Unit 7 Human Communities and the Environment

POINTS TO BE DISCUSSED:

•Human population growth: Impacts on environment, human health and welfare.
• Environmental Disaster: Natural Disasters-floods, earthquake, cyclones, tsunami and Landslides; Manmade Disaster- Bhopal and Chernobyl.
•Environmental movements: Bishnois, Chipko, Silent valley, big dam movements.
•Environmental ethics: Role of gender and cultures in environmental conservation.
•Environmental education and public awareness.

7.1 HUMAN POPULATION GROWTH:

Population consists of a group of organisms of a particular species occupying an area and continually being modified by increases (births and immigrations) and losses (deaths and emigrations).Population ecology is the study of individuals of the same species. Demography is the study of a population, the total number of people or organisms in a given area. Population is a dynamic phenomenon. The numbers, distribution and composition of the population are constantly changing. Growth of population is the change in the number of people living in a particular area between two points of time. An important feature of population study is the change in population. This is influenced by three main factors like birth, death, and migration of people in a given year.

- Birth rate: The number of children born per 1000 people in a year
- Death rate: The number of people died per 1000 people in a year.

The age composition of a population refers to the number of people in different age groups in a country. It is one of the most basic characteristics of a population. The most significant feature of the Indian population is the size of its adolescent population. It constitutes one-fifth of the total population of India. The current population of India is **1,388,530,816** as of February 17, 2021. India population is equivalent to **17.7%** of the total world population.

Overpopulation can have disastrous effects. When population exceeds available resources, calamity can result, including famine, shortages of energy sources and other natural resources, rapid and uncontrolled spread of communicable diseases in dense populations, and war over scarce resources, such as land. Dense populations may also settle available land and crowd out other land uses, such as agriculture.

As with any biological population, the size of a human population is limited by the supply of food, the effect of diseases, and other environmental factors. Future population growth is uncertain. Higher growth entails more emissions and means more people will be vulnerable to climate-related impacts.

7.2 ENVIRONMENTAL DISASTERS:

Environmental disasters have a detrimental effect on ecosystems. These events are often short in duration, but have a lasting impact on the organisms that live in the affected habitat. Environmental catastrophes change the physical environment so much that the damage to the ecosystem is permanent. In other cases, environmental damage can be contained and the habitat rehabilitated. The increasing incidence and severity of disasters such as hurricanes, floods and landslides are leaving more people vulnerable each year, particularly those below line. Disasters and climate change are a growing concern. Disasters can be either man made or natural.

7.2.1 NATURAL DISASTERS:

Natural disasters are large-scale geological or meteorological events that have the ability to cause loss of life or property. They are of the following type:

A. Floods: Flood is the overflowing of a body of water especially onto normally dry land. Floods are the most common and widespread of all natural disasters. India is one of the highly flood prone countries in the world. The situation caused when the water becomes uncontrollable is said to be flooded. The plain areas of a region which are drained by a number of rivers, are the places most affected by floods. They destroy houses and buildings, and carry soil away

from valuable farming land. Floods can also contaminate drinking water and lead to diseases. Global warming and climate change are the main causes of floods.

B. Earthquake: Earthquakes are among the many natural calamities that have caused devastation to properties and claimed thousands of lives over the years. An **earthquake** is what happens when two blocks of the earth suddenly slip past one another. Seismic waves are produced when some form of energy stored in Earth's crust is suddenly released. An earthquake is measured on Richter's scale. A seismometer detects the vibrations caused by an earthquake. It plots these vibrations on a seismograph.

C. Cyclones: The Word Cyclone is derived from the Greek Word "Cyclos" meaning coils of a snake. A cyclone is a huge strong wind system which blows around the centre of intense low pressure area. **Cyclone** refers to any spinning storm that rotates around a low-pressure center. The low-pressure center is also referred to as the 'eye' of the storm. Tropical cyclones are formed over warm ocean water near the equator. Warm moist air near the surface of the ocean rises upwards creating a low-pressure area near the surface. This results in the movement of cooler air from adjacent areas into the low-pressure area. Now this cool air becomes warm and rises up. This cycle keeps continuing. The warm moist air which rises upwards cools the water in the air, resulting in the formation of clouds. This whole system of clouds and winds spins and grows. This entire cycle results in a cyclone.

D. Tsunami: The phenomenon we call tsunami is a series of large waves of extremely long wavelength usually generated by a violent, impulsive undersea disturbance or activity near the coast or in the ocean. The word tsunami is composed of the Japanese words "tsu" (which means harbor) and "nami" (which means "wave"). Tsunamis travel at speeds of up to 500 miles an hour in the open ocean and rise to heights of several hundred feet as they come ashore. They can cause widespread devastation in coastal areas. Tsunamis are a series of massive waves that can arise from underwater earthquake, volcanic eruption or landslides.

E. Landslides: A landslide is the rapid mass movement of soil, mud or rocks downhill due to the pull of gravity. A landslide occurs when part of a natural slope is unable to support its own weight. Landslides and debris flows are caused by a number of factors, such as earthquakes, heavy rain and volcanic eruptions. Landslide movement can be sudden, especially when caused by intense rainstorms. Landslides cause property damage, injury, and death and

adversely affect a variety of resources. The adverse effects of landslides include the cost to repair structures, loss of property value, disruption of transportation routes, medical costs in the case of injury and loss of timber. Slope instability along transportation routes and in mountain valleys causes serious accidents and is a source of considerable economic losses.

7.2.2 MAN-MADE DISASTERS: Man-made disasters are the consequence of technological or human hazards. Disasters that are caused due to carelessness of human or mishandling of dangerous equipment's they are called manmade disasters. Man-made disasters are difficult to predict, however they are preventable.

A. BHOPAL GAS TRAGEDY: In the early morning hours of December 3, 1984, a poisonous grey cloud (forty tons of toxic gases) from Union Carbide India Limited pesticide plant at Bhopal spread throughout the city. Over 500,000 people were exposed to methyl isocyanate (MIC) gas. The disaster happened because water entered a tank containing MIC. A mixture of poisonous gases flooded the city, causing great panic as people woke up with a burning sensation in their lungs. The gas spread over the densely populated area around the plant, killing thousands of people immediately and creating a panic as others attempted to flee Bhopal. An estimated 10,000 or more people died. About 500,000 more people suffered agonizing injuries with disastrous effects of the massive poisoning. People suffered from respiratory disorders, genetic changes which caused cancer. Exposure to methyl isocyanine led not only to miscarriage but it also damaged growing fetus and affected fertility in men and women. Civil and criminal cases were filed in the District Court of Bhopal, India, involving UCC and Warren Anderson, UCC CEO at the time of the disaster. The Bhopal disaster is frequently cited as the worst industrial disaster.

B. CHERNOBYL DISASTER: On April 26, 1986, a sudden surge of power during a reactor test destroyed Unit 4 of the nuclear power station at Chernobyl, Ukraine, in the former Soviet Union. The accident and the fire that followed released massive amounts of radioactive material into the environment. The accident started during a safety test on an RBMK-type nuclear reactor. The accident, which occurred at reactor 4 of the plant in the early morning of April 26, 1986, resulted when operators took action in violation of the plant's procedures. A combination of poor design and human error caused the explosion. Operators ran the plant at very low power, without adequate safety precautions and without properly coordinating the procedure with safety personnel. The reactors were highly unstable at low power. The eventual disaster resulted from attempts to boost the reactor output once the experiment had been started, which was inconsistent with approved procedure. The Chernobyl disaster contaminated 150,000 square miles in Russia, Ukraine, and Belarus. In urban areas, open surfaces such as lawns, parks, streets, roads, squares, roofs and walls became contaminated with radionuclide. The main radiation-related effect of the Chernobyl accident is an increased risk of childhood thyroid

cancer. Chernobyl explosion caused 2 immediate deaths and 29 deaths from acute radiation sickness in the course of the next three months. Current estimates place it between the 4,000 deaths estimated by United Nations agencies in 2005 and the 90,000 suggested by Greenpeace International. It was the worst disaster in the history of nuclear power generation.

7.3 ENVIRONMENTAL MOVEMENTS: An environmental movement can be defined as a social or political movement, for the conservation of environment and for the improvement of the condition of the environment. Environmental and ecological movements are among the important examples of the collective actions of several social groups. An important characteristic of environmental movements in India is that they have been supported by the women, the poor and disadvantaged masses who have been affected by or are victims of environmental degradation.

A. Bishnoi movement: The Bishnois are considered as the first environmentalists of India. Bishnoi sect is said to have started in 1485AD by Shree Guru Jambheshwar in the Thar Desert of Rajasthan, India. The famous 'Chipko Movement' was inspired by a true story of a brave lady called Amrita Devi Bishnoi. Amrita Devi, a female villager could not bear to witness the destruction of 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 sect. He laid down 29 tenets for his followers which included a ban on killing animals, a ban to the felling of trees, especially the khejri, which grows extensively in these areas, and using material other than wood for cremations. The heartland of the Bishnois in the forests near Jodhpur is abundant in trees and wildlife.

B. Chipko movement: The Chipko movement was a turning point in the forest conservation efforts in India. During the 1970s, when reckless cutting of trees started affecting people's livelihoods, the villagers from Uttarakhand's Chamoli started hugging trees to prevent them from cutting. The movement originated in the Garhwal region of Uttrakhand in 1973.The movement was supported by peoples such as Sunderlalji Bahuguna and Chandi Prasad Bhat alongwith the local tribal women. From its inception the Chipko movement concentrated on ecological issues such as depletion of forest cover and soil erosion. The main demand in these protests was that the benefit of the forest, especially the right to fodder, should go to local people. The movement

followed Gandhian method of non-violent resistance though the act of hugging trees to protect them.

C. Silent Valley movement: The 'Save Silent Valley' movement was a successful example of environmental campaign in India. In the late 1970s the Kuntipuzha River in Kerala's Palakkad district flowing through a valley was considered an ideal place for constructing a dam. The project was supported by the Government of Kerala and the Kerala State Electricity Board. The Kerala State Electricity Board announced plans to begin the construction of a 240 MW hydroelectric project over the Kuntipuzha River in 1976. It triggered a wave of protests across the state. Kerala Shastra Sahitya Parishad (KSSP), an already existing, active, progressive local people's science movement group took steered the movement right from its infancy to maturing into a potent people's power. In 1982, a multidisciplinary committee with Prof. M. G. K. Menon as chairman and Madhav Gadgil, Dilip K. Biswas and others as members, was created to decide if the hydroelectric project was feasible without any significant damage to environment. Early in 1983, Prof. Menon's Committee submitted its report. After a careful study of the Menon report, the Prime Minister of India decided to abandon the Project. On September 1, 1986 Silent Valley National Park was designated as the core area of the Nilgiri Biosphere Reserve. The area is now considered as 'hot spot'.

7.4 ENVIRONMENTAL ETHICS: Role of gender and cultures in environmental conservation.

Environmental ethics is one of the most important modern environmental conservation and sustainable development tools. It promotes the most challenging moral questions that arise with such issues as resource management, industrialization and development, and climate change. Environmental ethics concerns human beings' ethical relationship with the natural environment. The most fundamental question that an environmental ethic faces is simply, why do we have any obligations concerning the natural environment? Aldo Leopold is undoubtedly the main influence on those who propose 'holistic' ethics. Aldo Leopold's 'land

ethic' demands that we stop treating the land as a mere object or resource. For Leopold, land is not merely soil.

The aim of cultural dimension in sustainable development is to raise the significance of culture and its factors in local, regional and global sustainable development. It is only through the full and meaningful participation of both women and men that the pressing environmental issues of our time be confronted. Culturally defined gender roles and responsibilities lead to differences in resource use; ecosystem services have a gendered component. Men and women differ in their perception of ecosystems and its value. Women constitute just over half the world's population, but women are responsible for feeding much of it — especially in rural regions of developing countries. Good governance in sustainable ecosystem management can only be achieved by understanding gender gaps and addressing the specific barriers. According to UN Women, gender equality refers to equal rights and opportunities of women, men, girls and boys.

7.5 ENVIRONMENTAL EDUCATION AND PUBLIC AWARENESS:

The growing environmental issues all over the world have made it necessary to embrace Environmental Education and Public awareness. Environmental Education focuses on reviving interest in preservation, conservation and improvement of the environment. Environmental education aims at improving individual perception about the environment, giving better insight to environmental issues with proper balancing of resource use and the economy, leading to better informed people. Education for the environmental enables us to learn how to preserve the environment to enable us derives maximum benefit for the present generation as well as for future. The environment sensitivity in our country can only grow through public awareness. In order to take any step towards protecting our environment surroundings, we need awareness, which can come only from studying concepts related to our ecosystems. There is need for environmental education which introduces awareness among the general public for its own environment and danger to which it may be exposed.

The general objectives of environmental education include the following:

1. To enlighten the people on the physical components of the environment.

2. To inform them about their dependence on the environmental resources.

3. To enlighten them about the changes in the environment in the last decade and the consequences of their present actions.

4. To alert them about the consequences of human actions on the environment both on man him and other forms of life.

5. To create concern for environmental quality and conservation and to foster understanding of man’s relationship and interactions with the ecosphere.

Unit 5: Environmental Pollution

POINTS TO BE DISCUSSED

• Environmental pollution: concepts and types.

• Air, water, soil, noise and marine pollution- causes effects and controls.

• Concept of hazardous waste and human health risks.

• Solid waste management: Control measures of Municipal, biomedical and e-waste.

5.1 INTRODUCTION :

Environment involves the biotic and abiotic components and their interaction making them to coexist. Natural or anthropogenic activities influence the balance which is manifested through changes occurring in air, water and land. Any disturbance in air, water and land is reflected in the deviation from natural balance in living beings. This undesirable change in the composition of air, water and land and the disturbed inter-relation (ecology) is called Environmental Pollution. Pollution can be defined as any undesirable change in the surroundings that may adversely affect human life, other living species and the environment. Environmental pollution is one the most significant challenges that the world is facing in our day. Pollutants include solid, liquid and gaseous substances present in excess than natural quantity causing detrimental effect on the environment.

A pollutant can be classified as:

a) Biodegradable: Pollutants which can be rapidly broken down into simpler, harmless, substances and decompose in nature in due course of time

b) Non biodegradable: Pollutants which cannot be degraded by natural processes easily or do not decompose very easily. They are difficult to eradicate from the environment; for example, toxic elements like lead or mercury, plastic, synthetic fibers.

5.1.1 Sources of pollution:

a. Industrial activities and mining processes.
b. Transportation and automobile exhaust.
c. Agricultural activities.
d. Disposal of solid wastes.
e. Construction activities.
f. Runoff from the land.

5.2 AIR POLLUTION:

It is any undesirable change in the quality of air that affects the environment and human beings. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for living organisms to survive. Air pollution kills an estimated seven million people worldwide every year. The presence of high concentration of pollutants in air affects the natural cleansing mechanism of the atmosphere causing air pollution. Air pollution may be caused by both natural and anthropogenic causes. However, naturally occurring pollutants tend to remain in atmosphere for a shorter period of time.

5.2.1 Classification of Air Pollutants:

a. Primary air pollutants: Pollutants that are directly emitted directly into air from identifiable sources. For example: carbon monoxide (CO), carbon dioxide (CO_2), nitrogen oxides (NO_x) etc.

b. Secondary air pollutants: Pollutants produced in the environment due to interaction among the primary pollutants. They are caused by the intermingling and reactions of primary pollutants. For example: sulphuric acid (H_2SO_4), nitric acid (HNO_3), PAN, O3.

5.2.2 Types of air pollution:

a. Indoor air pollution: Indoor air pollution is the degradation of indoor air quality by harmful chemicals and other materials. Indoor air pollution has a far greater impact because fuel, such as wood, charcoal and animal dung, is burned inside homes for cooking and heating within closed walls.

b. Outdoor air pollution: Outdoor air pollution is caused mainly by industrial activities and combustion processes from automobiles. Increasing industrialization and urbanization has lead to high concentration of outdoor air pollution in modern cities.

5.2.3 Sources of air pollution:

a) Anthropogenic sources:

- Motor vehicles: The automobile industry plays an important role in air pollution. In the cities, by far, the largest amount of pollutants is

emitted by the motor vehicles. It is due to the continuous increase in the number of motor vehicles. Combustion of carbon constituted fuels (coal, fuel oil, wood, natural gas) is never complete, and it produces carbon monoxide (CO) and hydrocarbons. Automobiles emit large amount of CO, hydrocarbons and nitrogen oxides.

- Industrial wastes: It is a major source of air pollution which includes metallurgical plants, chemical plants, petroleum refineries, fertilizer plants, steel plants and food processing. Various industrial processes may emit both organic and inorganic contaminants through accidental spills and leaks of stored chemicals or the handling and storage of chemicals – especially of volatile inorganic chemicals. Heavier machinery located inside big factories and industrial plants also emit pollutants into the air. Industry has a right to produce and make profit, but it has no right to ruin the public environment.

- Power plants: Fossil fuels also present a wider scale problem when they are burned for energy in power plants. Chemicals like sulfur dioxide are released during the burning process, which travel straight into the atmosphere. These types of pollutants react with water molecules to yield something known as acid rain. Pollutants like fly ash and soot are released from these power plants.

- Agricultural activities: **Agricultural sources** arise from activities that raise animals and grow crops, which can generate emissions of gases and particulate matter. For example, animals confined to a barn or restricted area produce large amounts of manure. Manure emits various gases, particularly ammonia into the air. This ammonia can be emitted from the animal houses, manure storage areas, or from the land after the manure is applied. In crop production, the misapplication of fertilizers, herbicides, and pesticides can potentially result in aerial drift of these materials and harm may be caused.

5.2.4 Effects of air pollution:

- Acid rain: Acid rain is precipitation containing harmful amounts of nitric and sulfuric acids. These acids are formed primarily by nitrogen oxides and sulfur oxides released into the atmosphere when fossil fuels are burned. These acids fall to the Earth either as wet precipitation (rain, snow, or fog) or dry precipitation (gas and particulates). Some are carried by the wind, sometimes hundreds of miles. Acid rain affects the amount of chemicals in soils and freshwater, affecting food chains. In the environment, acid rain damages trees and causes soils and water bodies to acidify, making the water unsuitable for some fish and other wildlife. It also speeds the decay of buildings, statues, and sculptures that are part of our national heritage.

- Global warming: Global warming is one of the most worrying effects for scientists and environmentalists**.** Global warming is a direct consequence of the greenhouse effect, which is produced by the high emission of CO_2 and methane into the atmosphere**.** Most of these emissions are produced by the industry, so this can be remedied by social responsibility and action by companies and factories. The Earth's atmosphere contains a delicate balance of naturally occurring gases that trap some of the sun's heat near the Earth's surface. This "greenhouse effect" keeps the Earth's temperature stable. Unfortunately, evidence is mounting that humans have disturbed this natural balance by producing large amounts of some of these greenhouse gases, including carbon dioxide and methane.

