MAN AND HIS ENVIRONMENT

Chapter 25

Major Concept

In this Unit you will learn:

- Biogeochemical Cycle
- The Flow of Energy
- Ecological Succession
- Population Dynamics
- Human Impacts on Environment
- Environmental

25.1 BIOGEOCHEMICAL CYCLE

Every living organism requires nutrition to survive, and the env ironment offers these nutrients.
These nutrients circulate in cycles through ecosystems. The movement and exchange of elements and essential compounds required for life between organisms, the environment, reservoirs of water, and the Earth's crust are known as "Biogeochemical cycle". These cycles refer to a wide range of biological, geological, and chemical activities that contribute to the balance and sustainability of ecosystems.

The protoplasm of living organisms contains a variety of elements, an ecosystem depends on a continuous supply of these substances. As a result, these elements follow a typical path from the environment to the organism and back to the environment within the atmosphere. Carbon, hydrogen, oxygen, and nitrogen are found in almost all chemicals connected with metabolic activities; these elements are required for life to exist. Phosphorus and nitrogen possess independent cycles, whereas carbon, hydrogen, and oxygen are bound together and form the carbon, hydrogen, and oxygen cycle.

25.1.1 Primary Reservoirs of Nutrients

The nutrient cycle is a system where matter and energy are transferred between living organisms and non-living environments.

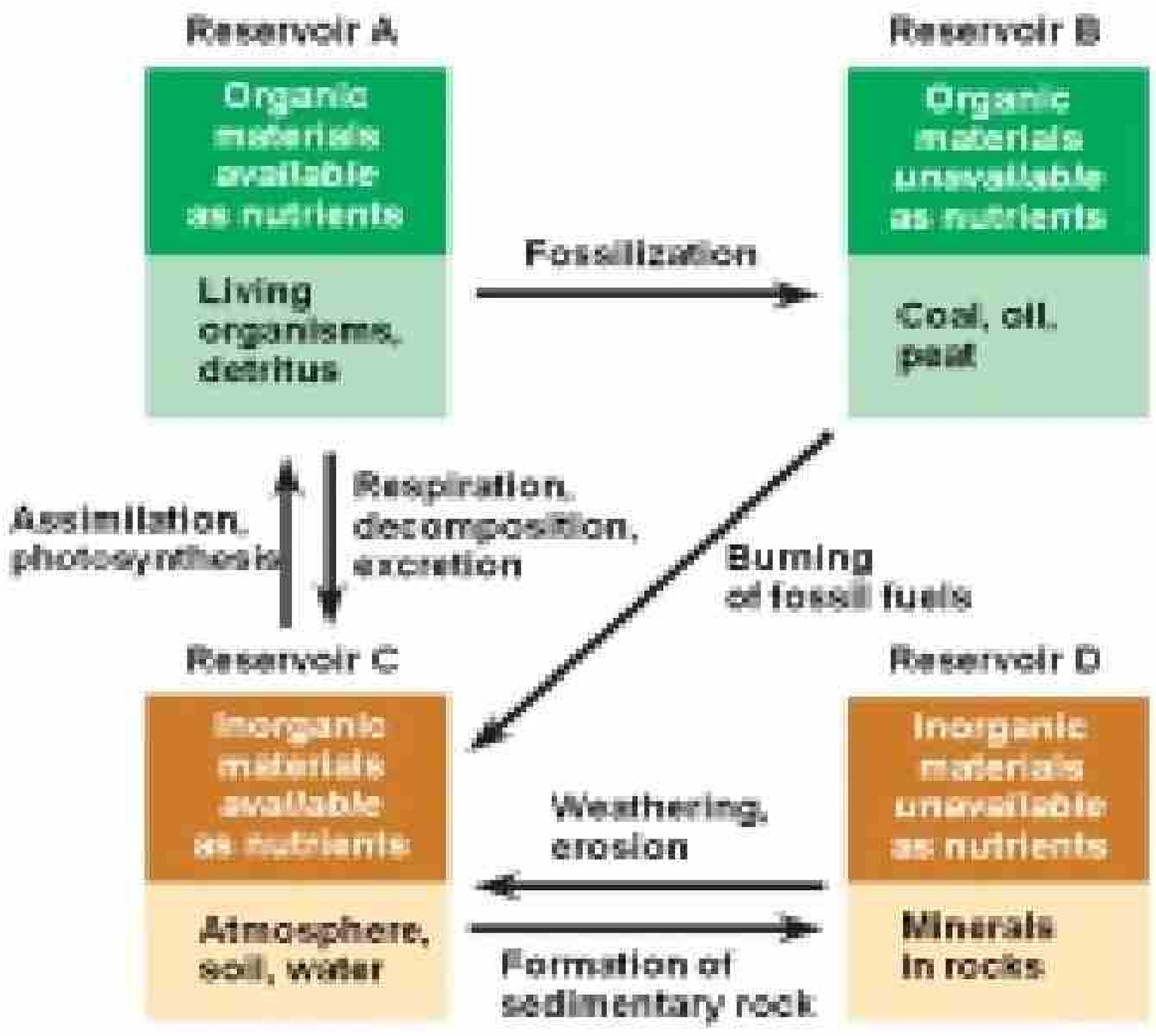

Fig: 25.1 Nutrients Cycle

The nutrients which are present in the natural reservoirs are consumed by living organisms, especially plants, and from plants to animals. These organisms release these nutrients back into the environment by their death and decay and other metabolic wastes. This movement of nutrients is called the nutrients cycle, in this way, the nutrients remain constant if equilibrium between them does not disturb.

Nature has different types of reservoirs of nutrients but all reservoirs must have the following two characteristics.
1. It must contain some inorganic or organic material for exchange.
2. They must have some material that is directly available for the use of living organisms on the basis of the above characteristics. The nature has following types of reservoirs.

Type-I: Living organisms and detritus provide organic material for respiration, decomposition, and excretion known as reservoir A.

Type-II: Coal, oil (fossil fuel), peat → provide gaseous nutrients like CO_2 on combustion reservoir B.

Type-III: Atmosphere, soil, water → provide inorganic materials like CO_2,, many inorganic ions like SO_n^{-2}, PO_4^{-3}, Fe^{+3}, Mg^{+2}, Ca^{+2}, etc. used in the assimilation reservoir C.

Type-IV: Minerals in rocks reservoir D provide inorganic materials, the majority of inorganic materials are available for metabolism.

25.1.2 Water Cycle

The water cycle, also known as the **hydrological cycle**, is a continuous process through which water circulates between the Earth's surface, the atmosphere, and bodies of water. It involves a series of physical and chemical processes that result in the movement, distribution, and transformation of water throughout the world. Water is a very important abiotic factor in our ecosystem. It plays a very significant role in the ecosystem and is vital for the existence of life. The protoplasm of cells contains 70-90% water. It is always available in the form of circulation.

