lower maintenance costs;
3. Reduces the demand for finite petroleum supply;
4. Reduction of carbon monoxide emission by over 90%;
5. Drastic reduction in the relative hydrocarbon emission by 80-93%;
6. Improves fuel consumption and engine efficiency;
7. Dry gaseous fuel does not dilute the lubricating oil, thus saving on oil filters and oil chargers;
8. reduced maintenance cost;
9. Reduction in engine noise levels significantly owing to its high octane number;
10. Reduction in air toxic emission impact by 90%.

Disadvantages of CNG

The disadvantages of CNG driven vehicles are as follows: •

1. Driving complaints due to loss of power with CNG.
2. Dynamometer tests indicate that CNG-fuelled vehicles have 10-15% lower power output than petrol engines.
3. Increased exhaust-valve wear in CNG-operated vehicles are anticipated due to the drying effect of the gaseous fuel.
4. Limited service availability in Delhi.
5. High cost of conversion of vehicle to CNG mode.
6. The additional weight of CNG cylinders does pose a problem.

The above disadvantages have been overlooked in view of advantageous reduction of air pollutants in ambient air quality which leads to an improvement in ambient air quality of Delhi.

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