- Crop and Forest Damage: Ground level ozone affects the yields of agricultural crops and commercial forests. This also stuns the growth and sustainability of tree seedlings. Crop and forest damage can also result from acid rain and from increased UV radiation caused by ozone depletion. The plants are also susceptible to diseases, pests, and environmental stresses.

- Eutrophication is a condition in a water body where high concentrations of nutrients (such as nitrogen) stimulate blooms of

algae, which in turn can cause fish kills and loss of plant and animal diversity. Although eutrophication is a natural process in the aging of lakes and some estuaries, human activities can greatly accelerate eutrophication by increasing the rate at which nutrients enter aquatic ecosystems. Air emissions of nitrogen oxides from power plants, cars, trucks, and other sources contribute to the amount of nitrogen entering aquatic ecosystems.

- Ozone depletion: Ozone gas occurs both on the ground level and Earth's upper atmosphere (stratosphere). Ground level ozone harms human health. Ozone is a gas that occurs both at ground-level and in the Earth's upper atmosphere, known as the stratosphere. At ground level, ozone is a pollutant that can harm human health. In the stratosphere, however, ozone forms a layer that protects life on earth from the sun's harmful ultraviolet (UV) rays. The ozone layer is gradually being destroyed by man-made chemicals referred to as ozone-depleting substances, including chlorofluorocarbons, hydro chlorofluorocarbons, and halons. Thinning of the protective ozone layer can cause increased amounts of UV radiation to reach the Earth, which can lead to more cases of skin cancer, cataracts, and impaired immune systems. UV can also damage sensitive crops, such as soybeans, and reduce crop yields.

5.2.5 Control of air pollution:

- Industries make a major contribution towards causing air pollution. Formation of pollutants can be prevented and their emission can be minimized at the source itself.
- Usage of air pollution control devices such as scrubbers, electrostatic precipitators, cyclones play an important role in controlling of pollution.
- The use of clean energy sources like solar, wind and geothermal energies reduce air pollution at a larger level.
- Making a vehicle more fuel efficient. Lighter more streamlined vehicles need less energy. Old and technologically obsolete

vehicles must be discarded. Vehicular emission check should also be implemented.

- Scientists agree that climate change is a global problem that must be attacked by a unified world with a single goal. All nations must come together to reduce greenhouse gas emissions.
- The use of clean fuels such as CNG and developing technologies that minimize the usage of fossil fuels should be encouraged.
- Proper legislative measures should be taken to reduce the impact of air pollution. Air pollution legislation should be enacted to enable legal measures to be taken against avoidable emissions both from the old and new industries.

5.3 WATER POLLUTION:

Water is the essential element that makes life on earth possible. The water found in streams, lakes, rivers, wetlands and reservoirs is called surface water. Water that is stored in underground in aquifers and percolates into the ground is called groundwater. Oceans, lakes, rivers, and other inland waters can naturally clean up a certain amount of pollution by dispersing it harmlessly.

According to the Water (Prevention and Control of Pollution) Act, 1974, ―water pollution means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may or is likely to, create a nuisance or render such water harmful or injurious to public health or safety or to domestic, commercial, industrial, agricultural or other legitimate uses, or the life and health of animals or plants or of aquatic organisms.

- Point source of pollution: In this type pollutants are discharged from one definite source where it enters the water. E.g.: effluent pipe, oil spillage.

- Non-point source of pollution: Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources.

5.3.1 Sources of water pollution:

- Domestic sewage: Wastes from residential homes, sewage etc. constitutes nearly 70 percent of the water pollution. The residential buildings do have connected sewage treatment system but it is either inadequate or misused. The garbage and sewage discharged from it is flown in drains or sewage lines thereby blocking the free flow of water. The primary source of pathogens (disease-causing microorganisms) and organic substances. The water discharged from untreated or inadequately treated sewage which goes into rivers, lakes, wells etc. causes serious infectious diseases like typhoid, cholera, dysentery and other skin diseases.

- Eutrophication: The increased level of nutrients in water bodies is known as Eutrophication. It results in the bloom of algae in the water. It also depletes the amount of oxygen in the water that negatively affects fish and other aquatic animal populations.

- Industrialization: Rapid industrialization is another cause of concern as far as water pollution is concerned. Immediately after the independence, major steps were taken in our country in its stride for development in order to give its economy a big push. Industrialization was then considered the most important factor that can put the country in the path of progress. However industrialization along with

development brought with it a danger to the human civilization- the problem of environmental pollution. Industries produce a tremendous amount of waste, which contains toxic chemicals and pollutants, causing damage to our environment and us. They contain harmful chemicals, including lead, mercury, sulfur, nitrates, asbestos, and many others.

- Oil spills: Poses a huge threat to marine life when a large amount of oil spills into the sea and does not dissolve in water. It causes problems for local marine wildlife, including fish, birds, and other sea organisms.

- Sediment pollution: Sedimentation due to runoff effects water quality. It decreases the capacity of streams, ditches, navigation channels and rivers. It decreases the penetration of light into water due to which due to under water flora is disturbed. So the fishes and other fauna feeding on that flora are also disturbed and whole food chain is disturbed. Pollutants like pesticides and phosphorus are transported and accumulated due to sedimentation. Sediment particles also attach to fish gills so fishes feel difficulty to respire in this way they causes fish death. Similarly sediments carry dangerous chemicals like pesticides and petroleum products to water bodies thus polluting them

5.3.2 Effects of air pollution:

- Water pollution leads to damage to human health. Disease carrying agents such as bacteria and viruses are carried into the surface and ground water. Drinking water is affected and health hazards result. Direct damage to plants and animals nutrition also affects human

health. Diseases spread by unsafe water include cholera, giardia, and typhoid

- When water pollution causes an algal bloom in a lake or marine environment, the proliferation of newly introduced nutrients stimulates plant and algae growth, which in turn reduces oxygen levels in the water. This dearth of oxygen, known as eutrophication, suffocates plants and animals.
- Chemicals and heavy metals from industrial and municipal wastewater contaminate waterways as well. These contaminants are toxic to aquatic life—most often reducing an organism's life span and ability to reproduce—and make their way up the food chain as predator eats prey. That's how tuna and other big fish accumulate high quantities of toxins, such as mercury.
- Disruption in food chains happens when toxins and pollutants in the water are consumed by aquatic animals (fish, shellfish etc) which are then consumed by humans.

5.3.3 Control of water pollution:

- The sewage pollutants are required to be treated in sewage treatment plants before their discharge in natural water bodies.
- Radioactive materials enter human body through water and food, and may be accumulated in blood and certain vital organs. They cause tumors and cancer.
- Pollution disrupts the food chain by moving the toxins from one level in the chain to higher levels. In some cases, pollution can wipe out an entire part of the food chain. Such affect the other organisms by either causing excessive growth, in case the predator dies or death.

- Hot water should not be disposed off directly into the river, as it adversely affects the life of aquatic organisms. Thermal pollution can be reduced by employing techniques such as cooling, cooling ponds, evaporative or wet cooling towers and dry cooling towers.
- Water pollution due to organic insecticides and pesticides can be reduced by the use of very specific stable chemicals in the manufacture of insecticides and pesticides. Moreover, use of bio-fertilizers needs to be promoted.
- Oil slicks should be skimmed off from the surface with suction device. Sawdust may be spread over oil slicks to absorb the oil components.

5.4 SOIL POLLUTION:

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of the contaminants in soil exceed the levels that should naturally be present. Soil pollution refers to anything that causes contamination of soil and degrades the soil quality. It occurs when the pollutants causing the pollution reduce the quality of the soil and convert the soil inhabitable for microorganisms and macro organisms living in the soil. The main reason why the soil becomes contaminated is due to the presence of man-made waste.

5.4.1 Causes of soil pollution:

- Industrial activity: The discharge of industrial waste into soils can result in soil pollution. The incorrect way of chemical waste disposal from different types of industries can cause contamination of soil.

Human activities like this have led to acidification of soil and contamination due to the disposal of industrial waste, heavy metals, toxic chemicals, dumping oil and fuel, etc.

- Agricultural activities involving the diffusion of herbicides, pesticides and/or insecticides and fertilizers. The utilization of chemicals has gone up tremendously since technology provided us with modern pesticides and fertilizers. They are full of chemicals that are not produced in nature and cannot be broken down by it. As a result, they seep into the ground after they mix with water and slowly reduce the fertility of the soil.

- Urban Activities: Lack of proper waste disposal, regular constructions can cause excessive damage to the soil due to lack of proper drainage and surface run-off. These waste disposed of by humans contain chemical waste from residential areas. Moreover leaking of sewerage system can also affect soil quality and cause soil pollution by changing the chemical composition of the soil.

- Acid Rain: is caused when pollutants present in the air mix up with the rain and fall back on the ground. The polluted water could dissolve away some of the essential nutrients found in soil and change the structure of the soil.

- Improper disposal of highly toxic industrial/chemical waste can severely pollute the soil. For example, the storage of toxic wastes in landfills can result in the seepage of the waste into the soil. This waste can go on to pollute groundwater.

5.4.2 Effects of soil pollution:

- Industrial effluents when discharged through sewage system poison the biological purification mechanism of sewage treatment causing several soil and water borne diseases.
- When soils are repeatedly contaminated and accumulate large amounts of poisonous materials and chemicals, the soil reaches a point where it cannot support plant life.
- Soil pollution allows emission of relatively large quantities of nitrogen, volatilization of ammonia, and the decomposition of organic materials in the soil. As a result, this releases sulfur compounds and sulfur dioxides into the atmosphere, causing acid rain. Acidic soils are inhospitable to several microorganisms that improve soil texture and help in the decomposition of organic matter.
- Soil pollution is often accompanied by a decrease in the availability of nutrients; plant life ceases to thrive in such soils. Soils contaminated with inorganic aluminum can prove toxic to plants.

5.4.3 Control of soil pollution:

- Control of land loss and soil erosion can be attempted through restoring forest and grass cover to check wastelands, soil erosion and floods. Crop rotation or mixed cropping can improve the fertility of the land.
- Materials such as glass containers, plastic bags, paper, cloth etc. can be reused at domestic levels rather than being disposed, reducing solid waste pollution.
- It is important to dispose of solid waste properly by treated it before it's released into the environment. Acidic and alkaline

waste, for example, can be neutralized before they are disposed of to avoid soil contamination.

- The best way to control soil pollution is to strictly control the mining and industrial pollutants. The government should also put in place measures to ensure electronic wastes and heavy metals do not contaminate the soil.
- The government should make an effort to improve the quality of soil through pollution treatment and remediation.

5.5 Noise pollution:

Noise is considered to be any unwanted sound that may negatively affect the well-being of individuals. According to the World Health Organization, sound levels less than 70 dB are not damaging to living organisms, regardless of how long or consistent the exposure is. Exposure for more than 8 hours to constant noise beyond 85 dB may be hazardous. Although noise constantly surrounds us, noise pollution generally receives less attention than water quality and air quality issues because it cannot be seen, tasted, or smelled. Noise pollution has a negative impact on wildlife species by reducing habitat quality, increasing stress levels, and masking other sounds.

5.5.1 Sources of noise pollution:

- Factories that use heavy machinery emit large amounts of sound that are damaging to the people that work for the company and those living in the neighborhood. Apart from that, various equipment like compressors, generators, exhaust fans, grinding mills also participates in producing big noise.
- Increased number of vehicles on the roads is the second reason for noise pollution. In the city, the main sources of traffic noise are the motors and exhaust system of autos, smaller trucks, buses, and motorcycles. This type of noise can be augmented by narrow streets and tall buildings, which produce a canyon in

which traffic noise reverberates. Increasing traffic has given rise to traffic jams in congested areas where the repeated hooting of horns by impatient drivers pierces the ears of all road users.

- Tractors, thrashers, harvesters, tube wells, powered tillers etc. have all made agriculture highly mechanical but at the same time highly noisy. Noise level 90 dB to 98 dB due to running of farm machines have been recorded in the state of Punjab.
- The noise from locomotive engines, horns and whistles, and switching and shunting operation in rail yards can impact neighboring communities and railroad workers. For example, rail car retarders can produce a high frequency, high level screech that can reach peak levels of 120 dB at a distance of 100 feet, which translates to levels as high as 138, or 140 dB at the railroad worker's ear.
- Apartment dwellers are often annoyed by noise in their homes, especially when the building is not well designed and constructed. In this case, internal building noise from plumbing, boilers, generators, air conditioners, and fans, can be audible and annoying. Improperly insulated walls and ceilings can reveal the sound of-amplified music, voices, footfalls and noisy activities from neighboring units. External noise from emergency vehicles, traffic, refuse collection, and other city noises can be a problem for urban residents, especially when windows are open or insufficiently glazed.
- The problem of low flying military aircraft has added a new dimension to community annoyance, as the nation seeks to improve its nap-of the- earth aircraft operations over national parks, wilderness areas , and other areas previously unaffected by aircraft noise has claimed national attention over recent years.
- We are surrounded by gadgets and use them extensively in our daily life. Gadgets like TV, mobile, mixer grinder, pressure cooker, vacuum cleaners, washing machine and dryer, cooler, air conditioners are minor contributors to the amount of noise

that is produced. Still, it affects the quality of life of your neighborhood in a bad way.

5.5.2 Effect of noise pollution:

- High-intensity sound waves cause unnecessary ripples in the ear canal, disturbing the fluid that aid communications between the ear and the brain. This disturbance destroys the tiny, very delicate, hair follicles that send signals to the brain whenever sounds enter the ear. Hearing loss is very probable after 50% of these hairs are gone, necessitating hearing devices, particularly for children. Research has also shown that uncontrolled exposure to high-intensity noises can seriously jeopardize a kid's memory and reading power.
- Noise can lead to serious psychological disorders and, sadly, you may not even realize it because it becomes a part of you. Research shows that too much noise makes people easily irritable, nervousness, irrational in decision making, and constant unease throughout the day.

- Man-made noises such as jackhammers, horns, machinery, airplanes, and even vehicles can be too loud for our hearing range.
- Constant exposure to loud levels of noise can easily result in the damage of our eardrums and loss of hearing, causing tinnitus or deafness. It also reduces our sensitivity to sounds that our ears pick up unconsciously to regulate our body's rhythm.

- Noise affects brain responses and people's ability to focus, which can lead to low-performance levels over time. Like other sound waves, too much noise

when it goes to the brain leads to lower response rates as well as making the mind dull.

- Cardiovascular diseases are another adverse effect of noise pollution. In our daily life, we are exposed to many different impressions. If we get to many impressions, our brain is unable to handle all of them properly which leads to stress. This stress can come from work, from our social life or from strokes of fate.
- It is quite obvious that an excessive amount of noise prevents us from communicating to each other since we simply are not able to hear what the other person says. This can often be seen in daily life when people walk on main streets.

5.5.3 Control of noise pollution:

- Making noise mounds, walls for noise attenuation and well-maintained roads and smooth surfacing of it are some of the noise abatement measures.
- Air traffic noise can be tackled by the appropriate introduction of noise regulations for takeoff and landing of aircraft at the airport.
- Use of soundproofing equipment like generators in areas producing a lot of noise can reduce industrial noise.
- Reducing noise level from domestic sectors, maintenance of automobiles, and prohibition of uses of loudspeakers for certain time.
- Controlling human activities like minimum use of loudspeakers or amplifiers and repeated honing in traffic-prone areas.

5.6 Marine pollution:

Oceans are the largest water bodies on the planet Earth. Excessive human activities have drastically affected marine life on the Earth's oceans. Ocean pollution, also known as marine pollution, is the spreading of harmful substances such as oil, plastic, industrial and agricultural waste and chemicals into the ocean.

Marine Pollution (UN definition) – "The introduction by man, directly, or indirectly, of substances or energy to the marine environment resulting in deleterious effects such as: hazards to human health, hindrance to marine activities, impairment of the quality of seawater for various uses and reduction of amenities.

- **Types of marine pollution:**

- **Acidification**: Oceans of our planet act as a natural carbon sink. The carbon-dioxide present in the atmosphere dissolves in the oceans. This lowers the atmospheric CO2 concentration which, in turn, reduces the effects of global warming on the planet. However, as the atmospheric concentration of the gas is increasing, the oceans are becoming more acidic. This change in the pH of the ocean water can have harmful effects on marine life. Structures made of calcium carbonate might become vulnerable to dissolution in the acidic environment. This will negatively impact the corals and shellfish living in the oceans.

- **Eutrophication**: When the concentration of chemical nutrients increases in a water body, the process is called eutrophication. The change can lead to an excessive growth of plants and their subsequent decay. When the highly polluted rivers drain into the ocean, it might result in the formation of dead zones where the water is highly depleted of oxygen**.** Eutrophication decreases the level of oxygen, reduces the quality of water, makes the water inhabitable for fish, affects the breeding process within the marine life and increases the primary productivity of the marine ecosystem.

- **Toxins:** Toxins such as pesticides, DDT, PCBs, furans, TBT, radioactive waste, phenols, and dioxins get accumulated in the tissue cells of the marine organisms and lead to bioaccumulation hampering the life underwater and sometimes leads to a mutation in aquatic life forms. The toxins pass from prey to predator through the food chain and start biomagnifying at each higher level in the food chain. Humans are often at the top of many marine food chains and thus are the receivers of large quantities of biomagnified toxins from seafood.

5.6.1 Sources of marine pollution:

- Municipal waste and sewage from residences and hotels in coastal towns are directly discharged into sea. Runoff from the land comes from both urban and agricultural areas. Often referred to as non-point source pollution, runoff can originate from sources such as cars and trucks, septic tanks, farms, and timber harvesting operations.

- Chemicals that end up on roads and highways flow over and under the ground with rainwater, as do pesticides; fertilizers; and carbon-, nitrogen-, and phosphorous-rich particulates, eventually reaching the ocean. Inland mining can cause an

influx of mineral and soil deposits. These travel through rivers and estuaries, making soil a real threat to marine ecosystems. Runoff can even smother marine plants and coral reefs.

- Toxic waste, including mercury, released by manufacturing plants enters the sea and the food chain, making its way up to larger species consumed by humans. Agricultural toxins can be direct biological hazards and raise ocean temperatures, which can be deadly for some animals and plants.
- Ship accidents and accidental spillage at sea can therefore be very damaging to the marine environment. Ships and platforms release large amounts of oil every year. However, oil isn't the only pollutant that comes from ships, which may also discharge fuel, plastic, and human waste. Crude oil is difficult to clean up.
- The ocean floor is a valuable source of gold, silver, copper, and zinc, but mining under the sea is a major source of pollution. Sulfide deposits created when these substances are drilled can have environmental impacts that aren't fully understood. Deep sea mining is a relatively new mineral retrieval process that takes place on the ocean floor. Ocean mining sites are usually done at about 1,400 – 3,700 meters below the ocean's surface.

5.6.2 Effects of marine pollution:

- Apart from causing Eutrophication, a large amount of organic wastes can also result in the development of 'red tides'. These are phytoplankton blooms because of which the whole area is discolored. Once these organisms start to sink and decompose, oxygen is depleted and the area becomes a dead zone because marine life cannot survive in that environment.
- Debris in the water, whether chemically harmful or not, can be hazardous. It can kill all kinds of marine life. Discarded metal cans and plastic, broken glass, fishing gear, and parts of ships can harm people who come into contact with them.