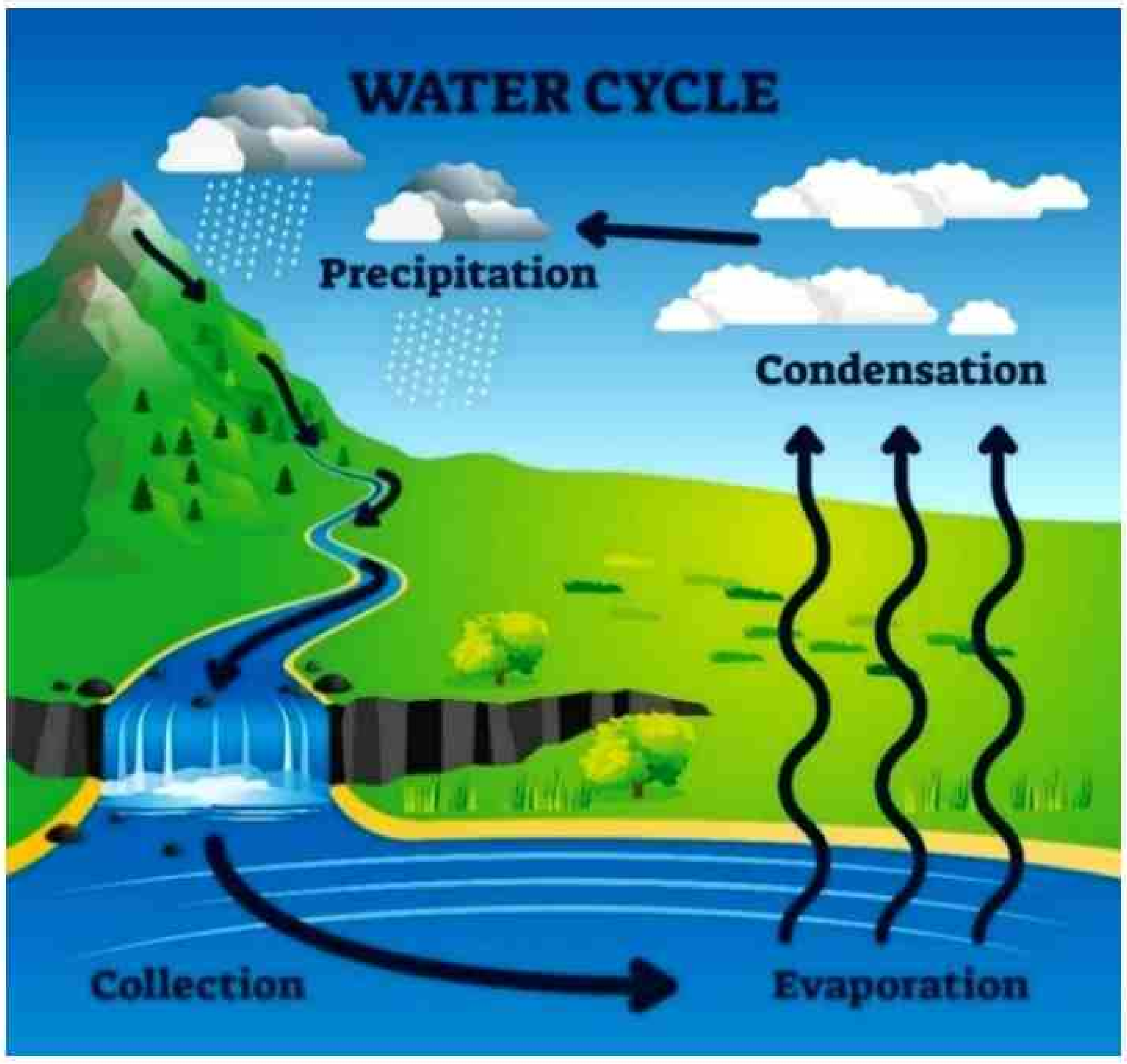

Fig: 25.2 Water Cycle

The water cycle is the continuous circulation of water on the earth and is found in different positions in the **atmosphere**. The most important process in the water cycle is the radiation from the sun which causes evaporation of water. The water cycle begins with the process of **evaporation.**
The heat evaporates water from oceans, lakes, rivers, and other bodies. Evaporation also occurs from moist soil and the surfaces of plants through a process called transpiration. As the water vapor rises higher into the atmosphere, it encounters cooler temperatures. This leads to the **condensation** of the water vapor into rain or ice crystals, forming clouds. Condensation occurs around tiny particles in the air, such as dust or aerosols, which serve as nuclei for the water droplets.

When these water droplets grow larger, remain suspended in the air, they fall back to the Earth's surface as precipitation. Precipitation can take various forms, including rain, snow, sleet, or hail, depending on the temperature and atmospheric conditions. It can occur over both land and water bodies. Water is present everywhere in the world in different forms. About 2.1 % of water exists as ice in the Polar Regions and permanent glaciers. Water in liquid form is found in the oceans, rivers, and lakes. Ocean is the main reservoir for water which holds more than 97 % of the available water.

The remaining amount of water is in the form of fresh water. It is found as atmospheric water vapors, groundwater, soil water, or inland surface water. A great amount of water is absorbed into the soil and from underground channels. Water is again returned to the atmosphere through evaporation.

Living organisms get water from the environment. Animals get water by drinking while plants can get it by absorption from the soil. This water is used in the formation of various substances in the body. It is ingested or consumed by heterotrophs. Animals release water by respiration, evaporation from the body surface, and excretion through the discharge of wastes. Plants (autotrophs) use water during photosynthesis and release water by transpiration, the majority of it is evaporated back into the atmosphere from the leaves of plants after being absorbed by their roots. During photosynthesis, a little quantity is mixed with carbon dioxide to create high-energy molecules. These eventually degrade during cellular respiration and are released back into the environment.

25.1.3 Aquifers and Water Table

Aquifers are transparent underground layers of rock, sediments, or soil that hold and transmit water. They play a significant role in the Earth's hydrological cycle because they serve as natural underground reservoirs that contain huge amounts of freshwater. Aquifers develop over time as rainwater or surface water seeps into the earth and slowly penetrates through the porous layers of rocks or sediments. Because they have the essential permeability to retain and share water, sandstone, limestone, and destroyed volcanic rock are the most common types of rocks that produce aquifers. When water enters an aquifer, it is trapped within the pore spaces or gaps of the rocks or sediments. Wells or natural springs can be used to acquire water when pressure forces it to the surface.

Aquifers are necessary for a wide range of human activities, including agriculture, industry, and domestic water supplies. Several regions depend heavily on aquifers for irrigation and as a source of drinking water. However, aquifers must be maintained in a sustainable manner to avoid overexploitation and the depletion of these vital resources. Excessive pumping or aquifer pollution can cause water level depletion, saltwater incursion into coastal areas, and water quality degradation. Understanding aquifer features, recharge rates, and vulnerabilities is critical for effective water resource management. Aquifer planning, water level monitoring, and the implementation of sustainable practices are all critical for sustaining the long-term supply and quality of groundwater from aquifers.

The water table, on the other hand, refers to the upper boundary or surface of the saturated zone within an aquifer. It represents the depth at which the soil and rock layers are fully saturated with water. The water table fluctuates depending on factors such as precipitation, evaporation, and the rate of groundwater extraction. In areas with abundant rainfall, the water table may be closer to the surface, while in arid regions, it may be deeper underground. The water table is significant because it determines the availability of groundwater in a particular area. Wells and groundwater extraction activities are typically bored or found below the water table to ensure access to an adequate supply of water. However, excessive pumping or overuse of groundwater can lead to a drop in the water table, resulting in a lowered water level and potential depletion of the aquifer.

25.1.4 Nitrogen Cycle

Nitrogen is an essential element for the existence of life on Earth. All living organisms need nitrogen for their growth and development because it is the necessary component of organic compounds like proteins, nucleic acids, and amino acids. The flow of nitrogen between the earth and the atmosphere in various forms throughout the environment is known as the **nitrogen cycle**.