- Organic waste addition results in end products such as hydrogen sulphide, ammonia and methane which are toxic to many organisms. This process results in the formation of an anoxic zone which is low in its oxygen content; from which most life disappears except for anaerobic microorganisms and renders the water foul smelling.
- Consumption of toxic substances stored in the fatty tissues of fish
- Toxic materials are a side effect of modern life. Toxic pollution often ends up in the ocean, sediment, and the sea surface micro-layer.

5.6.3 Control of marine pollution:

- To control marine pollution, wastewater from our thermal power stations is discharged only after being purified in our wastewater treatment facility.
- Plastic bags, bottles etc. have become one of the big reasons for marine pollution. We need to stop using plastic made material to save marine life and our environment.
- We all need to make sure that only rainwater goes into the drainage because most of the drain water goes into oceans. If we allow sewage and waste material to get into the drainage, it will eventually affect the marine life.
- Climate change and marine pollution are both results of excess human interference in the natural world. If we choose eco-friendly household cleaners and take measures to reduce the fumes we release into the air we can reduce the impact of our lives on the oceans.

5.7 Concept of hazardous waste:

Hazardous wastes are those that may contain toxic substances generated from industrial, hospital, some types of household wastes. These wastes could be corrosive, inflammable, explosive, or react when exposed to other materials. Some hazardous wastes are highly toxic to environment including humans, animals, and plants. Due largely to economic development, industrialization, and changing lifestyles, quantity of hazardous waste in India is rising significantly.

Hazardous waste is a waste with properties that make it dangerous or potentially harmful to human health or the environment. Hazardous waste in India is defined as "any substance, excluding domestic and radioactive wastes, which because of its quantity and/or corrosive, reactive, ignitable, toxic and infectious characteristics causes significant hazards to human health or environment when improperly treated, stored, transported and disposed ". Much of this hazardous material is stored in landfills or other containment areas. If these hazardous waste sites are not properly designed or managed, their contents can be released into the surrounding environment, posing a threat to public health. Households generate small quantities of hazardous waste, such as oil-based paints, paint thinners, wood preservatives, pesticides, household cleaners, used motor oil, antifreeze, and batteries.

Four defining characteristics of hazardous waste are:

- Ignitability: Ignitable waste can create fires under certain conditions or is spontaneously combustible. Examples include waste oils and used solvents.
- Corrosivity: Corrosive waste includes acids or bases capable of corroding metal, like storage tanks, containers, drums, and barrels. Battery acid is a good example.
- Reactivity: Reactive waste is unstable under "normal" conditions. It can cause explosions, toxic fumes, gases or vapors when mixed with water. Examples include lithium-sulphur batteries and explosives.
- Toxicity: Toxic waste is harmful or fatal when ingested or absorbed. When toxic waste is disposed on land, contaminated liquid may drain

(leach) from the waste and pollute groundwater. Certain chemical waste and heavy metals are examples of potential toxic waste.

5.8 Solid waste management:

Solid waste refers to the range of garbage materials—arising from animal and human activities—that are discarded as unwanted and useless. Waste can be categorized based on material, such as plastic, paper, glass, metal, and organic waste. Categorization may also be based on hazard potential, including radioactive, flammable, infectious, toxic, or non-toxic wastes. Solid waste disposal management is usually referred to the process of collecting and treating solid wastes. It provides solutions for recycling items that do not belong to garbage or trash. Solid waste management can be described as how solid waste can be changed and used as a valuable resource.

Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn lead to pollution of the environment. Diseases can be spread by rodents and insects. The tasks of solid waste disposal management are complex technical challenges. They can also pose a wide variety of economic, administrative and social problems that must be changed and solved.

The term municipal solid waste refers to solid waste from houses, streets and public places, shops, offices, and hospitals. Management of these types of waste is most often the responsibility of municipal or other governmental authorities. Although solid waste from industrial processes is generally not considered municipal waste, it nevertheless needs to be taken into account when dealing with solid waste because it often ends up in the MSW stream.

Solid waste management can be divided into five components:

a. Generation

b. Storage

c. Collection

d. Transportation

e. Disposal

An integrated waste management strategy includes three main components:

1. Source reduction
2. Recycling
3. Disposal

Disposal of solid waste is done most commonly through a sanitary landfill or through incineration. A modern sanitary landfill is a depression in an impermeable soil layer that is lined with an impermeable membrane. Even though land filling is an economic alternative for solid waste disposal, it has become increasingly difficult to find suitable land filling sites that are within economic hauling distance and very often citizens do not want landfills in their vicinity. Incineration is the process of burning municipal solid waste in a properly designed furnace under suitable temperature and operating conditions. Incineration is a chemical process in which the combustible portion of the waste is combined with oxygen forming carbon dioxide and water, which are released into the atmosphere. Incineration can reduce the municipal solid waste by about 90 percent in volume and 75 percent in weight. The risks of incineration however involve air quality problems and toxicity and disposal of the fly and bottom ash produced during the incineration process.

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NAME OF TEACHER: MD FAHAD HAQUE

NAME OF SUBJECT: ENVIRONMENTAL STUDIES

SEMESTERS 4 AND 6

CHAPTERS: UNIT 4 AND UNIT 2.

UNIT 4: Biodiversity and Conservation

- **Points of Discussion →**
  - Levels of biological diversity: genetic, species and ecosystem diversity.
  - Bio geographic zones of India; Biodiversity patterns and global biodiversity hot spots.
  - India as a mega – biodiversity nation; Endangered and endemic species of India.
  - Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions;
  - Conservation of biodiversity: In – sites and Ex-sites conservation.
  - Ecosystem and biodiversity serviced: Ecological, economic, social, ethical, aesthetic and informational value.

I. Levels of Biological Diversity:

Biological diversity refers to the richness in variety and variability of species of all living organisms in a given habitat. Thus, it deals with the degree of nature's variety in the biosphere. The variety can be described at three levels →

(a) Genetic diversity

(b) Species diversity

(c) Ecosystem diversity

The term 'biological diversity' was invented by Thomas Lovejoy in 1980 and the term 'biodiversity' was introduced by water G. Rosen in 1985.

Biodiversity includes genetic diversity, species diversity and ecosystem diversity. They can be described as follows:

(a) Genetic diversity: It refers to the variation of genes that occur within the species. Each member of any plant or animal species is distinct from others in its genetic makeup. Each organism has its own specific characteristics due to large number of combinations possible in the genes.

(b) Species diversity: It is the number of species of plants and animals present in a region and their diversity, in the given space. It is measured by species richness. The richness in species differs widely from one area to another. These areas that are rich in species diversity are called hotspots of diversity. India is among the world's 15 nations which have rich species diversity.

(c) Ecosystem diversity: It is the variation in different types of found ecosystem found within a particular region. Ecosystem diversity can be specified for a geographical region, country or state. Eg: Sunderban forests which include forests, wetlands, estuaries and rivers.

II. Biogeographic Zones of India

India is one of the most diverse regions of the world and is among the 12 mega – biodiversity countries of the world. The bio –geographic classification of India was carried out by Rodgers and Panwar (1988). The diverse and varied conditions across the country led to classification into 10 bio – geographic zones, which are as follows :

A. Trane – Himalayan Region →

This region covers around L.S million km2 of area within and outside of India. It is a vast stretch of cold, mountainous snow – covered region covering the entire Tibetan plateau, Ladakh and Lahul – Spiti district of Himachal Pradesh (India). Vegetation is sparse in this area. The mountains here have the richest habitat of wild sheep and goats. The region has a herbivore community (rabbits) consisting of Tibetan antelope, gazelle, wild yak and blue sheep. Other characteristic animals found are snow leopard, Tibetan wolf, ibex, marbled pole cat, Himalayan marmot etc.

B. The Himalayan Rangers →

This region extends from Jammu and Kashmir covering Himachal Pradesh, Sikkim, WB, Arunachal Pradesh, Mizoram and Assam to Manipur. They represent the world's youngest and highest mountain chains. The western Himalayas stretch from central

region of Kumaon to North West region of Kashmir. On the other hand, the Eastern Himalayas extend from Sikkim to NEFA. Rainfall is higher and conditions are warmer in the eastern part of Himalayas. Species diversity is also higher in the eastern part. Thus, there is a lot of variation in geology and climatic conditions in this zone.

Flora present in this region consists of Coniferous – pine forests, birch forests, oaks, magnolias, rhododendrons, chestnut, fir, junipers etc. Alpine pastures are predominant in the western Himalayas.

Fauna present in this region include Red panda, ibex, Hangul stag, snow leopard, serow, Goral, Himalayan Tapir, badgers, tapir, shrew etc. A large and rich diversity of animals are found in the Himalayas However, they are endangered as a result of habitat destruction.

C. Western Ghats

This region is one of the hotspots of India and stretches from southern tip of Indian peninsula to Tapti river in the north. The average altitude of mountains in this region is around 1,200m. The Western Ghats cover the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu.

This zone has highly rich biodiversity. The rainfall is heavy and exhibits mostly moist evergreen forests. Apart from evergreen forests, deciduous forests and mangrove forests are also present. Many major rivers originate from Western Ghats such as Godavari, Kaveri, Krishna and Tungabhadra. These rivers are the source of hydro – electricity generation and irrigation projects.

The Western Ghats are characterized by many endemic species. Significant species present in this region are Malabar Civet, Nilgiri Languor, Lion – tailed macaque, Niligiri tahr, Malabar grey hornbill, gaur etc. The hill ranges also form an important part of Project Elephant and Project Tiger reserves.

D. The Desert Regions :

This region consists of parts of Rajasthan, Kutch, Delhi and parts of Gujrat. The Climate is characterized by extremely hot and dry summers and cold winters. Rainfall is less than 70 cm. Kutch, Thar, Ladakh and parts of Delhi comprises the desert gone.

Xerophytic plants are found in this region such as Acacia nelotica, Tecomella spp. Salvadora oleoides, prosopis cineraria, Babul, Kikar and wild palms.

Fauna present are Great Indian Bust and (endangered) blackbuck, camels, desert fones, Chinkara, nilgai, Indian desert Cat, Lizards etc. Flamingoes are extensively found in Rann of Kutch.

E. The Deccan Plateaus :

The Deccan plateau cauets the largest area in the country among all biogeographic zones. It comprises Deccan plateau (south), Central plateau, East plateau, Chota Nagpur and Central Highland. It consists of dry deciduous forests and produces many forest products. Evergreen forests are very rare in this area. Trees like Sal, teak, Acacia are found here mainly.

Fauna present here consists of Tigers, sloth bear, nilgai, sambar, chital, eleplhant, wild buffaloes, barasingha and gaur.

It is the catchment area for rivers like Narmada, Tapti, Mahanadi and Godavari.

F. The Gangetic Plain :

The Gangetic Plains are the most fertile region and comprises the regions of uttar Pradesh, Bihar and Bengal. The plains are fertile due to alluvium sediments deposited across the region by rivers. The region has high population density and orgiculture is an important occupation. Ganga is the main river system here alonggeuidh Brahmaputra. Rainfall is varied across the region.

Important trees found in this region includes sal, mahua, arjun, teak, shishan, neem, khair, tendu etc. Animals found are elephant, black buck, buffalo, gazelle, chinkara, freshwater turtle, Bengal florican etc.

G. North – East India :

This is one of the hotspots of India and is richest in terms of vegetation and species. It is distributed in the states of Assam, Meghalaya, Nagaland, Manipur, Mizoram and Tripura. The region is actually a transition zone between the Indian, Indo – Burma and Indo – Chinese region. Rainfall is high and presence of evergreen and semi – evergreen forests are abundant.

Animals found here are rhinoceros, buffalo, elephant, swamp deer, pygmy hog, elephants, hornbill and many more. Floral species include orchids, bamboos, ferns, banana, diverse fruits etc.

H. Islands :

This zone comprises the islands of Lakshadweep and Andaman and Nicobar. The Andaman and Nicobar Islands are situated in Bay of Bengal. It is one of the hotspots

of India. They have a wide variety of mangroves, evergreen, and deciduous forests. Species richness is the characteristic of the island with distinct faunal species. Animals residing in this region include Andaman water monitor, Nicobar macaque, Narcondam hornbill, Nicobar parakeet etc.

Lakshadweep Islands are located in the Arabian Sea and exhibits evergreen forests. They form a distinct botanical region and contain many coral reefs. Faunal species include sea turtles, pygmy blue, orca, crabs, lobsters and pelagic birds.

I. The Semi – arid area :

This zone comprises the states of Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujrat, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Floral components include grasses, shrubs, thorny scrubs and bamboo trees. Trees include Tectonia grandis, Acacia, Anogeisus, Capparis, and Caltrops etc.

Herbivores like blackbuck, nilgai gazelle etc. are present. Other animals include jackals, leopards, fones, snakes, lions etc. The Asiatic lion is the endemic species found in the air national reserve.

J. Coasts :

India has a vast and elaborate coastline of approximately 7,500 km along the Arabian Sea in the west and the Bay of Bengal in the west.

The western coast is much narrower than the East coast. They have an average width of about 65 km. It extends from Gulf of Cambay in the north to Cape Comorin (Kanya kumari). It is characterised by the presence of estuaries, lagoons and backwaters. The largest lake present have is Vembanad lake.

The eastern coastal plains extent from Subarnarekha river to Kanyakumari. It is formed by alluvial fillings of rivers like Mahanadi, Godavari, Krishna and Kaveri. They are wider and extensive than the western coats with an average width of 120 km.

The Coastal plains are covered by fertile soils on which a variety of crops are cultivated. Rice is the main crop of these areas. Coconut trees grew along the coast. This region has high tiger population along with the presence of animals like Dugong, dolphins, salt-water crocodile, marine turtles, tortoises, hump – back dolphin etc.

IV. Threats to Biodiversity:

(1) **Habitat loss** → The primary cause of loss of biodiversity is habitat destruction, resulting from expansion of human population. Loss of habitat, habitat degradation and fragmentation represents significant causes of known extinctions – continuous increase of deforestation in the tropical forests has become the chief cause of mass extinctions. Fragmentation of landscape by construction of roads, infrastructure also results in biodiversity loss. Environmental fluctuations, disease outbreak leads to extinction of small isolated habitats.

(2) **Poaching of Wildlife** → Wildlife is being continuously hunted and poached for food, profit and other needs. This illegal trade in projected species operates as one of the most profitable illicit markets in the world. Specific invests to certain animals are related to large economic benefits. The skin and bones of tigers, ivory of elephants, horns of rhinos and perfume of the musk deer are extensively used and in high demand. Corals and shells are collected for export on beaches of Chennai, Kanyakumari and A. Nicobar Islands. A variety of wild plants with medicinal values are being overharvested eg : Nux Vomica, Datura.

(3) **Man – Wildlife Conflicts:** The loss of species occur due to the destruction of natural ecosystems, either for conversion to agriculture or industry by humans. Human – wildlife conflict is defined by the world wide Fund for Nature (WWF) as 'any interaction between humans and wildlife that result in negative impacts on human, social, economic or cultural life, on the conservation of wildlife populations, or on the environment. As human populations expand into wild animal habitats, natural wildlife territory is displaced.

(4) **Biological invasions:** The introduction of exotic or invasive species is a significant reason of extinction. Great majority of invasive species do not become established in the new environment. Alien species become 'invasive' when they displace the native species and upset the ecological balance. Same successful exotic species may kill or eat native species to the point of extinction; or may 80 after the habitat that many natives are no longer able to persist. Non – native invasive species are particularly destructive on islands.

eg : Introduction of Nile Perch in Lake Victoria has made way for extinction of most of the indigenous species.

Ship Rat (Rattus rattus) has caused declines of native birds on islands in the Indian subcontinent.

African apple snail (Achatina fulica) us the most invasive among allalien fauna in India.

V. Conservation of Biodiversity: In – sites and Ex – sites conservation of biodiversity.

In – Sites Conservation → It refers to the protection and maintenance of organisms in their natural habitats. In this type of conservation isolation of organisms is not required but it requires elimination of harmful factors in the ecosystem. In-sites Conservation is practised in the form of sanctuaries, National Parks and Biosphere Reserves.

Ex – Sites Conservation of components of biodiversity outside their national habitats. Species are conserved outside their natural habitats in a carefully controlled situation such as botanical garden for plants, a zoological park for animals. It is beneficial for species which are on the verge of extinction and must be immediately projected.

- **Examples of Wildlife Sanctuaries →**
  (1) Dachigam Sanctuary (Hangul/Kashmiri Stag)
  (2) Keoladeo Ghana Bird Sanctuary (Bharatpur) → Most famous water – bird sanctuaries in the world.
  (3) Manas Wildlife Sanctuary in Assam : Rare golden langur, Rare pygmy hog.
  (4) Periyar Wildlife Sanctuary, Kerala.
- **Examples of National Parks →**
  (1) Corbett National Park (Uttrakhand) [1936]
  (2) Kaziranga National Park (Assam) [1974]
  (3) Bandhavgarh National Park (M.P) [1968]
  (4) Sunderbans National Park (Rajasthan) [1981]
- **Examples of Biosphere Reserves :**
  (1) Nilgiri Biosphere Reserves: Tamil Nadu, Karnataka, Kerala. [1986]
  (2) Great Rann of Kutch : Gujarat [2008]
  (3) Nandadevi : Uttrakhand [1988]
  (4) Nokrek : Meghalaya [1988]
  (5) Panna : Madhya Pradesh [2011]
  (6) Sunderban: West Bengal, 1989.

VI. Ecosystem and Biodiversity Services:

- **Ecological Value :**
  (a) Safeguarding water resources through maintenance of water cycle.
  (b) Recycling of nutrients and storing.

(c) Degradation of Pollutants and its incorporation.
(d) Restoring Climate and preserving ecosystem.
(e) Protection of Soil.
(f) Resilience from unpredictable events like Tsunami, earthquakes and wildfires.

- **Economic Value :**
  (a) Direct utilisation of timber, food, fuel wood and fodder by local communities.
  (b) Biodiversity contained in the ecosystem provides forest dwellers with their daily needs food, material, medicines and other products.
  (c) Dried biomass and the petrified products of coal, petroleum and natural gas that serve as fuel are all derived from biodiversity.
  (d) Different varieties of creeds, pulses, vegetables, spices etc. comes directly from the diverse forms of wildlife.
  (e) Wildlife trade, farming and extraction of medicinal products are other benefits.
- **Social Value :**
  (a) Biodiversity has been presented by traditional societies till today. For example, many of the plants like banyan, peepal, tulsi etc. and animals like cow, snake etc. are regarded as holy and served.
  (b) Policy measures and resources utilization should be implemented in the aspect of social value.
  (c) Indian lifestyle, songs, dance, scriptures and customs are closely related with wildlife.