The nitrogen cycle is a complex biogeochemical process that ensures the availability and recycling of nitrogen in the Earth's ecosystems. Nitrogen gas (N_2) makes up about 78 % of the Earth's atmosphere, but most organisms cannot utilize it directly in the gaseous form. It begins with nitrogen fixation, where certain bacteria convert atmospheric nitrogen into ammonia (NH_3) or ammonium ions (NH_4^+). This process can occur through symbiotic relationships with plants or in the soil as free-living bacteria. In the nitrification process, the conversion of ammonia or ammonium ions into nitrate (NO_2) occurs through nitrifying bacteria. Nitrates are soluble and can be easily available for plants and other organisms in the soil. It is then absorbed by plants through their roots in a process called assimilation. Within plants, nitrate is converted into various organic nitrogen compounds, such as proteins and nucleic acids, supporting their growth and development.

Animals obtain nitrogen by consuming plants or other animals, assimilating organic nitrogen into their own tissues. When plants or animals die, or when waste products decompose, ammonification takes place. Bacteria and fungi decompose organic nitrogen compounds, releasing ammonia into the soil. Finally, de-nitrification occurs in oxygen-deprived environments, where denitrifying bacteria convert nitrate back into nitrogen gas, completing the cycle. This essential process helps to maintain the balance of nitrogen in ecosystems, supporting the growth of plants and sustaining life on Earth.

(1) Nitrogen fixation

The conversion of free or gaseous nitrogen into nitrate compounds or ammonia is called Nitrogen fixation. There are three principal ways in which nitrogen fixation can occur.

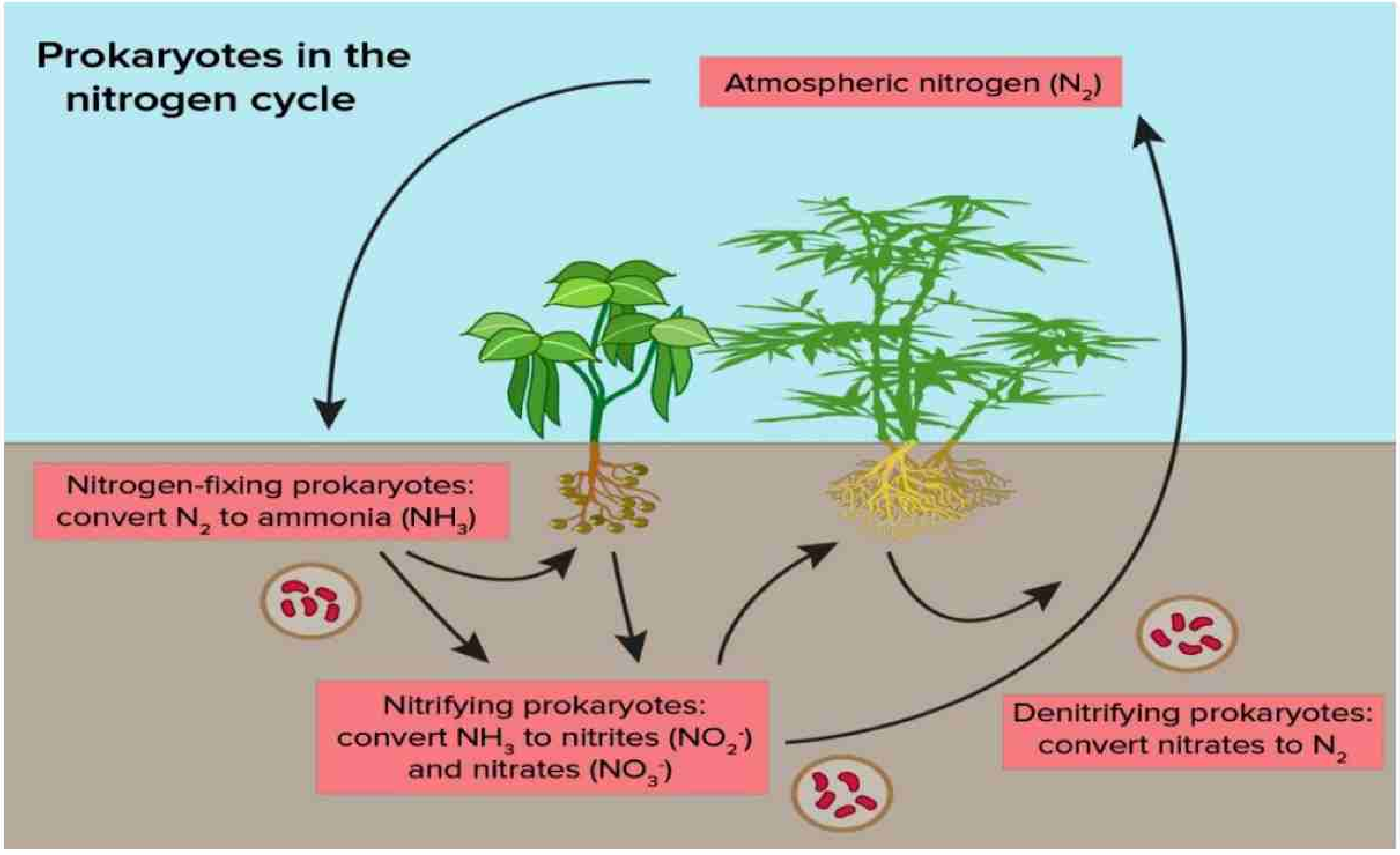

Fig: 25.3 Nitrogen Cycle

(i) Atmospheric fixation:

The fixation of nitrogen in the atmosphere is referred to as atmospheric fixation. Only a small portion (5-8%) is repaired in this manner. When lightning or thunderstorm occurs much quantity of atmospheric nitrogen is turned into nitrates or nitric acid. Nitrogen and oxygen can mix in lightning to form different nitrogen oxides. These are dissolved in rain and carried into Earth. These are deposited in the soil by the rain and then utilized by plants.

(ii) Industrial fixation:

The synthesis of nitrogen-containing fertilizers is called industrial fixation. Nowadays a large number of fixed nitrogen is artificially added to agricultural lands in the form of fertilizers.

(iii) Biological fixation:

Sixty percent of the nitrogen gas in the atmosphere is contributed by nitrogen-fixing bacteria. Nitrogen gas must be reduced to ammonia.

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

This reaction can only be carried out by a small number of microorganisms called nitrogen-fixing bacteria. By killing and lysing free-living nitrogen-fixing bacteria like *Azobacter* (aerobic) and *Clostridium* (anaerobic), free-living blue-green algae in an aquatic system like *Cyanobacteria*, *Anabaena*, *Gleotrichia*, *Trichodesmium,* etc. are important nitrogen fixers. In some nitrogen-fixing bacteria's mutually beneficial relationship with plants like *Rhizobium*, the fixed nitrogen is made available to plants. The roots of many plants contain these bacteria which fixed nitrogen, increasing soil fertility, the best example is leguminous plants.

(2) Nitrification:

When ammonia (NH_3) is converted into nitrate (NO_2) compounds by nitrifying bacteria through a process called **Nitrification**. A small number of ammonia leaks into the soil, and nitrifying bacteria convert the majority of the ammonium ions into nitrates. The nitrification is completed in two steps. First ammonia is converted into nitrites (NO_2) and then it is converted into nitrates (NO_3). Two types of nitrifying bacteria carry it out. Ammonia is converted to nitrites by the first group of bacteria, such as *Nitrosomonas*, and *Nitrococcus,* and the second phase is completed by bacteria like *Nitocystis*, *Nitrobacter* collectively known as **Nitrifying bacteria**, that's why the process is called as **nitrification**. Although bacteria are aerobic, nitrification only occurs in well-aerated soils.

(3) Denitrification:

The denitrifying bacteria are present in the soil. They reduce soil fertility by reversing the process of nitrification. Certain soil bacteria can cause nitrogen loss through their activities. In anaerobic condition these bacteria break down nitrates, releasing nitrogen back into the environment while consuming the oxygen for their own respiration. This process is termed de-nitrification, and the bacteria involved are known as denitrifying bacteria. For instance, *Pseudomonas* turns soil nitrates into gas.

$$NO_3 \longrightarrow NO_2 \longrightarrow NO \longrightarrow N_2O \longrightarrow N_2$$

(Nitrate) → (Nitrite) → (Nitric oxide) → (Nitrous Oxide) → (Nitrogen gas)

(4) Ammonification:

When animals and plants die, the saprophytic bacteria and fungi break down animal waste and the nitrogenous compounds in the soil to produce simple chemicals like water, carbon dioxide, amino acids, and sometimes energy. Ammonia or ammonium ions are created from amino acids. Ammonification is the process by which microbes break down organic materials to produce ammonia or ammonium molecules. Ammonification takes place in an aerobic environment in the soil. The ammonia is formed and released to the atmosphere or retained in the soil to be absorbed by plants or converted into nitrate compounds.

25.2 THE FLOW OF ENERGY

The ecosystem is the basic fundamental unit of ecology in which living and non-living things interact and influence each other. Without sunlight plants cannot prepare their food. While the on other hand animals are directly dependent on green plants for their food. Ecosystems act as energy converters. We can track the transformation of energy in the ecosystem by classifying the species in a community according to their trophic levels of feeding relationships. Species are categorized into trophic levels based on their primary energy and nutrition sources. This trophic hierarchy is based on function rather than species.

25.2.1 Concept of Trophic Levels

Each ecosystem has different trophic levels, or groups of organisms referred to as **trophic** or **feeding levels**. **Producers** (plants, algae, and some bacteria) are the lowest trophic level (T1) use solar energy to create organic plant material through photosynthesis. The second trophic level is made up of herbivores, cows, goats, sheep, dears, grazing animals, or **primary consumers** (T2). They cannot synthesize their own organic material and utilize solar energy therefore, depends on prepared food from plants. The third trophic level (T3) is known as predators or **secondary consumers** that consume herbivores. Meat eater animals are an example of this type including humans. If larger predators, or **tertiary consumers**, are present, they represent even higher trophic levels.

Omnivores are defined as organisms that feed at multiple trophic levels and are categorized at the highest trophic level (T4) at which they do so. Humans, since are able to consume primary (grass eater) herbivores and meat (eater) carnivores' fall into this category. The fifth trophic level (T5) is occupied by **decomposers**, which include bacteria, fungi, and detritivores like worms and insects. Decomposers break down waste and dead organic material and refill the fertility of the soil, termed the fifth trophic level.

25.2.2 Flow of Energy in Successive Trophic Level

Ecosystems are energy converters; on average, 10% of the net energy produced at each trophic level is transferred to the next one. In complex natural communities, organisms whose food is obtained from plants by the same number of steps are said to belong to the same trophic level. Thus green plants occupy the first trophic level, plant eaters the second level (the primary consumer level), carnivores, which eat herbivores, the third level (the secondary consumer level), and secondary carnivores the fourth level (the tertiary consumer level). The energy flow through a trophic level equals the total assimilation (A) at that level, which in turn, equals the production (P) of biomass plus respiration (R).

Processes including respiration, growth, reproduction, defecation, and non-predatory mortality reduce the amount of energy that is transmitted across trophic levels (organisms that die but are not eaten by consumers). Because consumers may absorb high-quality food sources into new living tissue more quickly than low-quality food sources, the nutritional quality of the material that is consumed also affects how effectively energy is transferred. In terms of energy flow, decomposers are typically more significant than producers due to the slow rate of energy transfer between trophic levels. Large volumes of organic matter are decomposed by decomposers, which return nutrients to the ecosystem in inorganic form, where they are reabsorbed by primary producers. During decomposition, energy is not regenerated but rather emitted, primarily as heat. That's why things made of plastic are good for our environment since unable to decompose. Similarly, other modern things are made by humans.