- Ethical Value :
  (a) Ethical values related to biodiversity are based on importance of protecting all forms of life.
  (b) All species were created equal and have the moral right to live, procreate and grow. However, being at the top of the food chain, humans have played havoc with the fragile ecosystems.
  (c) Humans should take a holistic view of the consequences of their actions and do things that are sustainable, inclusive and honour the rights of every living organism.
- Aesthetic Value :

(a) The appreciation of the presence of biodiversity for its inherent value and beauty.

(b) Biodiversity is instrumental in promoting the tourism industry. Tourists from all parts of the world spend a lot of money to visit the wilderness. They enjoy the tranquillity, the natural and the aesthetic beauty of the forests and wildlife.

(c) Plants and animals are often used as symbols in paintings, flags, sculptures, stamps etc.

(d) Species like Asiatic lion, panda are chosen as flagship species for their attractiveness and distinctiveness to represent an environmental cause.

Unit 2: Ecology and Ecosystem

- Points of Discussion :

1) Concept of Ecology and Ecosystem
2) Structure and Function of Ecosystem
3) Energy Flow in an Ecosystem
4) Food Chains and Food WEBS.
5) Basic Concept of Population and Community Ecology.
6) Ecological Succession.
7) Characteristic Features of the Following :
   (i) Forest Ecosystem.
   (ii) Grassland Ecosystem
   (iii) Desert Ecosystem
   (iv) Aquatic Ecosystem. (Ponds, streams, lakes, wetlands, rivers, oceans, estuaries).

1) Concept of Ecology and Ecosystem :

- Ecology: It is a branch of science which deals with the study of animal and plant inter-relationship and also their relation to the surrounding environment. The term was introduced by Hans Reiter, a German scientist, by combining two words 'Oikos' (house or dwelling place)' and 'logos' (to study). Ernst Haeckel in 1866 first used and defined the term in his book "Morphology of organisms" as – "By Ecology we mean the body of knowledge concerning the economy of nature – the total relations of the animal to both it's inorganic and organic environment".
- Some Definitions of Ecology :

- Andrewartha (1961) defined ecology as the "scientific study of the distribution and abundance of organisms".
- Odum (1963) defined ecology as "the study of the structure and function of nature".
- Charles J. Krebs (1978) proposed a practical version of Andrewartha's definition and defined ecology as the "Scientific study of the interactions that determine the distribution and abundance of organisms".

- The two subdivisions of ecology are autecology and synecology :
  (a) Autecology – Deals with the study of individual organisms or spices in an environment.
  (b) Synecology – Deals with the study of a group of organism in relation to the environment.
- Realm of Ecology :

  The following five levels of organisation make up the realm of ecology →
  (a) Organism/Individual: It is the lowest level of organisation which includes any form of life with cell as its basic unit.
  (b) Population: Denotes a group of individual organisms of the same species in a given area. Populations include individuals of the same spices, but may have different genetic makeup.
  (c) Community: It includes all the populations of different spices residing together in a specific area at a given time.
  (d) Ecosystem: The community of living organisms (biotic) interact with the non-living (abiotic) factors and together form the ecosystem. Thus an ecosystem consists of the whole biotic community in a given area plus its abiotic environment.
  (e) Biosphere: All the ecosystems functioning in Earth combine together to form a giant, closed, self-sufficient biological system, known as the biosphere.

BIOSPHERE
↑
ECOSYSTEMS
↑

COMMUNITY

↑

POPULATIONS

↑

ORGANISMS

Levels of Organisation

- Ecosystem: The living organisms and their non – living environment are inter – related and interact with each other closely to form a system. The biotic and abiotic components are linked through nutrient cycles and energy cycles. This ides of ecosystem was first introduced by the British ecologist, A.G.T ansley in 1935. He defined the term ecosystem as "the system resulting from the integration of all living and nonliving factors of the environment". The concept of ecosystem is based on the interactions and exchanges of materials. It gives importance to both the structural and functional aspects. An ecosystem is the basic functional unit in ecology and it includes both organisms and their abiotic environment. Thus, ecosystem represents the highest level of ecological integration.
- Some Definitions of Ecosystem :
  - Woodbury (1954) – "Ecosystem is a complex in which habitat, plants and animals are considered as one interesting unit, the materials and energy of one passing in and out of the others".
  - E.P. Odum – "The ecosystem is the basic functional unit of organisms and their environment interacting with each other and with their own components".
  - Chapin et al (1997) – "Populations do react to environmental stimulus and so ecosystems can also be defined by biota and by the environment".
- Types of Ecosystems :

  (a) Natural ecosystems: These ecosystems operate independently under natural existing conditions without any disruption from external factors (human interference).

  These ecosystems may be further dividend as:

  (i) Terrestrial ecosystems e.g.: forests, grasslands and deserts.

(ii) Aquatic ecosystems: They include both freshwater and marine ecosystems.

- Freshwater ecosystem consists of Lotic (running water as springs, streams or rivers) and lentic (standing water like lakes, ponds, swamps, ditches etc.)
- Marine ecosystems include oceans, sea bodies, estuary etc.

(b) Artificial (Man – cultured) Ecosystems: These ecosystems are maintained and managed artificially by humans. In these cases, man tries to control the biotic community as well as the physico – chemical environment e.g.: croplands, orchards, farmlands, garden etc.

2) Structure and Function of Ecosystem :

The structure of an ecosystem includes:

- The composition of biotic community which comprises spices diversity, their numbers, biomass and distribution.
- The amount of non – living materials (nutrients, water) and their distribution.
- The conditions of existence, i.e. temperature PH level intensity of sunlight etc.

The function of an ecosystem includes:

- Rates of energy flow i.e. the productivity and respiration rates.
- Rates of nutrient (material) cycles e.g.: Carbon, nitrogen, phosphorus etc.
- Ecological Regulation → Regulation of organisms by the environment and vice-versa.

In an ecosystem, the structure and function are inter – related and considered to be one unit.

- Components of Ecosystem :

  An ecosystem has the following two major components:

  (a) Abiotic (Non – living) Component: The non – diving factors or the physical environment prevailing in an ecosystem form the abiotic components. They have a strong influence on structure, distribution and inter – relationships of organisms. They include –

  - Inorganic substances (C, N, H, P, S, O) involved in nutrient cycles.
  - Inorganic chemicals e.g. : Chlorophyll,
  - Organic materials e.g.: Proteins, fats, vitamins, coenzymes etc.

The quantity of inorganic substances present of any given time in the system is known as standing state or standing quality.

(b) Biotic (living) components: The various living organisms (plants, animals, micro organisms) inhabiting the ecosystem from the biotic components. They are distinguished on the basis of their nutritional relationships, such as :

(i) Producers (Autotrophs) – These organisms have the ability to fix light energy and manufacture their own food from simple inorganic substances (H_2O, Co_2) by the process of photosynthesis. They include mainly green plants, algae, planktons, photosynthetic bacteria, chemosynthetic microbes etc.

(ii) Consumers (Heterotrophs): These organisms lack chlorophyll and 80 unable to synthesize their own food. They obtain nutrition and energy by feeding upon other organisms. The consumers are of the following two types →

- Macro consumers: They are phagotrophs and feed on other organism or particulate organic matter. In order of their occurrence in the food chain they are – herbivores (food on plants), carnivores (feed on other animals) and omnivores (feed on both plants and animals). Herbivores are also known as primary consumers. Carnivores and omnivores fall in the category secondary and tertiary consumers.
- Micro consumers: These are microscopic heterotrophic organisms also known as decomposers or saprotrophs. Micro consumers comprise bacteria, actinomycetes, fungi, small insects etc. They obtain energy from decomposed organic remains and wastes of other organism. During the process of decomposition of complex organic compounds, they release inorganic nutrients in environment, which can be utilized by the autotrophs again.

The function of an ecosystem includes: (mentioned before).

The function of an ecosystem is based on energy flow, exchange and the cycling of nutrients. Theses exchanges help to sustain life on planet and production of biomass. Ecosystem functions are essentially an integral part of ecological process and structures. The two ecological processes of energy flow and material cycling involves interaction between the physical environment

and the biotic components. The energy flow through the ecosystem is unidirectional whereas the minerals keep circulating in a cyclic manner.

- Productivity of an Ecosystem →

The amount of biomass (biological material) produced in a specific area during a given period of time denotes the productivity of an ecosystem. It is expressed in mass per unit area (or volume) per unit time.

E.g.: grams / square metres/day . A constant input of solar energy is required for any ecosystem to sustain.

Productivity at producer level (plants) is called primary productivity, whereas at consumer levels (animals) it is known as secondary productivity.

(i) Primary productivity: This type is generally associated with autotrophs (green plants), phytoplankton, photosynthetic bacteria, blue – green algae etc. These organisms have the ability to manufacture new organic materials from inorganic molecules such as H_2O and Co_2 by the process of photosynthesis. Photosynthesis is chiefly responsible for primary productivity as it sustains all subsequent life processes of other organisms. It is defined as "the rate at which radiant energy is stored by photosynthetic and chemosynthesis activity of producers".

It is of the following two types →

- Gross primary productivity: It is the total rate of organic matter produced during photosynthesis. A significant amount of GPP is used by plants for respiration. It is also known as total photosynthetic or total assimilation.
- Net primary productivity: Gross primary productivity (GPP) minus respiration losses CR is the net primary productivity (NPP).

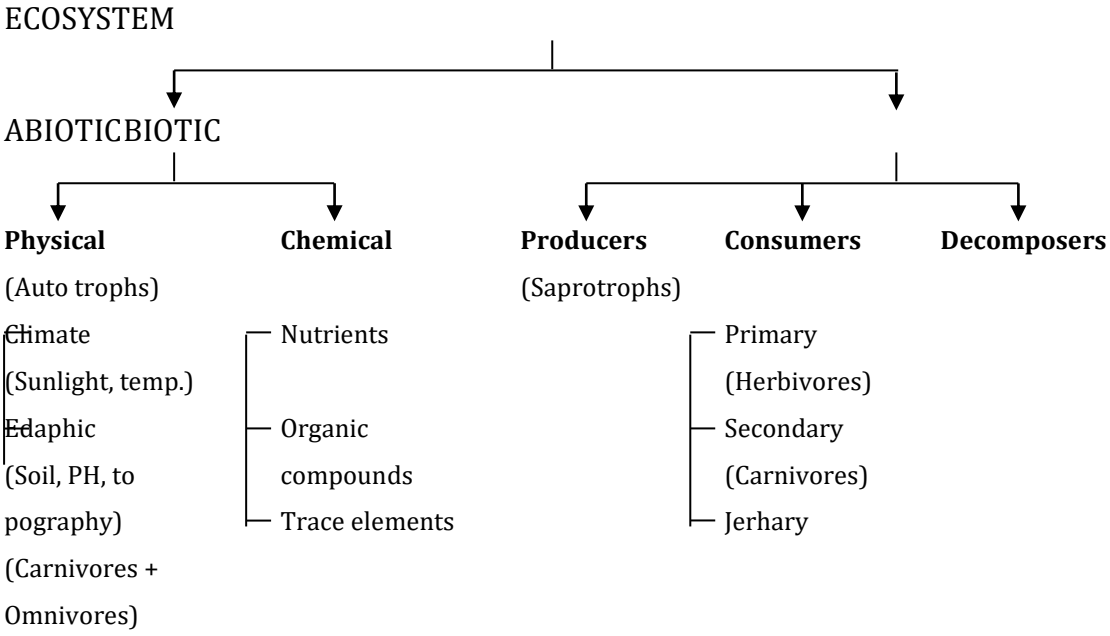
NPP = GPP – R

NPP can be measured as the difference between the rate of photosynthetic by plants and their rate of respiration. Thus, NPP is the rate of storage of organic matter in plant bodies in excess of the respiratory utilization by plants during the measurement period. It is also known as apparent photosynthesis or net assimilation.

(ii) Secondary productivity: This refers to the productivity at the consumer level. It is the total amount of energy assimilated by consumer organism. It can also be

referred to as the net rate of increase in biomass of consumers. Consumers utilize already produced food materials in their respiration and also convert primary organic matter into animal tissue per unit area in a given time.

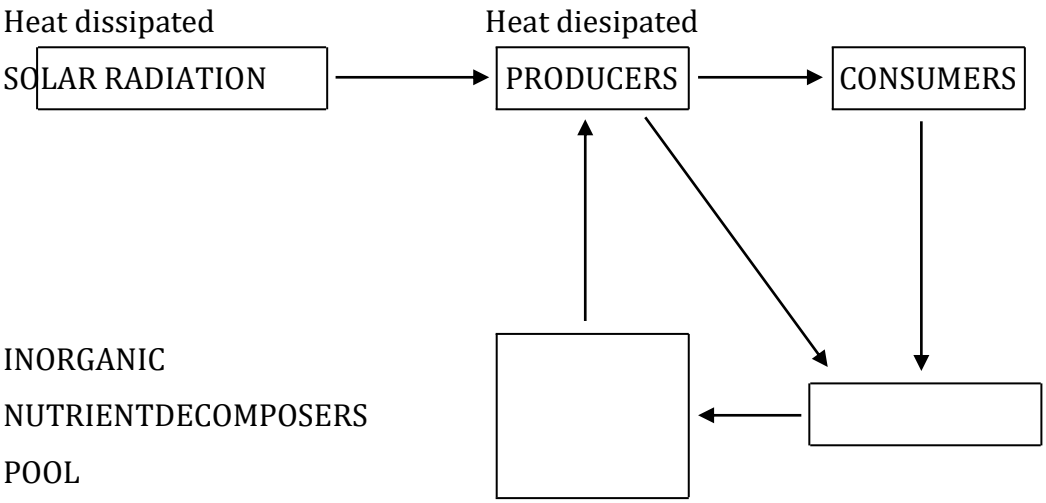
(iii) Net Productivity: The assimilated energy of the consumers is utilized in cellular respiration. All of the biomass is not consumed by the animals. Some are released in the form of faeces. Thus, the rate of storage of organic matter not used by the heterotrophs during the unit period of time (season/month/year) is the net productivity. It is expressed as production of ($g/m^2/day$). The period of time may be monthly, seasonal or yearly.



3) Energy Flow in an Ecosystem :

All living organisms including human beings require energy to exist and perform essential functions. Solar radiation is the major source of energy for almost all organisms. Less than 50 percent of incident solar radiation is photo synthetically active radiation is photosynthetically active radiation (PAR). Autotrophs have the ability to fix sun's radiant energy to make food from simple inorganic materials. Plants capture only 2 – 10 percent of the PAR and this miniscule amount supports all living organisms on Earth. Thus, Energy flow is the unidirectional transfer of energy through a series of organisms up the trophic

level. There is a progressive decrease in energy content at each trophic level due to dissipation of heat used up in metabolic activities.



Energy Flow in an Ecosystem

The flow of energy in an ecosystem is governed by the following laws :

(a) First Law of thermodynamics: Energy can neither be created nor destroyed but can only be transformed from one form to another. True, in a system total inflow of energy should be equal to total output of energy.

(b) Second Law of thermodynamics: The energy transfer in a system is always followed by a dissipation of energy into unavailable heat (i.e. entropy).

4) Food Chains and food WEBS :

Trophic Structure: Trophic structure demonstrates the various feeding levels in the biotic community in an organised and systematic manner. The organisms are classified into different trophic levels based on their nutritional habits. This pattern of organization helps in the transfer of energy through a series of organisms.

The Trophic Levels:

- 1^{st} → Primary Producer (Autotrophs / Green plants).
- 2^{nd} → Primary Consumer (Herbivores)
- 3^{rd} → Secondary Consumer (Carnivores / Omnivores)
- 4^{th} → Tertiary Consumer (“)

Food Chain: Food chain is a linear arrangement illustrating the flow of energy through a series of organisms which feed upon one another. The energy is transferred in a systematic manner up the various trophic levels. Autotrophs

(Green plants) occupy the first trophic level as they have the ability to fix sun's radiant energy. In any food chain energy flows in the following manner →

Primary Producers → Primary Consumers → Secondary Consumers

Tertiary Consumer

At each level in the food chain, a significant amount of energy is lost due to metabolic activities of the organisms.

Food chains can be of the following two types:

(a) Grazing food chain → This type of food chain starts from living green plants, goes to grazing herbivores (i.e. organisms eating living plants) and finally to carnivores (animal eaters).

Ecosystems with such type of food chain are directly dependent on influx of solar radiation. This type of food chain thus depends on autotrophic energy capture and the movement of this captured energy to herbivore. Usually, most of the food chains in nature are of this type.

eg : Grasses → Rabbit → Fox → Lion

(Producers) (Herbivores) (Carnivores) Jertiary Consumers

PrimarySecondary ConsumerConsumer

(b) Detritus food chain → This type of food chain begin with dead organic matter, which is fed on by microorganisms to detritivores to organisms feeding on detritivores. This type is less dependent on direct solar radiation. The detritus food chain is more complex.

Food Web: The concept of food web was first introduced by Charles Elton food chains exist in an ecosystem. These food chains cannot operate independently but are interlinked to each other in an organized manner and function simultaneously. It depicts how energy flows between various organisms residing in an ecosystem.

5) Basic Concept of Population and Community Ecology

- Population ecology: It is the study of population dynamics in relation to the environment, including environment influences on population density and distribution, age structure and population size.

The density of a population is measured as the number of individual per unit area or volume.

Ecologists use a variety of sampling techniques to estimate densities and total population sizes. Demography is the statistical study of factors that affect population density and dispersion patterns of human beings. In population ecology units of study are individuals of a single species.

- Community ecology: Here the units of study are groups of individuals belonging to different species plants as well as animals. Populations that interact within a given habitat form a community. The number of spices occupying the same habitat and their relative abundance is known as the diversity of the community. Scientists study ecology at the community level to understand how species interact with each other and compute for the same resources. It is also known as synecology.

6) Ecological Succession :

Studies by ecologist have shown that there have been gradual processes of change in ecological communities. Ecological succession is the process of change through which an ecological community evolves over time towards a stable condition. These changes are fairly predictable and progressive in nature. The time range can be years, decodes or even hundreds of years. Along with the changes in species composition, of the community the physical and chemical environment of the area also changes. The community moves towards a stable condition known as “Climax”.

- “Climax Community”: In the concept of ecological succession, ecosystems advance until they reach a climax community. In the climax community, all of the resources are efficiently used and the total mass of vegetation maxes out. Many forests that have been undistributed in many years are examples of a climax community. It is a stable community dominated by a small number of prominent species.
- Why does this change occur?

  Every species has a set of environmental conditions under which it will grow and reproduce most optimally. When the conditions of an environment change suddenly and drastically the existing species are dominated by another set of new species which are most suited to the new environment.

Two basic types of succession are as follows →

(a) Primary Succession: The series of community changes which occur in an entirely new habitat that has never been colonized before. Primary succession happens when new land is formed or bare rock is exposed, providing a habitat that can be colonized for the first time.

eg: Primary succession may take place in newly formed islands, or new volcanic rocks exposed by volcanic eruption.

(b) Secondary Succession: It occurs after a disturbance disrupts ecosystem processes and removes part of the existing biotic components. Thus the series of community changes takes place in a previously colonized, but disturbed or damaged habitat. Disturbances such as forest thinning, floods, forest fires and wind can all lead to secondary succession.

eg : Oak forests are cleared by wildfire in an ecosystem. Wildfires will burn most vegetation and kill animals unable to flee the area. Their nutrients, however, are returned to the ground in the form of ash. Since, the disturbed area already has nutrient – rich soil, it can be recolonized much more quickly than the bare rock of primary succession.

7) Characteristic Features of the Following :

(i) Forest Ecosystem

(ii) Desert Ecosystem

(iii) Grassland Ecosystem

I. Forest Ecosystem →

(i) Forests occupy roughly 31% of the Earth's land. In India forests occupy about 24.39% of the total geographical area of the country. Forests are among the most complex ecosystems in the world.

(ii) Forests assist in maintaining climatic conditions and rainfall of a particular area. Soil is rich in organic matter and minerals.

(iii) Forest canopy is an important distinguishing feature. IT denotes the top portion of a community of trees. This serves as a connection between the gaseous atmosphere and land. Moet organisms are able to survive in forest canopy because it is directly in contract with sunlight and water.

(iv) Forest floor is another distinct feature. It comprises fallen leaves, stems, branches and bark on the surface of soil. Many microorganisms also occupy the forest floor increasing the nutrient and mineral content of the soil. The major part of the nutrients of the forest ecosystem comes from forest floor due to decomposition of organic substances.

(v) Forest Soil → Soil type in various forests differs widely. The soil of temperate forests is much more fertile as leaves drop to the ground every winter. This litter contributes to increase of organic matter. On the other hand, soil in tropical rain forests has poor quality because of torrential rains. The rains dissolve the soil nutrients before trees can benefit. Decomposition by microorganisms enriches the forest soil.

(vi) The forest ecosystem supports the existence of many wild organisms and thus helps in protecting the biodiversity.

(vii) Penetration of light is fast, so conversion of organic matter into nutrients is fast.

II. Desert Ecosystem :

(i) Deserts occupy about 17 percent of our world's land area and about 10 percent of total geographical area of India.

(ii) Rainfall is very irregular. Annual rainfall is less than 25 centimetres (10 inches).

(iii) Abiotic components are characterised by low amount of nutrients in soil, scarcity of water, and high fluctuation in temperature.

(iv) In deserts many succulent (e.g. Cacti) plants are present along with shrubs, bushes and few xerophytic trees. They have water stored inside them to stay alive and a waxy layer externally to protect them from sun.

(v) The most common animals found are reptiles and insects, able to persist under xeric conditions. In addition, some nocturnal rodents and birds are also found. The ship of the desert', camels food on tender shoots of the plants. Some thermophillic fungi and bacteria are present.

(vi) The soil is very poor in nutrients and organic matter. So, vegetation is also poor.

(vii) High degree of fluctuations in day and night temperatures and also in seasons.

(viii) High wind velocity because of open spaces.

(ix) Highly arid conditions due to lack of water vapour in air.

(x) Soil is loose, sandy, devoid of organic carbon, nitrogen, moisture etc.

(xi) Solar radiation is very intense due to absence of clouds.

(xii) Drought is an important feature. The duration of drought is long in the extreme arid-zone and decreases towards the margins. Drought is a prolonged period of abnormally low rainfall, leading to a shortage of water.

(xiii) A few of world's deserts are → Sahara Desert, Sunoran Desert, Mojave Desert, Atacama Desert, Thar Desert, Gobi Desert, Siberia (cold does not) etc.

III. Grassland Ecosystem :

(i) Grasslands occupy around 19 to 25 percent of the Earth's surface. In India, they occupy 24 percent of the geographical area. A grassland is a type of ecosystem dominated by grasses and other Herbaceous (non – woody) flowering plants and a variety of scattered trees and bushes.

(ii) Grasslands are highly dynamic ecosystems.
They are of mainly two types →
Tropical Grasslands (Savannah) → located near Equator
Temperate Grasslands →
(i) Pampas (south America)
(ii) Prairies (North America)
(iii) Steppes (Central Asia)
(iv) Veldt (Africa)

(iii) Grasslands occur in areas where there is not enough rainfall to support the growth of a forest, but not so little as to form a desert. On an average they receive around 25 – 75 cm rainfall per year. In such low amount of rainfall big trees cannot survive. Mean annual temperature is between 0^{o} C and 25^{o}C.

(iv) Grasslands separate forests from deserts. Grasslands act as barrier towards desertification of land as they have plants which bind the soil and prevent erosion of the land.

(v) No other habitat is agriculturally as useful to humans as grasslands. Soils tend to be deep and fertile. Much of the North American Prairie Lands have been converted into one of the richest agricultural regions on Earth.

(vi) Savannahs have scattered trees and predominate in certain parts of Africa, South America and Asia. Temperate grasslands are largely devoid of trees, receive less rainfall than Savannah's and exhibit broader temperature extremes.

(vii) In tropical grasslands, growing season is usually in the monsoon. In temperate grasslands, the growing season is usually the short period between the cold, damp winter and the hot, dry summer.

(viii) The animals that live in grasslands have adapted themselves to the dry, windy conditions with time.

(ix) There is a large variety of animals found in tropical grasslands, especially Africa. Over forty different species of animals are found in African Savannahs. e.g.: Impala, Zebra, Elephant, Lion, Leopard and Cheetah.

The temperate grasslands have lower diversity of animal species in comparison to the tropical regions. e.g.: Some of the animals found here are → Bison, Antelope, Coyote, Wild horse and Polecats.

(x) Examples of Grasslands in India → Himalayan Pasture belt/semi – arid plains of Western India, Central India and the Deccan are covered by grassland tracts with patches of thorn forest.

Unit 2 → Ecology and Ecosystems (MCQ's)

(1) The term ecosystem was coined by →

(a) Ernst Haeckel (b) A.G. Tansley

(c) Fourier (d) H. Reiter

(2) The term ecology was coined by →

(a) Alexander Fleming (b) A.G. Tansley

(c) Ernst Haeckel (d) H. Reiter

(3) Which of the following fall under functional aspect of Ecosystem →

(a) Producers (b) Climatic factors

(c) Energy cycles (d) Micro - consumers

(4) Which of the following fall under structural aspect of Ecosystem →

(a) Saprotrophs (b) Food chains

(c) Evolution (d) Energy cycles

(5) Ecosystem comprises :

(a) Biotic components (b) Abiotic components

(c) Both a and b (d) None

(6) The study of group of organisms is known as :

(a) Synecology (b) Limnology

(c) Autecology (d) Pedology

(7) On Earth autotrophic components can directly fix :

(a) Mechanical energy (b) Light energy

(c) Chemical Energy (d) None

(8) Which of the following feed on 'detritus' :

(a) Producers (b) Consumers

(c) Decomposers (d) None

(9) A group of individual of the same species in a given area :

(a) Organism (b) Community

(c) Population (d) None

(10) Which of the following are producers in aquatic ecosystems

(a) Zooplanktons (b) Phytoplankton

(c) Cyanobacteria (d) None of these

(11) Energy flow in an ecosystem is :

(a) Multidirectional (b) Bidirectional

(c) Unidirectional (d) None of these

(12) Grazing animals are primarily found in :

(a) Desert Ecosystem (b) Grassland Ecosystem

(c) Forests (d) None of these

(13) Amount of rainfall in desert ecosystem is →

(a) More than 100 cms. (per year)

(b) 50 – 100 cms. (per year)

(c) Less than 25 cms. (per year)

(d) 25 – 50 cms

(14) Rainforests of the sea' are →

(a) Estuaries (b) Lagoons

(c) Coral Reefs (d) Mangroves

(15) Which of the following is an important feature of deserts :

(a) Canopy (b) Drought

(c) Rainforests (d) Estuaries

(16) Benthos are →

(a) that flows with water current

(b) strong swimmers

(c) bottom dwellers

(d) Rest or swim on the water surface

(17) Prairies (Grassland) are found in :

(a) Australia (b) North America

(c) Russia (d) Africa

(18) Largest hot desert in the world is →

(a) Mojave (b) Atacama

(c) Thar (d) Sahara

(19) Process through which an ecosystem tend to change to change over a period of time →

(a) Energy Cycle (b) Ecological Succession

(c) Ecotone (d) None

(20) Special ecosystems in which the water level fluctuates dramatically in different seasons :

(a) Estuaries (b) Deltas

(c) Wetlands (d) Lakes

(21) Immobile, still or stagnant water bodies fall under :

(a) Lotic (b) Lentic

(c) Marine (d) None

(22) Amount of rainfall in Savannah type of grasslands :

(a) 0 – 25 cms (b) 25 – 50 cms

(c) 50 – 75 cms (d) 75 to 100 cms

(23) Transfer of energy through a series of organisms takes place through →

(a) Food web (b) Food pyramid

(c) Trophic Level (d) Food chain

(24) Which of the following depends primarily on sunlight :

(a) Grazing food chain (b) Detritus food chain

(c) Both (d) None of the above

(25) Large number of food chains are interlinked to form :

(a) Biome (b) Food web

(c) Food pyramid (d) none

(26) Veldt grassland is located in →

(a) Russia (b) South Africa

(c) Canada (d) Europe

(27) Savannah's are found near →

(a) Equator (d) Poles

(c) Tropic of Capricorn (d) None

(28) Zone of junction or transition area b/w two diverse ecosystems :

(a) Ecocity (b) Ecological Niche

(c) Ecocline (d) Ecotone

(29) Which of the following describes the functional position and role of an organism within it's environment :

(a) Ecocity (b) Ecotone

(c) Ecological Niche (d) Ecotype

(30) In concept of ecological succession, ecosystems advance until they reach →

(a) Stable Community (b) Climax community

(c) Zero populations (d) none of the above

(31) Area which remains under water only at high tide conditions :

(a) Oceanic zone (b) Benthic zone

(c) Intertidal zone (d) Neritic zone

(32) Freshwater contains – % of the world's known fish species →

(a) 65% (b) 32%

(c) 41% (d) 82%

(33) Edaphic factors in an ecosystem is related to →

(a) Climate (b) Soil

(c) Light (d) Temperature

(34) Which of the following forests grow in coastal environment :

(a) Deciduous (b) Temperate

(c) Mangroves (d) Evergreen

(35) Simplest aquatic ecosystem :

(a) Wetland (b) Streams

(c) Lakes (d) Ponds

(36) The organisms which feed on waste product are :

(a) Herbivores (b) Carnivores

(c) Detritivores (d) None

(37) Sharp temperature boundary between two layers of lake :

(a) Hypolimnion (b) epilimnion

(c) thermostat (d) thermocline

(38) The study of freshwater ecosystem :

(a) Cryology (b) Oceanology

(c) Limnology (d) Hydrobiology

(39) Animals that lack chlorophyll and unable to synthesis their own food :

(a) Autotrophs (b) Heterotrophs

(c) Saprotrophs (d) Both (b) and (c)

(40) Primary consumers are basically

(a) Carnivores (b) Herbivores

(c) Both a and b (d) None

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Biodiversity and Conservation

- **Points of Discussion →**
  - Levels of biological diversity : genetic, species and ecosystem diversity.
  - Biogeographic zones of India ; Biodiversity patterns and global biodiversity hot epots.
  - India as a mega – biodiversity nation; Endangered and endemic species of India.
  - Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions;
  - Conservation of biodiversity : In – sites and Ex-sites conservation.
  - Ecosystem and biodiversity serviced : Ecological, economic, social, ethical, aesthetic and informational value.

I. Levels of Biological Diversity :

Biological diversity refers to the richness in variety and variability of species of all living organisms in a given habitat. Thus, it deals with the degree of natures variety in the bioephere. The variety can be described at three levels →

(a) Genetic diversity
(b) Species diversity
(c) Ecosystem diversity

The term 'biological diversity' was invented by Thomas Lovejoy in 1980 and the term 'biodiversity' was introduced by water G. Rosen in 1985.

Biodiversity includes genetic diversity, species diversity and ecosystem diversity. They can be described as follows :

(a) Genetic diversity : It refers to the variation of genes that occur within the species. Each member of any plant or animal species is distinct from others in its genetic makeup. Each organism has its own specific characteristics due to large number of combinations possible in the genes.
(b) Species diversity : It is the number of species of plants and animals present in a region and their diversity, in the given space. It is measured by species richness. The richness in species differs widely from one area to another. These areas that are rich in species diversity are called hotspots of diversity. India is among the world's 15 nations which have rich species diversity.

(c) Ecosystem diversity : It is the variation in different types of found ecosystem found within a particular region. Ecosystem diversity can be specified for a geographical region, country or state. eg : Sunderban forests which include forests, wetlands, estuaries and rivers.

II. Biogeographic Zones of India

India is one of the most diverse regione of the world and is among the 12 mega – biodiversity countries of the world. The bio –geographic classification of India was carried out by Rodgers and Panwar (1988). The diverse and varied conditions across the country led to classification into 10 bio – geographic zones, which are as follows :

A. Trane – Himalayan Region →

This region cover around L.S million km2 of area within and outside of India. It is a vast stretch of cold, mountainous snow – covered region covering the entire tibetian plateau, Ladakh and Lahul – Spiti district of Himachal Pradesh (India). Vegetation is sparse in this area. The mountains here have the richest habitat of wild sheop and goats. The region has a herbirore community (grabets) consisting of Jibetian antelope, gazelle, wild yak and blue sheep. Other characteristic animals found are snow leopard, Jibetian wolf, ibek, marbled pole cat, Himalayan marmot etc.

B. The Himalayan Rangers →

This region extends from Jammu and Kashmir covering Himachal Pradesh, Sikkim, WB, Arunachal Pradesh, Mizoram Assam to Manipur. They represent the world's youngest and highest mountain chains. The western Himalayas stretches from central region of Kumaon to north west region of Kashmir. On the other hand, the Eastern Himalayas extend from Sikkim to NEFA. Rainfall is higher and conditions are warmer in the eastern part of Himalayas. Species diversity is also higher in the eastern part. Thus, there is a lot of variation in geology and climatic conditions in this zone.

Flora present in this region consists of Coniferous – pine forests, birch forests, oaks, magnolias, rhododendrons, chestnut, fir, junipers etc. Alpine pastures are predominant in the wastern Himalayas.

Fauma present in this region include Red panda, ibek, Hangul stag, snow leopard, serow, Goral, Himalayan Tahr, badgers, tapir, shrew etc. A large and rich diversity of

animals are found in the Himalayas However, they are endangered as a result of habitat destruction.

C. Western Ghats

This region is one of the hotspots of India and stretches from southern tip of Indian penineula to japti river in the north. The average altitude of mountains in this region is around 1,200m. The western ghats cover the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu.

This zone has highly rich biodiversity. The rainfall is heavy and exhibits mostly moist evergreen forests. Apart from evergreen forests, deciduous forests and mangrove forests are also present. Many major rivers originate from western ghats such as Godavari, Kaveri Krishna and Jungabhadra. These rivers are the source of hydro – electricity generation and irrigation projects.

The wester Ghats are characterized by many endemic species. Significant species present in this region are Malabar Civet, Nilgiri Langur, Lion – tailedmaeaque, Niligiri tahr, Malabar grey hornbill, gaur etc. The hill ronges also form an important part of Project Elephant and Project Jiger reserves.

D. The Desert Regions :

This region consists of parts of Rajasthan, Kutch, Delhi and parts of Gujrat. The Climate is characterized by entremely hot and dry summers and cold winters. Rainfall is less than 70 cm. Kutch, Jhar, Ladakh and parts of Delhi comprises the desert gone.

Xerophytic plants are found in this region such as Acacia nelotica, Jecomella spp. Salvadora oleoides, prosopis cineraria, Babul, Kiran and wild palms.

Fauma present are Great Indian Bust and (endadgered), blackbuck, camels, desert fones, Chinkara, nilgai, Indian desert Cat, Lizards etc. Flamingoes are entensively found in Rann of Kutch.

E. The Deccan Plateus :

The Deccan plateau cauets the largest area in the country among all biogeographic zones. It comprises deccan plateau (south), Central plateau, East plateau, Chota Nagpur and Central Highland. It consists of dry deciduous forests and produces many forest products. Evergreen forests are very rare in this area. Trees like Sal, teak, Acacia are found here mainly.

Fauna present here consists of Tigers, sloth bear, nilgai, sambar, chital, eleplhant, wild buffaloes, barasingha and gaur.

It is the catchment area for rivers like Narmada, Tapti, Mahanadi and Godavari.

F. The Gangetic Plain :

The Gangetic Plains are the most fertile region and comprises the regions of uttar Pradesh, Bihar and Bengal. The plains are fertile due to alluvium sediments deposited across the region by rivers. The region has high population density and orgiculture is an important occupation. Ganga is the main river system here alonggeuidh Brahmaputra. Rainfall is varied across the region.

Important trees found in this region includes sal, mahua, arjun, teak, shishan, neem, khair, tendu etc. Animals found are elephant, black buck, buffalo, gazelle, chinkara, freshwater turtle, Bengal florican etc.

G. North – East India :

This is one of the hotspots of India and is richest in terms of vegetation and species. It is distributed in the states of Assam, Meghalaya, Nagaland, Manipur, Mizoram and Tripura. The region is actually a transition zone between the Indian, Indo – Burma and Indo – Chinese region. Rainfall is high and presence of evergreen and semi – evergreen forests are abundant.

Animals found here are rhinoceros, buffalo, elephant, swamp deer, pygmy hog, elephants, hornbill and many more. Floral species include orchids, bamboas, ferms, banana, divers fruits etc.

H. Islands :

This zone comprises the islands of Lakshadweep and Andaman and Nicobar. The Andaman and Nicobar Islands are situated in Bay of Bengal. It is one of the hotspots of India. They have a wide variety of mangroves, evergreen, and deciduous forests. Species richness is the characteristic of the island with distinct faunal species. Animals residing in this region include Andaman water monitor, Nicobar macaque, Narcondam hornbill, Nicobar parakeet etc.

Lak shwadeep Islands are located in the Arabian sea and exhibits evergreen forests. They form a distinct botanical region and contain many coral reefs. Faunal species include sea turtles, pygmy blue, orca, crahs, lobsters and pelagic bircls.

I. The Semi – arid areal :

This zone comprises the states of Rajasthan, Punjab, Haryana, Uttar Pradesh, Gujrat, Madhya Pradesh, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu.

Floral components include grasses, shrubs, thorny scrubs and bamboo trees. Trees include Tectonia grandis, Acacia, Anogeisus, Capparis, Calotropis etc.

Herbivores like blackbuck, nilgei gazelle etc. are present. Other animals include jackals, leopards, fones, snakes, lions etc. The Asiatic lion is the endemic species found in the air national reserve.

J. Coasts :

India has a vast and elaborate coastline of approximately 7,500 km along the Arabian Sea in the west and the Bay of Bengal in the west.

The western coast is much nanower than the East coast. They have an average width of about 65 km. It entends from culf of Combay in the north to Cape Comorin (Kanya kumari). It is characterised by the presence of estuaries, lagoons and backwaters. The largest lake present have is vembanael lake.