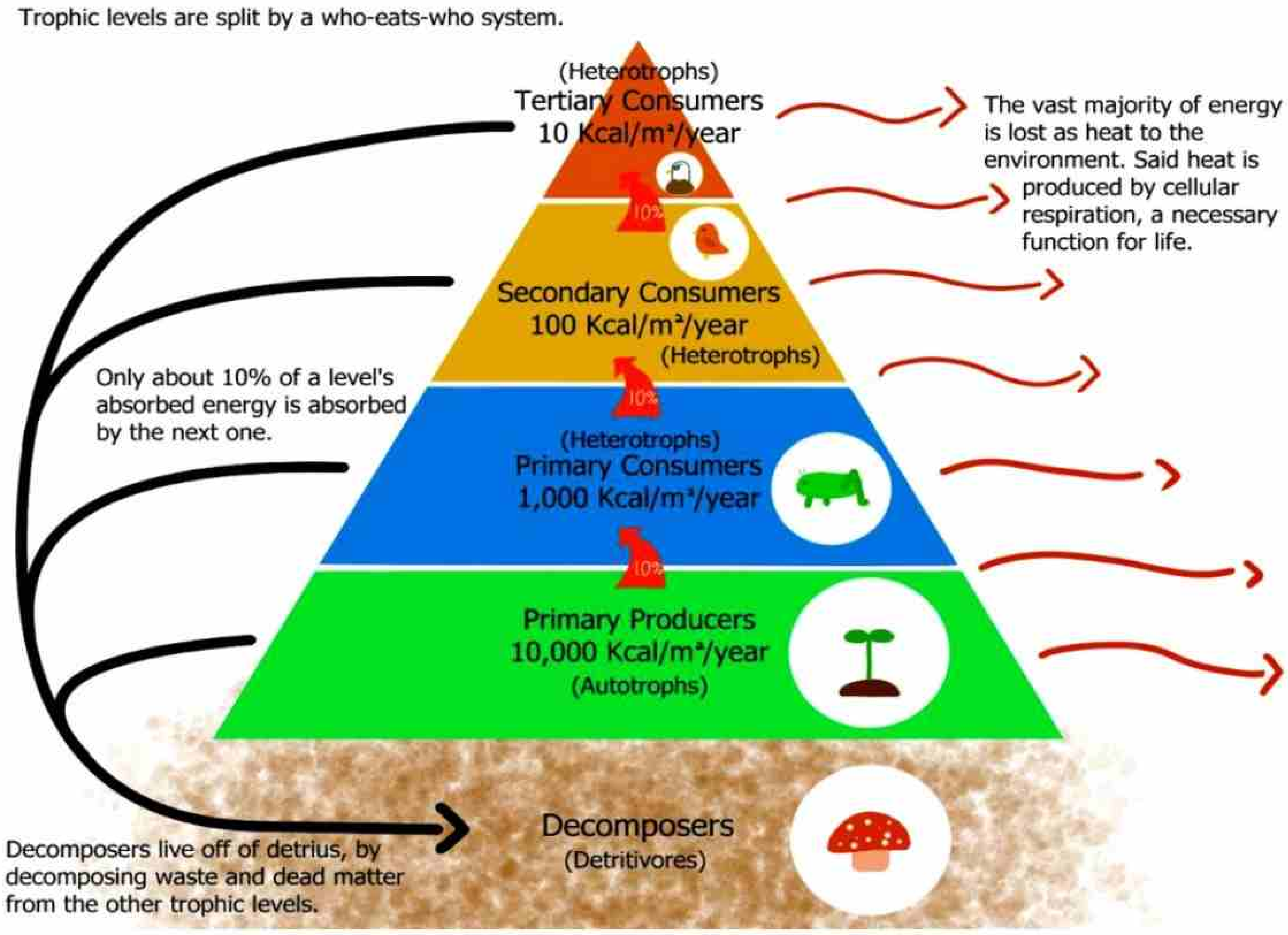

Fig: 25.4 Energy Flow in Ecosystem

25.2.3 Concept of Productivity

Productivity is crucial for an ecosystem's dynamics and stability in the context of energy flow. It deals with how quickly organisms acquire, store, and transfer energy through different trophic levels. It affects trophic relationships, population sizes, and the overall efficiency of biological systems. It also symbolizes how well available energy is converted into biomass or organic matter. Ecologists understand the energy flow, nutrient cycling, and connectivity of organisms in an ecosystem by investigating productivity. **Gross primary productivity** (GPP) and **net primary productivity** (NPP) are two important measures used to quantify the efficiency of energy conversion in ecosystems.

1. Gross Primary Productivity (GPP): It is the total quantity of energy that primary producers obtain through photosynthesis in a given area and time period. All of the energy that plants store, including the energy consumed for respiration, is included in GPP.

2. Net Primary Productivity (NPP): After primary producers have consumed some of the energy they have captured for their own respiration and metabolic requirements, the amount of energy left over is known as **net primary productivity**. The energy that is available for herbivores to consume or store in plant tissues (such as roots and stems)

23.2.4 Ecological pyramids

A visual representation of the relationships between various trophic levels in an ecosystem is provided by **ecological pyramids**. Ecological pyramids are graphs that have developed a complex design as a result of the arrangement of these data. At different trophic levels, ecologists compare the number of species, biomass, or relative energy available. Within each trophic level, they show the quantitative features of energy flow, biomass, and population sizes.

A description of the three different ecological pyramids is provided below:

Pyramid of energy: An energy pyramid shows how much energy is contained in the biomass of each trophic level. These pyramids show that more energy is lost to the environment moving from one trophic level to the next as trophic levels rise. Because some of the energy at the lower trophic level is utilized by those species to carry out work and some of it is lost, less energy reaches each succeeding trophic level from the level beneath it. Energy pyramids provide an explanation for the lack of trophic levels. Because energy content rapidly decreases at each subsequent trophic level, food webs are short.

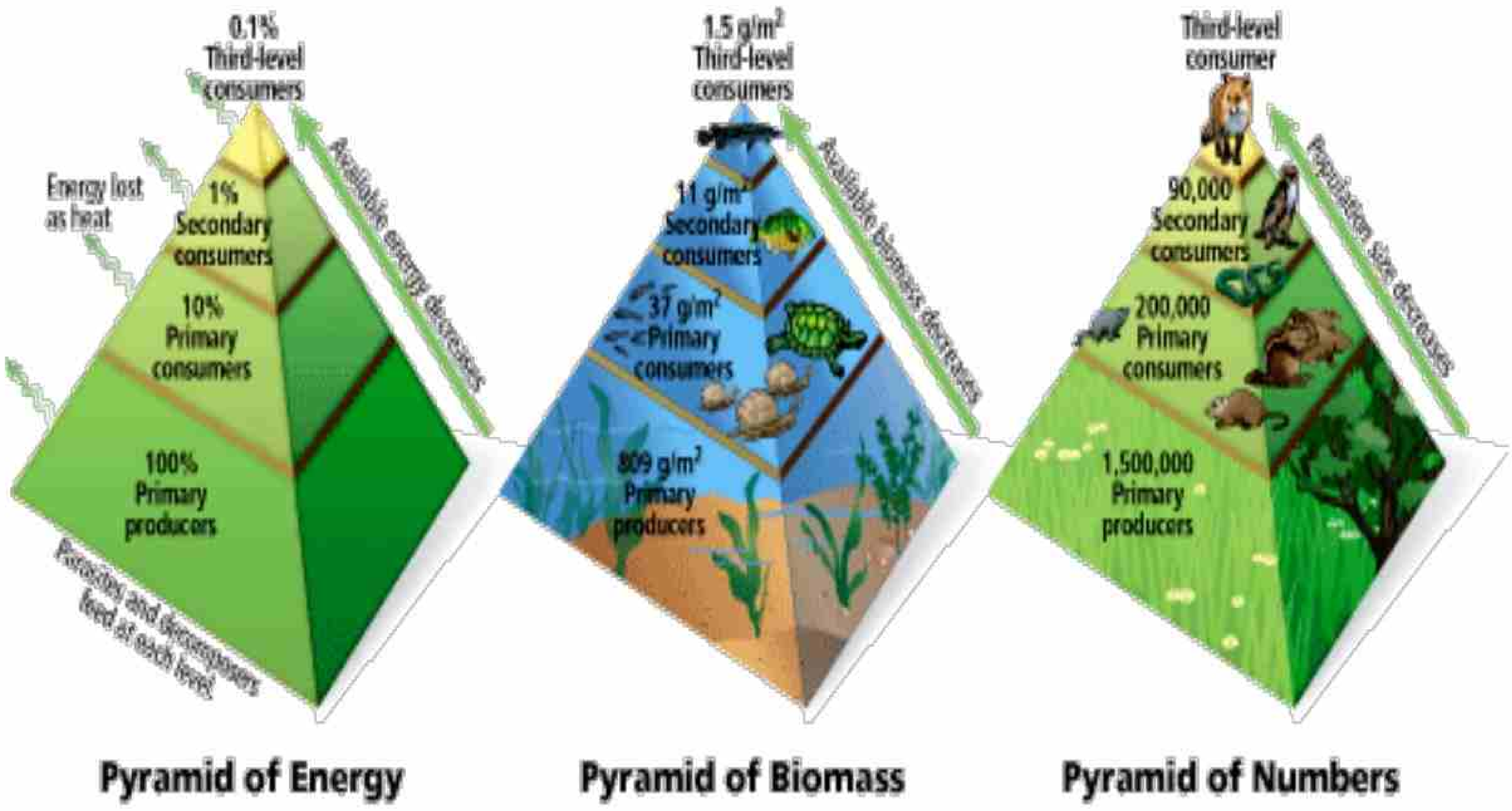

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Fig: 25.5 Ecological Pyramids

Pyramids of biomass:

The amount of biomass at each level is represented as a pyramid. Indicating the amount of fixed energy at a specific time, biomass is a quantitative estimate of the total mass or amount of living stuff. Biomass can be measured in a variety of ways, including total volume, dry weight, and live weight. Typically, the pyramids show how biomass declines across subsequent trophic levels.

Pyramids of numbers:

The number of species at each trophic level in a given ecosystem is represented by a pyramid of numbers, with larger numbers being represented by a broader pyramid. In the majority of pyramids of numbers, fewer individuals occupy each subsequent trophic level. Because of this, there are more herbivores than carnivores.

25.3.1 Ecological Succession

Ecological succession refers to the process through which an ecosystem changes and develops from a simple to a complex state over time. It occurs in response to changes in environmental conditions, such as light availability, soil composition, and moisture level. When a new environment is created, after a disturbance on a newly formed land, a community of plants and animals begins to establish itself. The term succession was first used by **Hult** in (1885), and **Clements** 1907, 1916) elaborated the principle and theory of succession. "*The process of evolution of plant communities on a bare area from birth to maturity is called* ***succession***".

The process of ecological succession involves a series of stages, known as **seral stages**, where different plant and animal species gradually replace each other. As the ecosystem matures species composition and processes change, leading to a more complex and stable community. This succession can take place over short or long periods of time, depending on the specific conditions and the rate at which species establish and adapt to the environment. The process by which species are gradually replaced over time is called **ecological succession**.

25.3.2 Kinds of Succession

Ecological successions can be divided into the following categories:

i) Primary succession   ii) Secondary succession

(1) Primary succession

Primary succession occurs in areas that are barren of life and lack soil, such as newly formed land or bare rock surfaces. It begins in environments where there is no previous soil or vegetation existed. Primary succession typically follows major disturbances such as volcanic eruptions, retreating glaciers, or the formation of new islands. The process of primary succession starts with the colonization of **pioneer species**, such as lichens and mosses, which are capable of surviving in harsh conditions and can break down rocks to form soil. Primary succession is a slow and gradual process that can take hundreds or even thousands of years to reach a stable and diverse ecosystem. It involves the creation of an entirely new community from scratch in an area that was previously devoid of life.

(2) Secondary succession

Secondary succession occurs in areas that were previously occupied by living organisms but vanished when the original ecosystem was disturbed or disrupted while the soil remained undamaged. It happens as a result of natural disasters like forest fires or storms, or due to human activities like logging or farming. Secondary succession is often faster than primary succession since the soil and some elements of the previous community are already present, supporting in the ecosystem's recovery and rebuilding.

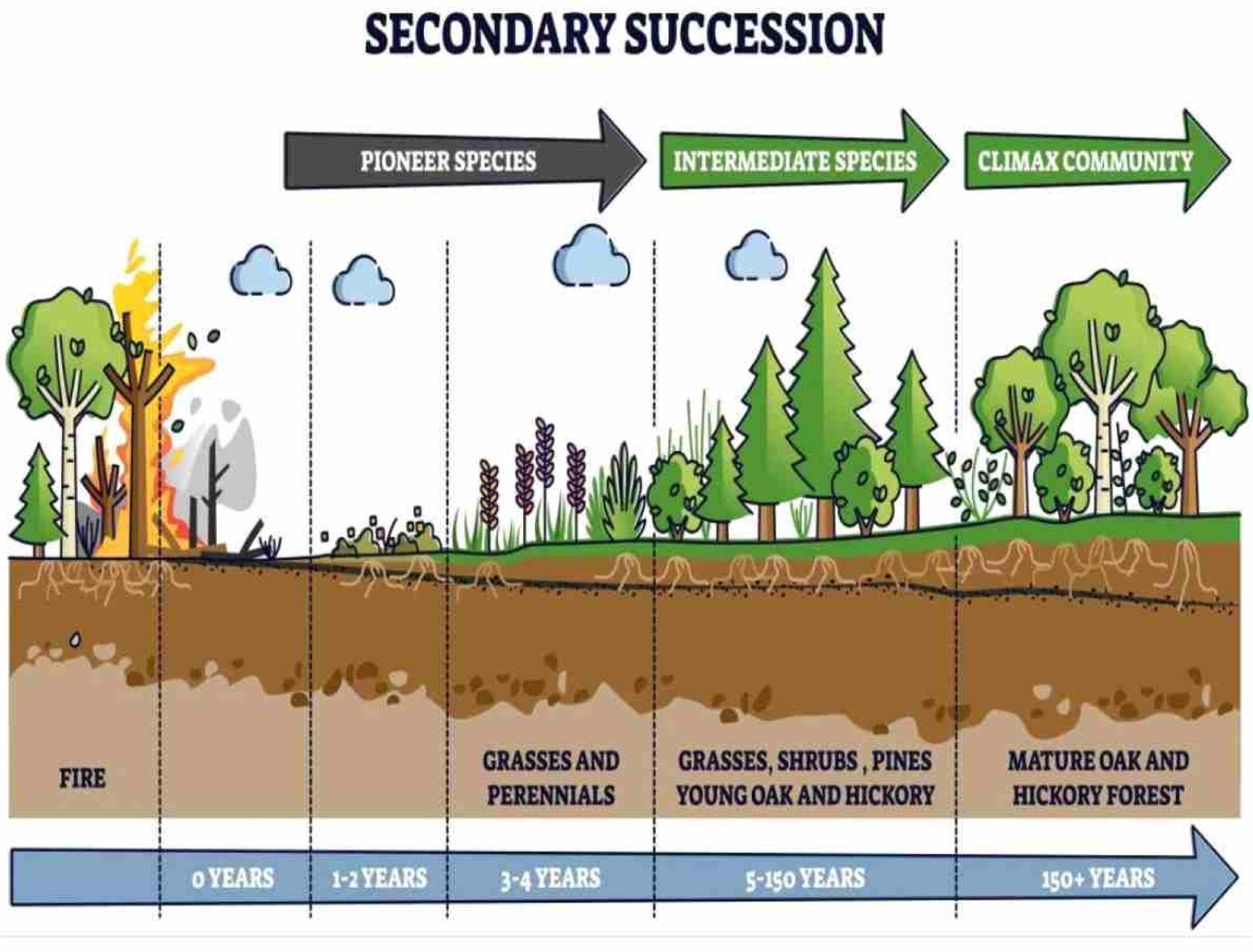

Fig: 25.6 Secondary Succession

25.3.3 Differentiate between Xerarch and Hydrarch Succession

	Xerarch Succession	Hydrarch Succession
1	It begins with lichens or blue green algae	It begins with phytoplankton
2	Initial succession is a slow process	Initial succession is quite fast
3	Succession is seen all over the area	Succession is observed in area where water is not very deep
4	The whole of the area is involved in formation of climax community	Climax community develops on the edge only
5	It reduces bare land area and converts it into fertile forested area	It fill up water body and changes it into forested land

25.3.4 Xerarch Succession

Ecological succession occurs in arid environments like deserts, mountains, or dunes known as **xerarch succession.** It describes how vegetation grows and how ecosystems adapt in response to limited water resources and harsh conditions in the environment. When there is a lack of water and organic matter for plant growth and where little or no vegetation existed, xerarch succession starts to occur. Species that have evolved specifically to survive in arid environments are frequently the pioneer species. These pioneer species tolerate high temperatures and limited water supplies and are often drought-tolerant. Lichens, mosses, and several desert plant species are examples of xerarch pioneer species.

(i) Crustose-lichen stage

When the surface is exposed to the sun, the temperature rises significantly. At this stage, the substratum's lack of water and nutrients makes the rocky habitat severely xeric. Crustose lichens, which appear on the rock surface as membranous crusts, are the first organisms to occupy the bare area. The crustose lichens *Rhizocarpus, Lacidea*, etc. are significant. They have a porous structure, which allows them to absorb more water and minerals.

Lichens produce an excessive amount of carbonic acid. That acid is produced when excess CO_2 reacts with water.

(ii) Foliose-lichens stage

This kind of lichen grows on rocks that are close to or surrounding areas where crustose lichens have already colonized. After a little amount of soil and humus has accumulated, xeric foliose and fruticose lichens, such as *Dermatocarpon, Parmelia, Umbilicaria*, and others are prominent protagonists in this stage grow on the rock surface that was previously covered by crustose lichens. These lichens cover the rocks with their delicate, leaf-like structure, covering the crustose lichens that already exist.