The eastern coastal plains extent from Subarnarekha river to Kanyakumari. It is formed by alluvial fillings of rivers like Mahanadi, Godavari, Krishna and Kaveri. They are wider and entensive than the western coats with an average width of 120 km.

The Coastal plains are covered by fertile soils on which a variety of crops are cultivated. Rice is the main crop of these areas. Coconut trees grew along the coast.

This region has high tiger population alongwith the presence of animals like Dugong, dolphins, salt-water crocodile, marine turtles, tortoises, heamp – back dolphin etc.

IV. Threats to Biodiversity :

(1) Habitat loss → The primary cause of loss of biodiversity is habitat destruction, resulting from expansion of human population. Loss of habitat, habitat degradation and fragmentation represents significant causes of known extinctions – continuous increase of deforestation in the tropical forests has become the chief cause of mars entinctions. Fragmentation of landscape by construction of roads, infrastructure also results in biodiversity loss. Environmental fluctuations, disease outbreak leads to entinction of small isolataed habitats.

(2) Poaching of Wildlife → Wildlife is being continuously hunted and poached for food, profit and other needs. This illegal trade in projected species operates as one of the most profitable illicit markets in the world. Specific invests to certain animals

are related to large economic benefits. The skin and bones of tigers, ivory of elephants, horne of rhinos and perfume of the musk deer are entensively used and in high demand. Corals and shells are collected for export on beaches of Chennai, Kanyakumari and A. Nicobar Islands. A variety of wild plants with medicinal values are being overharvested eg : Nun Vomica, Datura.

(3) Man – Wildlife Conflicts : The loss of species occur due to the destruction of natural ecosystems, either for conversion to agriculture or industry by humans. Human – wildlife conflict is defined by the world wide Fund for Nature (WWF) as 'any interaction between humand and wildlife that result in negative impacts on human, social, economic or cultural life, on the conservation of wildlife populations, or on the environment. As human populations expand into wild animal habitats, natural wildlife territory is displaced.

(4) Biological invasions : The introduction of exotic or invasive species is a significant reason of extinction. Great majority of invasive species do not become established in the new environment. Alien species become 'invasive' when they displace the native species and upset the ecological balance. Same successful exotic species may kill or eat native species to the point of extinction; or may 80 after the habibat that many natives are no longer able to persist. Non – native invasive species are particularly destructive on islands.

eg : Introduction of Nile Perch in Lake Victoria has made way for extinction of most of the indigenous species.

Ship Rat (Rarrus rattess) have caused declines of native birds on inslands in the Indian subcontinent.

African apple snail (Achatina fulica) us the most invasive among allalien fauna in India.

V. Conservation of Biodiversity : In – sites and Ex – sites conservation of biodiversity.

In – Sites Conservation → It refers to the protection and maintenance of organisms in their natural habitats. In this type of conservation isolation of organisms is not required but it requires elimination of harmful factors in the ecosystem. In-sites Conservation is practised in the form of sanctesaries, National Parks and Biusphere Reseues.

Ex – Sites Conservation of components of biodiversity outside their national habitats. Species are conserved outside their natural habitats in a carefully controlled situation

such as botanical garden for plants, a zoological park for animals. It is beneficial for species which are on the verge of extinction and must be immediately projected.

- **Examples of Wildlife Sanctuaries →**
  (1) Dachigam Sanctuary (Hangeel/Kashmiri Stag)
  (2) Keoladeo Ghana Bird Sanctuary (Bharat pur) → Most famous water – bird sanctuaries in the world.
  (3) Manas Wildlife Sanctuory in Assam : Rare golden langur, Rare pygmy hog.
  (4) Periyar Wildlife Sanctuary, Kerala.
- **Examples of National Parks →**
  (1) Corbett National Park (Uttrakhand) [1936]
  (2) Kaziranga National Park (Assam) [1974]
  (3) Bandhavgarh National Park (M.P) [1968]
  (4) Sunderbans National Park (Rajasthan) [1981]
- **Examples of Biosphere Reserves :**
  (1) Nilgiri Biosphere Reserves : Tamil Nadu, Karnataka, Kerala. [1986]
  (2) Great Rann of Kutchh : Gujarat [2008]
  (3) Nandadevi : Uttrakhand [1988]
  (4) Nokrek : Meghalaya [1988]
  (5) Panna : Madhya Pradesh [2011]
  (6) Sunderbans : West Bengal, 1989.

VI. Ecosystem and Biodiversity Services :

- **Ecological Value :**
  (a) Safeguarding water resources through maintenance of water cycle.
  (b) Recycling of nutrients and storing.
  (c) Degradation of Pollutants and its incorporation.
  (d) Restoring Climate and preserring ecosystem.
  (e) Protection of Soil.
  (f) Resilience from unpredictable events like Tsunami, earthquakes and wildfires.
- **Economic Value :**
  (a) Direct utilisation of timber, food, fuelwood and fodder by local communities.
  (b) Biodiversity contained in the ecosystem provides forest dwellers with their daily need,s food, material, medicines and other products.

(c) Dried biomass and the petrified products of coal, petroleum and natural gas that serve as fuel are all derived from biodiversity.

(d) Different varieties of creeds, pulses, vegetables, spices etc. comes directly from the diverse forms of wildlife.

(e) Wildlife trade, farming and extraction of medicinal products are other benefits.

- **Social Value :**

(a) Biodiversity has been presented by traditional societies hill today. For example, many of the plants like banyan, peepal, tulsi etc. and animals like cow, snake etc. are regarded as holy and served.

(b) Policy measures and resources utilization should be implemented in the aspect of social value.

(c) Indian lifestyle, songs, dance, scriptures and customs are closely related with wildlife.

- Ethical Value :

(a) Ethical values related to biodiversity are based on importance of protecting all forms of life.

(b) All species were created equal and have the moral right to live, procreate and grow. However, being at the top of the food chain, humans have played havoc with the fragile ecosystems.

(c) Humans should take a holistic view of the consequences of their actions and do things that are sustainable, includive and honor the rights of every living organisms.

- Aesthetic Value :

(a) The appreciation of the presence of biodiversity for it's inhevent value and beauty.

(b) Biodiversity is instrumental in promoting the tourism industry. Tourists from all parts of the world spend a lot of money to visit the wilderness. They enjoy the tranquillity, the natural and the aesthetic beauty of the forests and wildlife.

(c) Plants and animals are often used as symbols in paintings, flags, sculptures, stamps etc.

(d) Species like Asiatic lion, panda are chosen as flagship species for their attractiveness and distinctiveness to represent an environmental cause.

Unit 2 : Ecology and Ecosystem

- Points of Discussion :
  1) Concept of Ecology and Ecosystem
  2) Structure and Function of Ecosystem
  3) Energy Flow in an Ecosystem
  4) Food Chains and Food WEBS.
  5) Basic Concept of Population and Community Ecology.
  6) Ecological Succession.
  7) Characteristic Features of the Following :
     (i) Forest Ecosystem.
     (ii) Grassland Ecosystem
     (iii) Desert Ecosystem
     (iv) Aquatic Ecosystem. (ponds, streams, lakes, wetlands, rivers, oceans, estuaries).

1) Concept of Ecology and Ecosystem :

- Ecology : It is a branch of science which deals with the study of animal and plant inter-relationship and also their relation to the surrounding environment. The term was introduced by Hans Reiter, a German scientist, by combining two words 'Oikos' (house or dwelling place)' and 'logos' (to study). Ernst Haeckel in 1866 first used and defined the term in his book "Morphology of organisms" as – "By Ecology we mean the body of knowledge concerning the economy of nature – the total relations of the animal to both it's inorganic and organic environment".
- Some Definitions of Ecology :
  - Andrewartha (1961) defined ecology as the "scientific study of the distribution and abundance of organisms".
  - Odum (1963) defined ecology as "the study of the structure and function of nature".
  - Charles J. Krebs (1978) proposed a practical version of Andrewartha's definition and defined ecology as the "Scientific study of the interactions that determine the distribution and abundance of organisms".
- The two subdivisions of ecology are autecology and synecology :

(a) Autecology – Deals with the study of individual organisms or spices in an environment.

(b) Synecology – Deals with the study of a group of organism in relation to the environment.

- Realm of Ecology :

  The following five levels of organisation make up the realm of ecology →

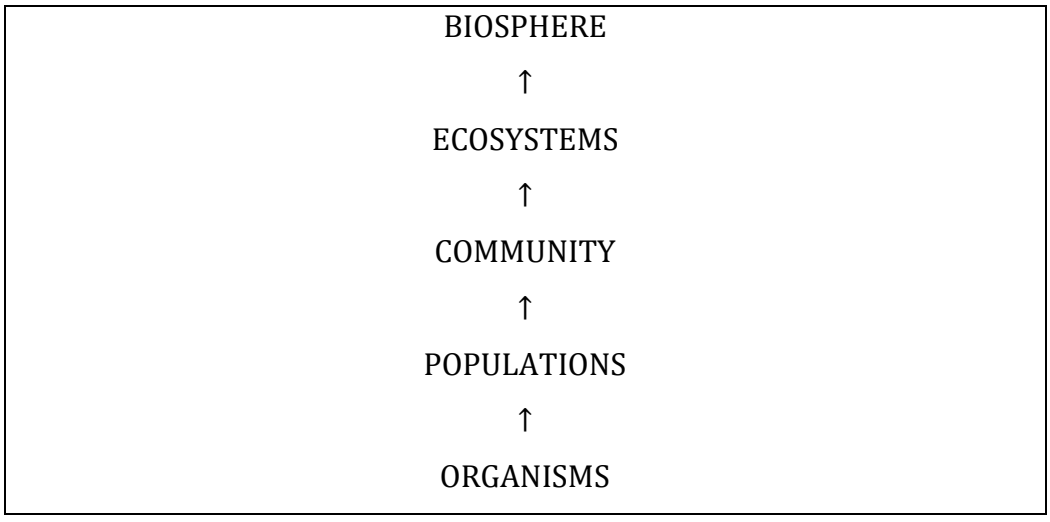
  (a) Organism/Individual : It is the lowest level of organisation which includes any form of life with cell as it's basic unit.

  (b) Population : Denotes a group of individual organisms of the same species in a given area. Populations include individuals of the same spices, but may have different genetic makeup.

  (c) Community : It includes all the populations of different spices residing together in a specific area at a given time.

  (d) Ecosystem : The community of living organisms (biotic) interact with the non-living (abiotic) factors and together formo the ecosystem. Thus an ecosystem consists of the whole biotic community in a given area plus it's abiotic environment.

  (e) Biosphere : All the ecosystems functioning in Earth combine together to form a giant, closed, self-sufficient biological system, known as the biosphere.



Levels of Organisation

- Ecosystem : The living organisms and their non – living environment are inter – related and interact with each other closely to form a system. The biotic and abiotic components are linked through nutrient cycles and energy cycles. This

ides of ecosystem was first introduced by the British ecologist, A.G.T ansley in 1935. He defined the term ecosystem as "the system resulting from the integration of all living and nonliving factors of the environment". The concept of ecosystem is based on the interactions and exchanges of materials. It gives importance to both the structural and functional aspects. An ecosystem is the basic functional unit in ecology and it includes both organisms and their abiotic environment. Thus, ecosystem represents the highest level of ecological integration.

- Some Definitions of Ecosystem :
  - Woodbury (1954) – "Ecosystem is a complex in which habitat, plants and animals are considered as one interesting unit, the materials and energy of one passing in and out of the others".
  - E.P. Odum – "The ecosystem is the basic functional unit of organisms and their environment interacting with each other and with their own components".
  - Chapinetal (1997) – "Populations do react to environmental stimulus and so ecosystems can also be defined by biota and by the environment".
- Types of Ecosystems :

(a) Natural ecosystems : These ecosystem operate independently under natural existing conditions without any disruption from exernal factors (human interference).

These ecosystems may be further dividend as :

(i) Jerrestrial ecosystems eg : forests, grasslands and deserts.

(ii) Aquatic ecosystems : They include both freshwater and marine ecosystems.

- Freshwater ecosystem consists of Lotic (running water as springs, streams or rivers) and lentic (standing water like lakes, ponds, swamps, ditches etc.)
- Marine ecosystems include oceans, sea bodies, estuary etc.

(b) Artificial (Man – cultured) Ecosystems : These ecosystem are maintained and managed artificially by humans. In these cases, man tries to control the biotic community as well as the physico – chemical environment eg : croplands, orchards, farmlands, garden etc.

2) Structure and Function of Ecosystem :

The structure of an ecosystem includes :

- The composition of biotic community which comprises spices diversity, their numbers, biomas and distribution.
- The amount of non – living materials (nutrients, water) and their distribution.
- The conditions of existence, i.e. temperature PH level intensity of sunlight etc.

The function of an ecosystem includes :

- Rates of energy flow i.e. the productivity and respiration rates.
- Rates of nutrient (material) cycles eg : Carbon, nitrogen, phosphorus etc.
- Ecological Regulation → Regulation of organisms by the environment and vice-versa.

In an ecosystem, the structure and function are inter – related and considered to be one unit.

- Components of Ecosystem :

  An ecosystem has the following two major components :

  (a) Abiotic (Non – living) Componet : The non – diving factors or the physical environment prevailing in an ecosystem form the aboitic components. They have a strong influence on structure, distribution and inter – relationships of organisms. They include –

  - Inorganic substances (C, N, H, P, S, O) involved in nutrient cycles.
  - Inorganic chemicals eg : Chlorophyll,
  - Organic materials eg : Protiens, fats, vitamins, coenzymes etc.

  The quantity of inorganic substances presnt of any given time in the system is known as standing state or standing quality.

  (b) Biotic (living) components : The various living organisms (plants, animals, micro organisms) inhabiting the ecosystem from the biotic components. They are distinguished on the basis of their nutritional relationships, such as :

  (i) Producers (Auto trophs) – These organisms have the ability to fix light energy and manufacture their own food from simple inorganic substances (H_2O, Co_2) by the process of photosynthesis. They include mainly green plants, algae, planktons, photosynthetic bacteria, chemosynthetic microbes etc.

(ii) Consumers (Heterotrophs) : These organisms lack chlorophyil and 80 unable to synthesize their own food. They obtain nutrition and energy by feeding upon other organisms. The consumer are of the following two types →

- Macroconsumers : They are phagotrophs and feed on other organism or particulate organic matter. In order of their occurrence in the food chain they are – herbivores (food on plants), carnivores (feed on other animals) and omnivores (feed on both plants and animals). Herbivores are also known as primary consumers. Carnivores and omnivores fall in the category secondary and tertiary consumers.
- Microconsumers : These are microscopic heterotrophic organisms also known as decomposers or saprotrophs. Microconsumers comprise bacteria, actinomycetes, fungil, small insects etc. They obtain energy from decomposed organic remains and wastes of other organism. During the process of decomposition of complex organic compounds, they release inorganic nutrients in environment, which can be utilized by the autotrops again.

The function of an ecosystem includes : (mentioned before).

The function of an ecosystem is based on energy flow, exchange and the cycling of nutrients. Theses exchanges helps to sustain life on planet and production of biomass. Ecosystem functions are essentially an integral part of ecological process and structures. The two ecological processes of energy flow and material cycling involves interaction between the physical environment and the biotic components. The energy flow through the ecosystem is unidirectional whereas the minerals keep circulating in a cyclic manner.

- Productivity of an Ecosystem →

The amount of biomass (biological material) produced in a specific area during a given period of time denotes the productivity of an ecosystem. It is expressed in mass per unit area (or volume) per unit time.

Eg : grams / square metres/day . A constant input of solar energy is required for any ecosystem to sustain.

Productivity at producer level (plants) is called primary productivity, whereas at consumer levels (animals) it is known as secondary productivity.

(i) Primary productivity : This type is generally associated with autotrophs (green plants), phytoplanktons, photosyenthetic bacteria, blue – green algae etc. These organisms have the ability to manufacture new organic materials from inorganic molecules such as H_2O and Co_2 by the process of photosynthesis. Photosynthesis is chiefly responsible for primary productivity as it sustains all subsequent life processes of other organisms. It is defined as "the rate at which radiant energy is stored by photosynthetic and chemosynthesis activity of producers".

It is of the following two types →

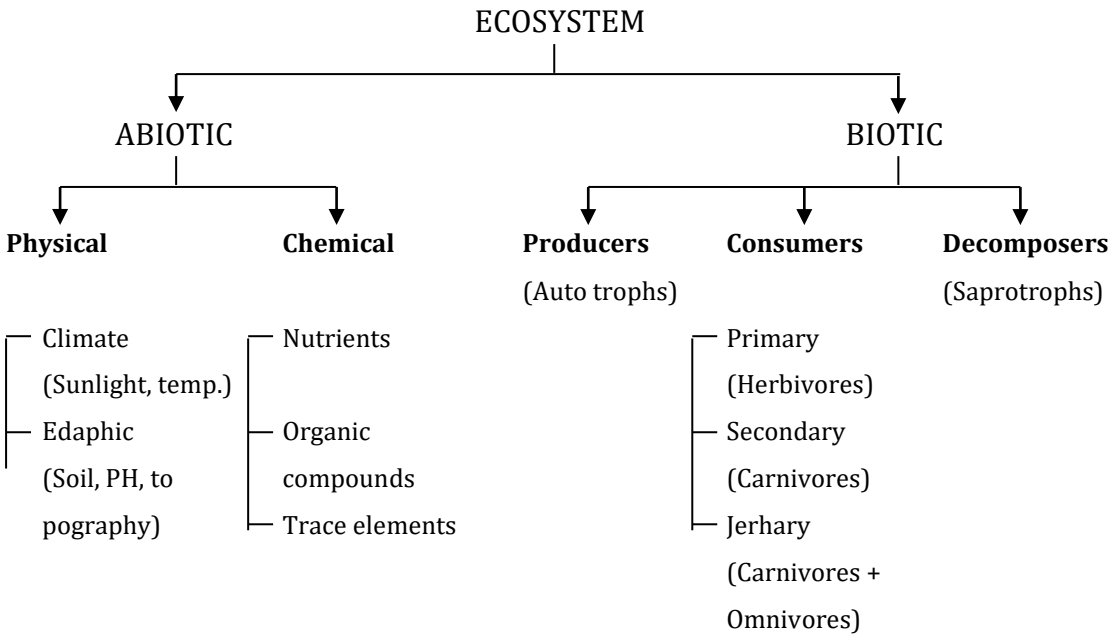
- Gross primary productivity : It is the total rate of organic matter produced during photosynthesis. A significant amount of GPP is used by plants for respiration. It is also known as total photosynthetic or total assimilation.
- Net primary productivity : Gross primary productivity (GPP) minus respiration losses CR is the net primary productivity (NPP).

NPP = GPP – R

NPP can be measured as the difference between the rate of photosynthetic by plants and their rate of respiration. Thus, NPP is the rate of storage of organic matter in plant bodies in excess of the respiratory utilization by plants during the measurement period. It is also known as apparent photosynthesis or net assimilation.