Additionally, they release carbonic acid, which further breaks down or loosens the rocks into tiny pieces. With the continued buildup of humus and soil particles, the habitat's ability to hold water improves.

(iii) Moss stage

Like other lichens, xerophytic mosses that is *Polytrichum, Tortula, and Grimmia* are transported to rocks and adapted to survive in extreme drought conditions and become dominant. It replaces the entire habitat and the existing foliose lichens disappear. Mostly they grow in crevices and rocks depressions where they can get more humus and moisture. These mosses significantly get more water and other mineral nutrients by competing with other lichens. They develop rhizoids to penetrate deeply into the soil of rocks. A mat could develop on the rock surface as a result of its demise and decomposition. Together with the soil, this can store more water, creating an environment that is good for growing herbs.

(iv) Herb stage

The rock is covered by herbaceous weeds, Herbaceous vegetation, which is primarily made up of annual and perennial herbs, grows rapidly as soil thickness increases. Herbs grow better in that soil which has more moisture. The roots of these plants can almost reach the level of continuous rocks below the surface, release acids, and speed up degradation. Herbs that die and foliage enrich the soil with humus. A decrease in evaporation and a small rise in temperature are the effects of soil shading. As a result, the xeric environment starts to shift, allowing for the emergence of biennial and perennial herbs as well as xeric grasses.

(v) Shrub stage

The soil is covered in xeric vegetation. These shrubs, which are low, woody plants that are smaller than trees and have little to no trunks, can grow from seeds or spread by rhizomes from nearby places. These overpower them and make the situation inappropriate for herbs. Due to their inability to compete, shrubs have taken the place of herbs. Early shrub invasion is gradual, but once a few shrubs have grown stronger, birds move in and help with seed dispersal. As a result, there is dense growth, shading the soil and creating unfavorable conditions for herb growth, which causes the herbs to migrate.

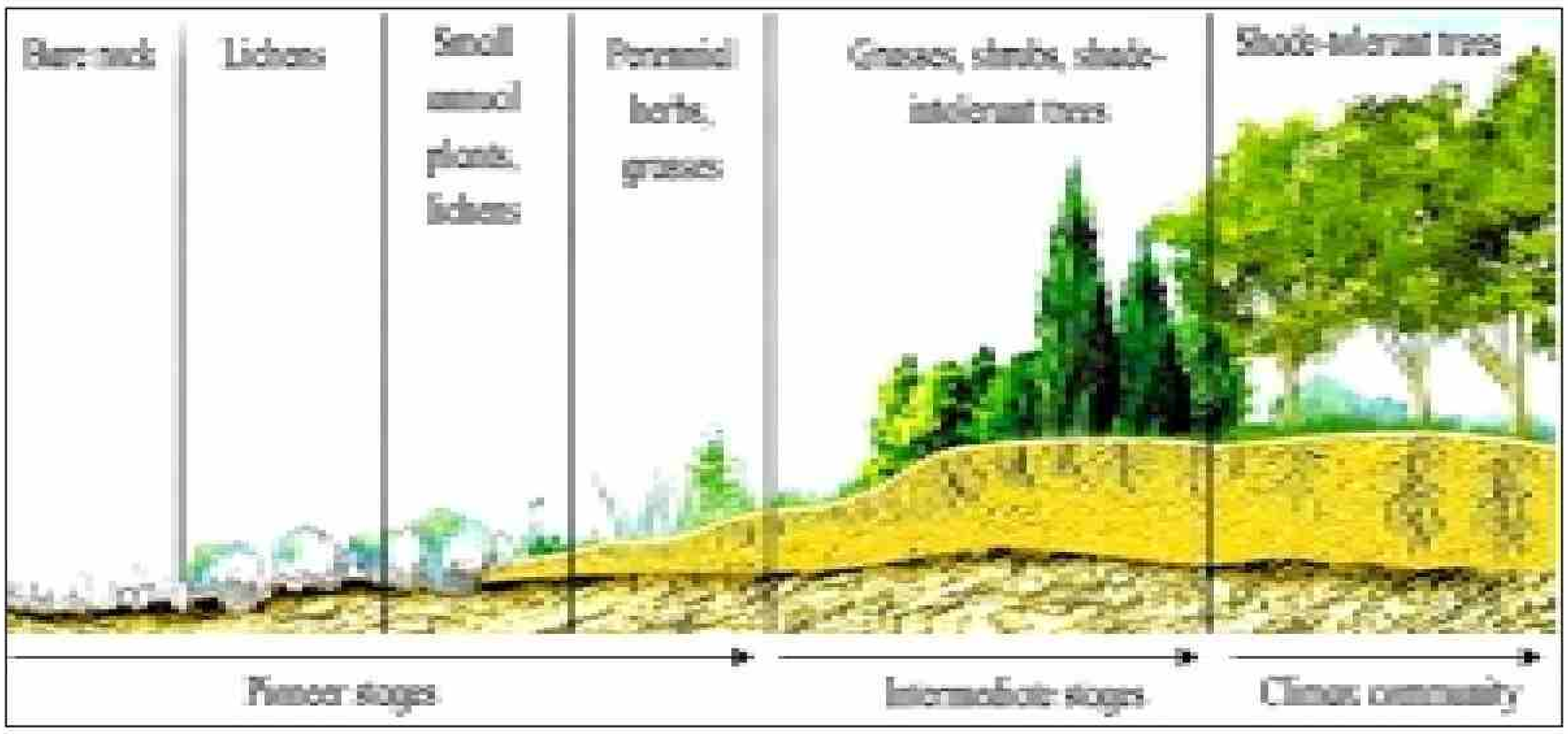

Fig: 25.7 Xerarch Succession on bare rock (Primary Succession)

(vi) Climax stage

Some shade-loving herbs and shrubs that are acclimated to humid environments also appear in the shade and create their own communities. After an extremely long period of time, the climax stage appears when perfect harmony between the plant communities and their habitat emerges. The earliest tree species are largely xeric. The xeric plants are replaced by mesophytic kinds of trees as the weathering process started and the soil becomes deeper. Eventually, a forest might grow.

25.3.4 Hydrarch Succession in Lakes

The process of ecological succession known as hydrarch succession takes place in aquatic habitats like ponds, pools, or lakes before transforming into terrestrial communities. Below, different hydrarch succession stages are briefly described.

(i) Phytoplankton stage

Phytoplanktons are microscopic, photosynthetic organisms, primarily consisting of algae and cyanobacteria, which drift in water bodies, such as oceans, lakes, and rivers. The phytoplankton stage is essential in aquatic ecosystems as these organisms form a base for the **food chain**. They serve as primary producers, converting sunlight and nutrients into organic matter, which then becomes a source of food for other organisms, including zooplankton, small fish, and ultimately larger predators.

(ii) Submerged stage

During the submerged stage, aquatic plants like algae, submerged rooted plants, and floating leaf plants are the main inhabitants of the water body. These plants are essential to the ecosystem's early development and stabilization. The first organisms to colonize are frequently algae, and then buried rooted plants, which anchor to the substrate and help the water, become more oxygenated. As the succession develops, floating-leaved plants appear, adding to the habitat and nutrient cycling.

(iii) Floating stage

During the floating stage plants, such as water lilies, water hyacinths, or duckweeds, are prevalent. These plants have adaptations that allow them to float on the surface of the water, often with their roots submerged. Floating plants are typically able to increase in nutrient-rich environments, as they can extract nutrients directly from the water. They also contribute to the overall productivity of the ecosystem by photosynthesizing and converting sunlight and carbon dioxide into organic matter.