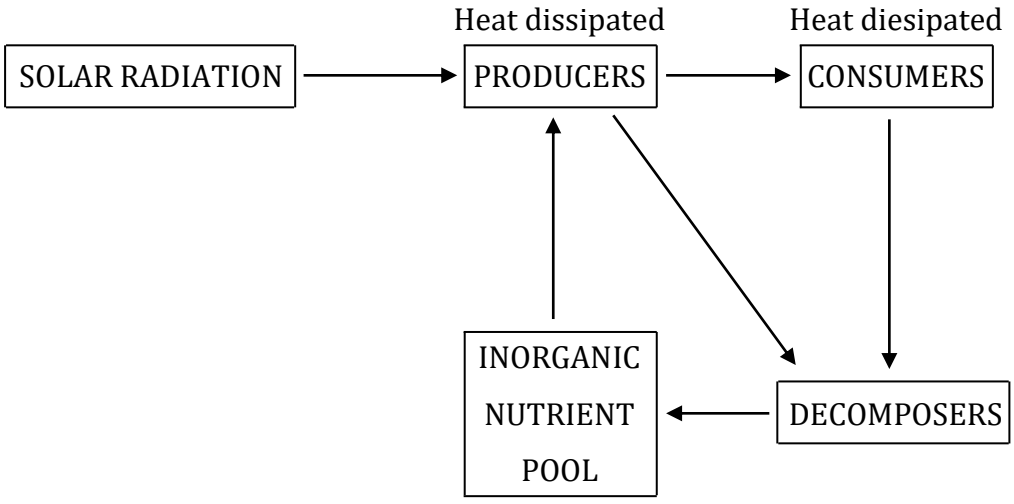
(ii) Secondary productivity : This refers to the productivity at the consumer level. It is the total amount of energy assimilated by consumer organism. It can also be referred to as the net rate of increase in biomass of consumers. Consumers utilize already produced food materials in their respiration and also convert primary organic matter into animal tissue per unit area in a given time.

(iii) Net Productivity : The assimilated energy of the consumers is utilized in cellular respiration. All of the biomass is not consumed by the animals. Some are released in the form of faeces. Thus, the rate of storage of organic matter not used by the heterotrophs during the unit period of time (season/month/year) is the net productivity. It is expressed as production of ($g/m^2/day$). The period of time may be monthly, seasonal or yearly.



3) Energy Flow in an Ecosystem :

All living organisms including human beings require energy to exist and perform essential functions. Solar radiation is the major source of energy for almost all organisms. Less than 50 percent of incident solar radiation is photo synthetically active radiation is photosynthetically active radiation (PAR). Autotrophs have the ability to fix sun's radiant energy to make food from simple inorganic materials. Plants capture only 2 – 10 percent of the PAR and this miniscule amount supports all living organisms on Earth. Thus, Energy flow is the unidirectional transfer of energy through a series of organisms up the trophic level. There is a progressive decrease in energy content at each trophic level due to dissipation of heat used up in metabolic activities.



Energy Flow in an Eosystem

The flow of energy in an ecosystem is governed by the following laws :

(a) First Law of thermodynamics : Energy can either be created nor destroyed but can only be transformed from one form to another. True, in a system total inflow of energy should be equal to total output of energy.

(b) Second Law of thermodynamics : The energy transfer in a system is always followed by a dissipation of energy into unavailable heat (i.e. entrophy).

4) Food Chains and food WEBS :

Trophic Structure : Trophic structure demonstrates the various feeding levels in the biotic community in an organised and systematic manner. The organisms are classified into different trophic levels based on their nutritional habits. This pattern of organization helps in the transfer of energy through a series of organisms.

The Trophic Levels :

- 1^{st} → Primary Producer (Autotrophs / Given plants).
- 2^{nd} → Primary Consumer (Herbivores)
- 3^{rd} → Secondary Consumer (Carnivores / Omnivores)
- 4^{th} → Tertiary Consumer (“)

Food Chain : Food chain is a linear arrangement illustrating the flow of energy through a series of organisms which feed upon one another. The energy is transferred in a systematic manner up the various trophic levels. Autotrophs (Green plants) occupy the first trophic level as they have the ability to fix sun’s radiant energy. In any food chain energy flows in the following manner →

Primary Producers → Primary Consumers → Secondary Consumers

Jerhary Consumer

At each level in the food chain, a significant amount of energy is lost due to metabolic activities of the organisms.

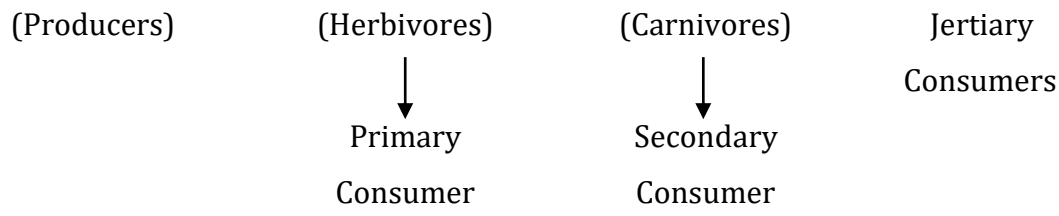
Food chains can be of the following two types :

(a) Grazing food chain → This type of food chain starts from living green plants, goes to grazing herbivores (i.e. organisms eating living plants) and finally to carnivores (animal eaters).

Ecosystems with such type of food chain are directly dependent on influx of solar radiation. This type of food chain thus depends on autotrophic energy capture

and the movement of this captured energy to herbivore. Usually, most of the food chains in nature are of this type.

eg : Grasses → Rabbit → Fox → Lion



(b) Detritus food chain → This type of food chain begin with dead organic matter, which is fed on by microorganisms to detritivores to organisms feeding on detritivores. This type is less dependent on direct solar radiation. The detritus food chain is more complex.

Food Web : The concept of food web was first introduced by Charles Various food chains exist in an ecosystem. These food chains cannot operate independently but are interlinked to each other in an organized manner and function simultaneously. It depicts how energy flows between various organisms residing in an ecosystem.

5) Basic Concept of Population and Community Ecology

- Population ecology : It is the study of population dynamics in relation to the environment, including environment influences on population density and distribution, age structure and population size.

  The density of a population is measured as the number of individual per unit area or volume.

  Ecologists use a variety of sampling techniques to estimate densities and total population sizes. Demography is the statistical study of factors that affect population density and dispersion patterns of human beings. In population ecology units of study are individuals of a single species.

- Community ecology : Here the units of study are groups of individuals belonging to different species plants as well as animals. Populations that interact within a given habitat form a community. The number of spices occupying the same habitat and their relative abundance is known as the diversity of the community. Scientists study ecology at the community level to understand how species interact with each other and compute for the same resources. It is also known as synecology.

6) Ecological Succession :

Studies by ecologist have shown that there have been gradual processes of change in ecological communities. Ecological succession is the process of change through which an ecological community evolves over time towards a stable condition. These changes are fairly predictable and progressive in nature. The time range can be years, decodes or even hundreds of years. Along with the changes in species composition, of the community the physical and chemical environment of the area also changes. The community moves towards a stable condition known as "Climax".

- "Climax Community" : In the concept of ecological succession, ecosystems advance until they reach a climax community. In the climax community, all of the resources are efficiently used and the total mass of vegetation maxes out. Many forests that have been undistributed in many years are examples of a climax community. It is a stable community dominated by a small number of prominent species.
- Why does this change occur?

  Every species has a set of environmental conditions under which it will grow and reproduce most optimally. When the conditions of an environment change suddenly and drastically the existing species are dominated by another set of new species which are most suited to the new environment.

Two basic types of succession are as follows →

(a) Primary Succession : The series of community changes which occur in an entirely new habitat that has never been colonized before. Primary succession happens when new land is formed or bare rock is exposed, providing a habitat that can be colonized for the first time.

eg: Primary succession may take place in newly formed islands, or new volcanic rocks exposed by volcanic eruption.

(b) Secondary Succession : It occurs after a disturbance disrupts ecosystem processes and removes part of the existing biotic components. Thus the series of community changes takes place in a previously colonized, but disturbed or damaged habitat. Disturbances such as forest thinning, floods, forest fires and wind can all lead to secondary succession.

eg : Oak forests are cleared by wildfire in an ecosystem. Wildfires will burn most vegetation and kill animals unable to flee the area. Their nutrients, however, are returned to the ground in the form of ash. Since, the disturbed area already has nutrient – rich soil, it can be recolonized much more quickly than the bare rock of primary succession.

7) Characteristic Features of the Following :

(i) Forest Ecosystem

(ii) Desert Ecosystem

(iii) Grassland Ecosystem

I. Forest Ecosystem →

(i) Forests occupy roughly 31% of the Earth's land. In India forests occupy about 24.39% of the total geographical area of the country. Forests are among the most complex ecosystems in the world.

(ii) Forests assist in maintaining climatic conditions and rainfall of a particular area. Soil is rich in organic matter and minerals.

(iii) Forest canopy is an important distinguishing feature. IT denotes the top portion of a community of trees. This serves as a connection between the gaseous atmosphere and land. Moet organisms are able to survive in forest canopy because it is directly in contract with sunlight and water.

(iv) Forest floor is another distinct feature. It comprises fallen leaves, stems, branches and bark on the surface of soil. Many microorganisms also occupy the forest floor increasing the nutrient and mineral content of the soil. The major part of the nutrients of the forest ecosystem comes from forest floor due to decomposition of organic substances.

(v) Forest Soil → Soil type in various forests differ widely. The soil of temperate forests is much more fertile as leaves drop to the ground every winter. This litter contributes to increase of organic matter. On the other hand, soil in tropical rain forests has poor quality because of torrential rains. The rains dissolves the soil nutrients before trees can benefit. Decomposition by microorganisms enriches the forest soil.

(vi) The forest ecosystem supports the existence of many wild organisms and thus helps in protecting the biodiversity.

(vii) Penetration of light is fast, so conversion of organic matter into nutrients is fast.

II. Desert Ecosystem :

(i) Deserts occupy about 17 percent of our world's land area and about 10 percent of total geographical area of India.

(ii) Rainfall is very irregular. Annual rainfall is less than 25 centimeters (10 inches).

(iii) Abiotic components are characterised by low amount of nutrients in soil, scarcity of water, and high fluctuation in temperature.

(iv) In deserts many succulent (eg. Cacti) plants are present along with shrubs, bushes and few xerophytic trees. They have water stored inside them to stay alive and a waxy layer externally to protect them from sun.

(v) The most common animals found are reptiles and insects, able to persist under xeric conditions. In addition, some nocturnal rodents and birds are also found. The ship of the desert', camels food on tender shoots of the plants. Some thermophillic fungi and bacteria are present.

(vi) The soil is very poor in nutrients and organic matter. So, vegetation is also poor.

(vii) High degree of fluctuations in day and night temperatures and also in seasons.

(viii) High wind velocity because of open spaces.

(ix) Highly arid conditions due to lack of water vapour in air.

(x) Soil is loose, sandy, devoid of organic carbon, nitrogen, moisture etc.

(xi) Solar radiation is very intense due to absence of clouds.

(xii) Drought is an important feature. The duration of drought is long in the extreme arid-zone and decreases towards the margins. Drought is a prolonged period of abnormally low rainfall, leading to a shortage of water.

(xiii) A few of world's deserts are → Sahara Desert, Sunoran Desert, Mojave Desert, Atcama Desert, Thar Desert, Gobi Desert, Siberia (cold does not) etc.

III. GrassLand Ecosystem :

(i) Grasslands occupy around 19 to 25 percent of the Earth's surface. In India, they occupy 24 percent of the geographical area. A grassland is a type of ecosystem dominated by grasses and other Herbaceous (non – woody) flowering plants and a variety of scattered trees and bushes.

(ii) Grasslands are highly dynamic ecosystems.
They are of mainly two types →
Tropical Grasslands (Savannah) → located near Equator
Temperate Grasslands →
(i) Pampas (south America)
(ii) Prairies (North America)
(iii) Steppes (Central Asia)
(iv) Veldt (Africa)

(iii) Grasslands occur in areas where there is not enough rainfall to support the growth of a forest, but not so little as to form a desert. On an average they receive around 25 – 75 cm rainfall per year. In such low amount of rainfall big trees cannot survive. Mean annual temperature is between 0^{o} C and 25^{o}C.

(iv) Grasslands separate forests from deserts. Grasslands act as barrier towards desertification of land as they have plants which bind the soil and prevent erosion of the land.

(v) No other habitat is agriculturally as useful to humans as grasslands. Soils tend to be deep and fertile. Much of the North American Prairie Lands have been converted into one of the richest agricultural regions on Earth.

(vi) Savannahs have scattered trees and predominate in certain parts of Africa, South America and Asia. Temperate grasslands are largely devoid of trees, receive less rainfall than Savannah's and exhibit broader temperature extremes.

(vii) In tropical grasslands, growing season is usually in the monsoon. In temperate grasslands, the growing season is usually the short period between the cold, damp winter and the hot, dry summer.

(viii) The animals that live in grasslands have adapted themselves to the dry, windy conditions with time.

(ix) There is a large variety of animals found in tropical grasslands, especially Africa. Over forty different species of animals are found in African Savannahs. eg : Impala, Zebra, Elephant, Lion, Leopard and Cheetah.

The temperate grasslands has lower diversity of animal species in comparison to the tropical regions. eg : Some of the animals found here are → Bison, Antelope, Coyote, Wild horse and Polecats.

(x) Examples of Grasslands in India → Himalayan Pasture belt/semi – arid plains of Western India, Central India and the Deccan are covered by grassland tracts with patches of thorn forest.

Unit 2 → Ecology and Ecosystems (MCQ's)

(1) The term ecosystem was coined by →

(a) Evnst Haeckel (b) A.G. Tansley

(c) Fourier (d) H. Reiter

(2) The term ecology was coined by →

(a) Alexandar Fleming (b) A.G. Tansley

(c) Ernst Haeckel (d) H. Raiter

(3) Which of the following fall under functional aspect of Ecosystem →

(a) Producers (b) Climatic factors

(c) Energy cycles (d) Micro - consumers

(4) Which of the following fall under structural aspect of Ecosystem →

(a) Saprotrophs (b) Food chains

(c) Evolution (d) Energy cycles

(5) Ecosystem comprises :

(a) Biotic components (b) Abiotic components

(c) both a and b (d) None

(6) The study of group of organisms is known as :

(a) Synecology (b) Limnology

(c) Autecology (d) Pedology

(7) On Earth autotrophic components can directly fix :

(a) Mechanical energy (b) Light energy

(c) Chemical Energy (d) None

(8) Which of the following feed on 'detritus' :

(a) Producers (b) Consumers

(c) Decomposers (d) None

(9) A group of individual of the same species in a given area :

(a) Organism (b) Community

(c) Population (d) None

(10) Which of the following are producers in aquatic ecosystems

(a) Zooplanktons (b) Phytoplanktons

(c) Olanobacteria (d) None of these

(11) Energy flow in an ecosystem is :

(a) Multidirectional (b) Bidirectional

(c) Unidirectional (d) None of these

(12) Grazing animals are primarily found in :

(a) Desert Ecosystem (b) Grassland Ecosystem

(c) Forests (d) None of these

(13) Amount of rainfall in desert ecosystem is →

(a) More than 100 cms. (per year)

(b) 50 – 100 cms. (per year)

(c) Less than 25 cms. (per year)

(d) 25 – 50 cms

(14) Rainforests of the sea' are →

(a) Estuaries (b) Lagoons

(c) Coral Reefs (d) Mangroves

(15) Which of the following is an important feature of deserts :

(a) Canopy (b) Drought

(c) Rainforests (d) Estuaries

(16) Benthos are →

(a) that flows with water current

(b) strong swimmers

(c) bottom dwellers

(d) Rest or swim on the water surface

(17) Prairies (Grassland) are found in :

(a) Australia (b) North America

(c) Russia (d) Africa

(18) Largest hot desert in the world is →

(a) Mojave (b) Atacama

(c) Thar (d) Sahara

(19) Process through which an ecosystem tend to change to change over a period of time →

(a) Energy Cycle (b) Ecological Sucesion

(c) Ecotone (d) None

(20) Special ecosystems in which the water level fluctuates dramatically in different seasons :

(a) Estuaries (b) Deltas

(c) Wetlands (d) Lakes

(21) Immobile, still or stagnant water bodies fall under :

(a) Lotic (b) Lentic

(c) Marine (d) None

(22) Amount of rainfall in Savannah type of grasslands :

(a) 0 – 25 cms (b) 25 – 50 cms

(c) 50 – 75 cms (d) 75 to 100 cms

(23) Transfer of energy through a series of organisms takes place through →

(a) Food web (b) Food pyramid

(c) Trophic Level (d) Food chain

(24) Which of the following depends primarily on sunlight :

(a) Grazing food chain (b) Detritus food chain

(c) Both (d) None of the above

(25) Large number of food chains are interlinked to form :

(a) Biome (b) Food web

(c) Food pyramid (d) None

(26) Veldt grassland is located in →

(a) Russia (b) South Africa

(c) Canada (d) Europe

(27) Savanna's are found near →

(a) Equator (d) Poles

(c) Trophic of Capricorn (d) None

(28) Zone of junction or transition area b/w two diverse ecosystems :

(a) Ecocity (b) Ecological Niche

(c) Ecocline (d) Ecotone

(29) Which of the following describes the functional position and role of an organism within it's environment :

(a) Ecocity (b) Ecotone

(c) Ecological Niche (d) Ecotype

(30) In concepr of ecological succession, ecosystems advance until they reach →

(a) Stable Community (b) Climan community

(c) Zero populations (d) None of the above

(31) Area which remains under water only at high tide conditions :

(a) Oceanic zone (b) Benthic zone

(c) Intertidal zone (d) Neritic zone

(32) Freshwater contains – % of the world's known fish species →

(a) 65% (b) 32%

(c) 41% (d) 82%

(33) Edaphic factors in an ecosystem is related to →

(a) Climate (b) Soil

(c) Light (d) Temperature

(34) Which of the following forests grow in coastal environment :

(a) Decidious (b) Temperate

(c) Mangroves (d) Evergreen

(35) Simplest aquatic ecosystem :

(a) Wetland (b) Streams

(c) Lakes (d) Ponds

(36) The organisms which feed on waste product are :

(a) Herbivores (b) Carnivores

(c) Detritivores (d) None

(37) Sharp temperature boundary between two layers of lake :

(a) Hypolimnion (b) epilimnion

(c) thermostat (d) thermocline

(38) The study of freshwater ecosystem :

(a) Cryology (b) Oceanology

(c) Limnology (d) Hydrobiology

(39) Animals that lack chlorophyll and unable to synthesis their own food :

(a) Autotrophs (b) Heterotrophs

(c) Saprotrophs (d) Both (b) and (c)

(40) Primary consumers are basically

(a) Carnivores (b) Herbivores

(c) Both a and b (d) None

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COLLEGE NAME: UMESCHANDRA COLLEGE

TEACHER: MD FAHAD HAQUE

SUBJECT: ENVIRONMENTAL STUDIES

CHAPTER: UNIT 6

UNIT 6: ENVIRONMENTAL POLICIES AND PRACTICES

POINTS TO BE DISCUSSED-

- **Climate change, global warming, ozone layer depletion, acid rain and their impacts on human communities and agriculture.**
- **Environment laws: Wildlife Protection Act; Forest Conservation Act; Water (Prevention and Control of Pollution) Act; Environment Protection Act; Biodiversity Act.**
- **International agreements: Montreal protocol, Kyoto protocol and climate negotiations; Convention on Biological Diversity (CBD).**

1.1 Climate change and global warming:

Climate change is one of the prime issues threatening the world's environment. Climate change will have wide-ranging effects on the environment, and on socio-economic and related sectors, including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones. Changes in rainfall pattern are likely to lead to severe water shortages and/or flooding. Melting of glaciers can cause flooding and soil erosion. Rising temperatures will cause shifts in crop growing seasons which affects food security and changes in the distribution of disease vectors putting more people at risk from diseases such as malaria and dengue fever. Temperature increases will potentially severely increase rates of extinction for many habitats and species (up to 30 per cent with a 2° C rise in temperature).

Rising fossil fuel burning and land use changes have emitted, and are continuing to emit, increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO_2), methane (CH_4) and nitrogen dioxide (N_2O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, heat that would normally be radiated back into space. This increase in heat has led to the greenhouse effect, resulting in climate change. The main characteristics of climate change are increases in average global temperature (global warming); changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers and reduced snow cover; and increases in ocean temperatures and ocean acidity – due to seawater absorbing heat and carbon dioxide from the atmosphere

Over the next decades, it is predicted that billions of people, particularly those in developing countries, face shortages of water and food and greater risks to health and life as a result of climate change

"Global warming" refers to the long-term warming of the planet. Global temperature shows a well-documented rise since the early 20th century and most notably since the late 1970s. "Climate change" encompasses global warming, but refers to the broader range of changes that are happening to our planet. These include rising sea levels, shrinking mountain glaciers, accelerating ice melt in Greenland, Antarctica and the Arctic, and shifts in flower/plant blooming times. These are all consequences of the warming, which is caused mainly by people burning fossil fuels and putting out heat-trapping gases into the air. The terms "global warming" and "climate change" are sometimes used interchangeably, but strictly they refer to slightly different things.

1.2 ACID RAIN:

When fossil fuels such as coal, oil and natural gas are burned, chemicals such as sulphur dioxide and nitrogen oxides are released into the air. **Acid rain is one of the consequences of air pollution**. It occurs when emissions from factories, cars or heating boilers contact with the water in the atmosphere. **These emissions contain nitrogen oxides, sulfur dioxide and sulfur trioxide, which when mixed with water becomes sulfurous acid, nitric acid and sulfuric acid**. This process also occurs naturally through volcanic eruptions.

The major sources of SO_2 and NO_X in the atmosphere are:

- Burning of fossil fuels to generate electricity. Two thirds of SO_2 and one fourth of NO_X in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.

- Manufacturing, oil refineries and other industries.

EFFECTS OF ACID RAIN:

- Acid rain is very harmful to agriculture, plants, and animals. It washes away all nutrients which are required for the growth and survival of plants. Acid rain affects agriculture by the way how it alters the composition of the soil. It causes respiratory issues in animals and humans.
- When acid rain falls down and flows into the rivers and ponds it affects the aquatic ecosystem. As it alters the chemical composition of the water, to a form which is actually harmful to the aquatic ecosystem to survive and causes water pollution.
- Acid rain also causes the corrosion of water pipes. Which further results in leaching of heavy metals such as iron, lead and copper into drinking water.
- It damages the buildings and monuments made up of stones and metals.

1.3 OZONE LAYER DEPLETION:

The ozone layer is a layer in Earth's atmosphere which contains relatively high concentrations of ozone (O3). This layer absorbs 93-99% of the sun's high frequency ultraviolet light, which is potentially damaging to life on earth. Over 91% of the ozone in Earth's atmosphere is present here. It is mainly located in the lower portion of the stratosphere from approximately 10 km to 50 km above Earth, though the thickness varies seasonally and geographically. The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson.

The ozone layer in the stratosphere absorbs a portion of the radiation from the sun, preventing it from reaching the planet's surface. Most importantly, it absorbs the portion of UV light called UVB. UVB has been linked to many harmful effect, including skin cancers, cataracts, and harm to some crops and marine life.

Scientists have established records spanning several decades that detail normal ozone levels during natural cycles. Ozone concentrations in the atmosphere vary naturally with sunspots, seasons, and latitude. These processes are well understood and predictable. Each natural reduction in ozone levels has been followed by a recovery. Beginning in the 1970s, however, scientific evidence showed that the ozone shield was being depleted well beyond natural processes. Atmospheric concentrations of ozone vary naturally depending on temperature, weather, latitude and altitude, while substances ejected by natural events such as volcanic eruptions can also affect ozone levels. The "Dobson unit", a convenient measure of the total amount of ozone.

However, these natural phenomena could not explain the levels of depletion observed and scientific evidence revealed that certain man-made chemicals were the cause. These ozone-depleting substances were mostly introduced in the 1970s in a wide range of industrial and consumer applications, mainly refrigerators, air conditioners and fire extinguishers. When chlorine and bromine atoms come into contact with ozone in the stratosphere, they destroy ozone molecules. One chlorine atom can destroy over 100,000 ozone molecules before it is removed from the stratosphere. Ozone can be destroyed more quickly than it is naturally created. Some compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere. These compounds contribute to ozone depletion, and are called ozone-depleting substances and methyl bromide. Although ODS are emitted at the Earth's surface, they are eventually carried into the stratosphere in a process that can take as long as two to five years.

Ozone measurements fluctuate from day to day, season to season and one year to the next. Ozone concentrations are normally higher in the spring and lowest in the fall. In spite of these fluctuations, scientists have determined, based on data collected since the 1950's, which ozone levels were relatively stable until the late 1970's. Observations of an Antarctic ozone "hole"[1] and atmospheric records indicating seasonal declines in global ozone levels provide strong evidence that global ozone depletion is occurring.

Severe depletion over the Antarctic has been occurring since 1979 and a general downturn in global ozone levels has been observed since the early 1980's. The ozone hole over the Antarctic reached record proportions in the spring of 2000 at 28.3 million square kilometers and vertical profiles from stations near the South Pole showed complete ozone destruction in the lower stratosphere. Ozone decreases of as much as 70% have been observed on a few days.

2.1 WILDLIFE PROTECTION ACT, 1972

An Act to provide for the protection of wild animals, birds and plants and for matters connected therewith or ancillary or incidental thereto with a view to ensuring the ecological and environmental security of the country.

The rapid decline of India's wild animals and birds, one of the richest and most varied in the world, has been a cause of grave concern. Some wild animals and birds have already become extinct in this country and others are in the danger of being so. Areas which were once teeming with wild life have become devoid of it and even in Sanctuaries and National Parks the protection afforded to wild life needs to be improved. The Wild Birds and Animals Protection Act, 1912 (8 of 1912), has become completely outmoded. The existing State laws are not only out-dated but provide punishments which are not commensurate with the offence and the financial benefits which accrue from poaching and trade in wild life produce. Further such laws mainly relate to control of hunting and do not emphasis the other factors which are also prima reasons for the decline of India's wild life, namely, taxidermy and trade in wild life and products derived there from.

The Bill seeks to-

(a) Constitute a Wild Life Advisory Board for each State;

(b) Regulate hunting of wild animals and birds;

(c) Lay down the procedure for declaring areas as Sanctuaries, National Parks, etc.;

(d) Regulate possession, acquisition or transfer of, or trade in wild animals, animal articles and trophies and taxidermy thereof;

(e) Provide penalties for contravention of the Act.

2.2 FOREST CONSERVATION ACT, 1980

An Act to provide for the conservation of forests and for matters connected therewith or ancillary or incidental thereto. Forest (Conservation) Act, 1980 is a unique piece of legislation, and a regulatory mechanism that reflects the collective will of the nation to protect its rich biodiversity and natural heritage and that permits only unavoidable use of forest land for various developmental purposes. It embodies the firm commitment of the Government of India to balance the conservation of forests with the sustainable development need of the country contributing to better environment, health and economy. The remarkable feature of this Act is that it is regulatory and not prohibitory. Concurrent to regulated forest land diversions, the Government of India in the Ministry of Environment and Forests has also made efforts to consolidate the forest area and regenerate the forest cover through compensatory afforestation process.

Objectives

1. Forest dwellers must have access to subsidized sources of fuel, fodder, building material etc so that they do not cut trees.
2. Modify working plans into environmentally sound action plans based on scientific research.

    1. Protection of standing Forests.
    2. Creation of new stock.
    3. Building up of information base.

Measures

1. Aquatint yourself with the laws, detailed rules and orders issued by the government.
2. Create awareness about the existence & value of national parts & sanctuaries.
3. Help to create public pressure to change rules, laws & procedures when necessary.
4. Do not litter in a forest area.

5. Participate in preservation of greenery, by planting watering & caring for plants.

2.3 Water (Prevention and Control of Pollution) Act, 1974

An Act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution, for conferring on and assigning to such Boards powers and functions relating thereto and for matters connected therewith. WHEREAS it is expedient to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water, for the establishment, with a view to carrying out the purposes aforesaid, of Boards for the prevention and control of water pollution and for conferring on and assigning to such Boards powers and functions relating thereto.

The government formulated this act in 1974 to prevent the pollution of water by industrial, agricultural and household wastewater that can contaminate our water sources. Wastewaters with high levels of pollutants that enter wetlands, rivers, lakes, wells as well as the sea are serious health hazards. The main objectives of the Water Act are to provide for prevention, control and abatement of water pollution and the maintenance or restoration of the wholesomeness of water. It is designed to assess pollution levels and punish polluters. The Central Government and State Government have set up PCBs to monitor water pollution.

Controlling the point sources by monitoring the levels of different pollutants is one way to prevent pollution, by punishing the polluter. Individuals can also do several things to reduce water pollution such as using biodegradable chemicals for household use, reducing the use of pesticides in gardens, and identifying polluting sources at work places and in industrial units where oil are or other petroleum products and heavy metals are used. Excessive organic matter, sediments and infecting organism from hospital wastes can also pollute our water. Citizen needs

to develop a watchdog force to inform authorities to appropriate actions against different types of water pollution. However, preventing pollution is better than trying to cure the problems it has created, or punishing offenders.

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

The Water Act, 1974 with certain amendments in 1978 is an extensive legislation with more than sixty sections for the prevention and control of water pollution. Among other things, the Act provides for constitution of central and State Boards for preventing water pollution, power to take water samples and their analysis, discharge of sewage or trade effluents, appeals, revision, minimum and maximum penalties, publication of names of offenders, offences by companies and Government departments, cognizance of offences, water laboratories, analysis etc.

2.4 THE ENVIRONMENT PROTECTION ACT, 1986

An Act to provide for the protection and improvement of environment and for matters connected there with: WHEREAS the decisions were taken at the United Nations Conference on the Human Environment held at Stockholm in June, 1972, in which India participated, to take appropriate steps for the protection and improvement of human environment; AND WHEREAS it is considered necessary further to implement the decisions aforesaid in so far as they relate to the protection and improvement of environment and the prevention of hazards to human beings, other living creatures, plants and property.

It was enacted with the main objective to provide the protection and improvement of environment and for matters connected therewith. The Act is one of the most comprehensive legislations with a pretext to protection and improvement of the environment.

The Constitution of India also provides for the protection of the environment. Article 48A of the Constitution specifies that the State shall endeavor to protect and improve the environment and to safeguard the forests and wildlife of the country. Article 51 A further provides that every citizen shall protect the environment.

Objectives

As mentioned earlier, the main objective of the Act was to provide the protection and improvement of environment and for matters connected therewith. Other objectives of the implementation of the EPA are:

- To implement the decisions made at the UN Conference on Human Environment held at Stockholm in June 1972.
- To enact a general law on the areas of environmental protection which were left uncovered by existing laws. The existing laws were more specific in nature and concentrated on a more specific type of pollution and specific categories of hazardous substances rather than on general problems that chiefly caused major environmental hazards.
- To co-ordinate activities of the various regulatory agencies under the existing laws
- To provide for the creation of an authority or authorities for environmental protection
- To provide deterrent punishment to those who endanger the human environment, safety and health

It is the power vested in the central government that they can take any reasonable and valid steps and measures for the purpose of the protection and improvement of the quality of the environment. These measures are taken for the prevention, control and abatement of environmental Pollution.

2.5 BIODIVERSITY ACT, 2002

An Act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources, knowledge and for matters connected therewith or incidental thereto. WHEREAS India is rich in biological diversity and associated traditional and contemporary knowledge system relating thereto. AND WHEREAS India is a party to the United Nations Convention on Biological Diversity signed at Rio de Janeiro on the 5th day of June, 1992. Biodiversity has been defined under Section 2(b) of the Act as "the variability among living organisms from all sources and the ecological complexes of which they are part, and includes diversity within species or between species and of ecosystems".

The Biological Diversity Act 2002 is a law meant to achieve three main objectives: the conservation of biodiversity; the sustainable use of biological resources; equity in sharing benefits from such use of resources. The Biological Diversity Act 2002 was born out of India's attempt to realize the objectives enshrined in the United Nations Convention on Biological Diversity (CBD) 1992 which recognizes the sovereign rights of states to use their own Biological Resources. The Act aims at the conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process for purposes of implementing the objects of the Act it establishes the National Biodiversity Authority in Chennai.

Some salient features of the Act are: 1) To regulate access to biological resources of the country with equitable share in benefits arising out of the use of biological resources. 2) To conserve and sustainably use biological diversity. 3) To set up National Biodiversity Authority (NBA) , State Biodiversity Board (SBB) and Biodiversity Management Committees (BMC’s) 4) To create National , State and local biodiversity fund and its use for conservation of biodiversity. 5) To respect and protect knowledge of local communities and traditional knowledge related to biodiversity. 6) To conserve and develop areas of importance from the stand point of biological diversity by declaring them as biological diversity heritage sites.

3.1 MONTREAL PROTOCOL

The Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol) is an international agreement signed on 16th September 1987. It was designed to stop the production and import of ozone depleting substances and reduce their concentration in the atmosphere to help protect the earth's ozone layer.

The Montreal Protocol sits under the Vienna Convention for the Protection of the Ozone Layer (the Vienna Convention). The Vienna Convention was adopted in 1985 following international discussion of scientific discoveries in the 1970s and 1980s highlighting the adverse effect of human activity on ozone levels in the stratosphere and the discovery of the 'ozone hole'. Its objectives are to promote cooperation on the adverse effects of human activities on the ozone layer. The Montreal Protocol is widely considered as the most successful environment protection agreement. It sets out a mandatory timetable for the phase out of ozone depleting substances. The United Nations Industrial Development Organization (UNIDO) became an implementing agency of the Montreal Protocol in 1992 and is proud to be associated with its success. Since then UNIDO has recognized the significance of meeting the global environmental challenge of ozone depletion while observing national priorities, and of making meaningful technological adjustments resulting in a higher standard of living.

The Montreal Protocol has proven to be innovative and successful, and is the first treaty to achieve universal ratification by all countries in the world. Leveraging worldwide participation, the Montreal Protocol has sent clear signals to the global market and placed the ozone layer, which was in peril, on a path to repair. Full implementation of the Montreal Protocol is expected to result in avoidance of more than 280 million cases of skin cancer, approximately 1.6 million skin cancer deaths, and more than 45 million cases of cataracts in the United States alone by the end of the century, with even greater benefits worldwide. The Montreal Protocol's Scientific Assessment Panel estimates that with implementation of the Montreal Protocol we can expect near complete recovery of the ozone layer by the middle of the 21st century.

3.2 KYOTO PROTOCOL

The Kyoto Protocol was adopted on 11 December 1997. Owing to a complex ratification process, it entered into force on 16 February 2005. Currently, there are 192 Parties to the Kyoto Protocol.

The Kyoto Protocol is an international agreement that aimed to reduce carbon dioxide (CO_2) emissions and the presence of greenhouse gases (GHG) in the atmosphere. The essential tenet of the Kyoto Protocol was that industrialized nations needed to lessen the amount of their CO_2 emissions. The Protocol was adopted in Kyoto, Japan in 1997, when greenhouse gases were rapidly threatening our climate, life on the earth, and the planet, itself. Today, the Kyoto Protocol lives on in other forms and its issues are still being discussed. The Kyoto Protocol is significant because it introduces, for the first time, legally binding greenhouse gas emission commitments for the developed countries (this includes most of the developed countries listed in Annex I of the UNFCCC). The commitments agreed to should, according to the Protocol, lead to an overall global reduction of at least five per cent in 1990 levels of greenhouse gases by 2008-2012.

The most important greenhouse gas is carbon dioxide (CO_2), and its biggest source by far is the burning of fossil fuels (coal, oil and gas) for energy. Six billion tons of carbon is released as carbon dioxide every year from this source. Burning fossil fuels also gives off two other greenhouse gases: methane (CH_4) and nitrous oxide (N_2O). Carbon dioxide, methane and nitrous oxide are also given off as a result of deforestation, removal of grassland cover and agricultural practices. Deforestation is responsible for about 1.6 billion tons of carbon released as CO_2 per year. Methane is also emitted during the management and disposal of waste. Chlorofluorocarbons (CFCs), hydro chlorofluorocarbons (HCFCs) and halons are chemical gases which cause both ozone depletion and global warming. They are being phased out or controlled under the Montreal Protocol and so are not included in the UNFCCC or its Kyoto Protocol. The three industrial global warming gases controlled under the Kyoto Protocol are hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

3.3 Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD) is an international legally-binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; fair and equitable sharing of the benefits arising from the use of genetic resources. Its overall objective is to encourage actions, which will lead to a sustainable future. It was adopted at the Earth Summit, in Rio de Janeiro, in 1992.

One of the CBD's greatest achievements so far has been to generate an enormous amount of interest in biodiversity, both in developed and developing countries. Biodiversity is now seen as a critically important environment and development issue.

The Convention sets out general principles for action to achieve its main objectives: the conservation of biological diversity, the sustainable use of its components and the equitable sharing of benefits derived from the use of genetic resources. Over the years, the Conference of the Parties to the Convention—the body responsible for reviewing and guiding implementation—has adopted a number of programs of work on a range of thematic and cross-cutting issues. The thematic issues focus on the biodiversity of particular biomes or ecosystem types, such as marine and coastal areas, agricultural lands, dry lands, mountains, inland waters, and so forth. The cross-cutting issues are of a more general relevance and aim both to support the implementation of the thematic programmes of work and to implement specific articles of the Convention. The programs of work on access to genetic resources and benefit-sharing and indigenous and traditional knowledge fall into the latter category. The Conference of the Parties has also a number of tools and mechanisms to advance implementation of the Convention, such as operational guidance and principles for using the ecosystem approach and guidelines for incorporating biodiversity considerations into environmental impact assessment.