(iv) Reed swamp stage

This stage is also known as the amphibious stage. Even though most species are anchored in the ground now, the majority of their body parts are still above the water table. Ponds get shallower as a result of plant loss and degradation. The plants grow thick vegetation and have well-developed rhizomes. *Typha, Polygonum, Phragmites*, and *Sagittaria* are characteristic plants of this stage, and there are also animals like *Lymnea* and *Physae* as well as insects like water scorpions and huge bugs.

(v) Sedge meadow stage

A transitional stage in the ecological growth of a freshwater ecosystem is known as the sedge meadow stage of a lake. It happens after the lake has been initially colonized by floatable and submerged vegetation. Emergent vegetation, especially sedges (grassy plants), predominates in the region around the lake during the sedge meadow stage. These plants have evolved to survive in moist, marshy environments and contribute to soil stabilization. The growth of more complex plant communities and the eventual conversion of the lake into a terrestrial ecosystem are made possible by the sedge meadow stage, which is essential to future succession. It also makes it simple for organic matter to collect and contributes to the formation of soil.

(vi) Woodland stage

The woodland stage is a stage in which trees and a dense forest canopy dominate the vegetation. Tree species, including deciduous and evergreen trees, become established in the woodland stage and form a closed canopy, shading the forest floor and creating a more shady and diversified habitat.

(vii) Climax stage

The climax stage is the final stage of ecological succession in which trees eventually dominate the woodland community. The type of climax community that forms is determined by environmental conditions. Tropical rainforests occur in areas with abundant rainfall, displaying a diverse range of tree species. In areas with more moderate rainfall, such as temperate zones, a mixed forest develops, with a variety of deciduous and evergreen trees.

25.4 POPULATION DYNAMICS

A population is a group of individuals belonging to the same species who live in the same place for an extended length of time. **Population dynamics** is the study of how a species' populations evolve through time and is one of the key areas of research into population dynamics. Management of natural resources, such as fisheries, also depends on population dynamics to determine appropriate management actions. Population dynamics play a essential role in many approaches to preserving biodiversity, but little is known about it. Population dynamics is the study of both long-term and short-term variations in population numbers as well as the factors that control population size, such as:

Inflow: births, immigration

Overflow: Habitat destruction, decreased recruitment, increased mortality, and inadequate conditions.

Outflow: Culling (to pick and destroy individuals, e.g. seals, deer) emigration, natural disasters, accidents, and predators.

25.4.1 Characteristics of a Population

Characteristics of a population can vary depending on the species and the specific environment it occupies. A population's constituents depend on the same resources, are impacted by comparable environmental conditions, and are very likely to interact and reproduce with one another. However, here are some general characteristics often used to describe populations: There are population attributes including growth, distribution, carrying capacity, and viable size.

(i) Growth: Population growth refers to the increase in the number of individuals within a population over time. It can be influenced by factors such as birth rates, death rates, immigration (individuals moving into the population), and emigration (individuals leaving the population).

(ii) Density : Population density is the number of individuals per unit area or volume. It provides an indication of how crowded or dispersed a population is within its habitat. High population density can lead to increased competition for resources and a higher risk of disease transmission.

(iii) Distribution: The distribution of a population refers to how individuals are spread out within a region or habitat. Populations can exhibit different distribution patterns, such as clumped (individuals grouped together in patches), uniform (evenly spaced individuals), or random distribution (unpredictable spacing among individuals).

(iv) Carrying capacity: There is a limited number of individuals that can live in a territory. The carrying capacity is the maximum number of individuals that a particular habitat or ecosystem can sustainably support. It represents the balance between available resources (food, water, shelter) and the population's needs.

(v) Minimum or viable size: The minimum or viable size of a population refers to the smallest number of individuals required to maintain long-term survival and genetic diversity. Small populations are more vulnerable to negative effects such as inbreeding, genetic drift, and reduced adaptability. Establishing a viable population size is essential for the long-term survival of a species.

25.4. 2. Problems related to Rapid Growth of Human Population

The rapid growth of the human population presents several problems that can be explained using demographic principles. These problems have significant implications for future generations and the Earth's carrying capacity. To address these problems and mitigate their effects, sustainable population management, resource conservation, and sustainable development practices are necessary. This includes promoting education and access to family planning, adopting sustainable consumption and production patterns, investing in renewable energy sources, preserving ecosystems and biodiversity, and fostering equitable social and economic development. By considering the carrying capacity of the Earth and adopting sustainable practices, we can work towards ensuring a better future for future generations.

1. **Over-population:** Rapid population growth can lead to over-population, where the number of individuals exceeds the carrying capacity of the Earth.
2. **Strain on Resources:** The growing population requires more resources to meet basic needs, such as food, water, and energy.

Increased consumption of resources can lead to environmental degradation, deforestation, overfishing, water scarcity, and depletion of non-renewable resources.

3. **Environmental Impact:** A rapidly growing population generates a greater ecological footprint, which is the measure of the impact of human activities on the environment. Higher population densities contribute to increased pollution, greenhouse gas emissions, habitat destruction, and loss of biodiversity. These environmental impacts have far-reaching consequences, including climate change, loss of ecosystem services, and degradation of natural habitats.
4. **Pressure on Infrastructure:** Rapid population growth puts pressure on infrastructure systems, such as transportation, housing, healthcare, and education. Meeting the needs of a growing population requires substantial investments in infrastructure development and maintenance.
5. **Intergenerational Equity:** The rapid growth of the human population can compromise intergenerational equity, which refers to ensuring that future generations have the same opportunities and resources as the present generation. Unsustainable population growth and overconsumption of resources can deplete and degrade resources, leaving fewer available for future generations. This can lead to inequitable distribution of resources and compromised well-being for future populations.

25.4.3 Role of Population Welfare department controlling the Population of Pakistan

The Population Welfare Department of Pakistan plays a vital role in controlling population growth through awareness campaigns, family planning services, training, research, policy formulation, and partnerships. It aims to provide education, access to contraceptives, and reproductive health services to empower individuals and couples to make informed choices about family planning.

The Population Welfare Department of Pakistan aims to control population growth by promoting family planning, providing access to services, raising awareness, and ensuring effective policy implementation. These efforts contribute to empowering individuals and couples to make informed decisions about their reproductive health and contribute to sustainable population management.

25.5 HUMAN IMPACTS ON ENVIRONMENT

25. 5.1 Nuclear Power

A nuclear power plant is similar to a large coal-fired power plant, with pumps, valves, steam generators, turbines, electric generators, condensers, and associated equipment. Except for the reactor, which plays the role of a boiler in a fossil-fuel power plant?

Fig: 25.8 A boiling water reactor

The use of sustained nuclear fission to generate heat and electricity is known as **nuclear power**. According to 2005 statistics, nuclear power provided 6.3% of global energy and 15% of global electricity. The scarcity of fossil fuels, which is not available in every country, is the reason behind the development of nuclear power plants. The nuclear power industry went through a period of remarkable growth until about 1990. That percentage remained stable through the 1990s and began to decline around the turn of the century. This trend appears likely to continue well into the 21st century. The Energy Information Administration projects world electricity generation between 2005 and 2035 will roughly double.

Pakistan also has these type of plants, namely the Karachi Nuclear Power Plant (KNPP) located in Karachi and the Chashma Nuclear Power Plant (CHASNUPP), is located in the vicinities of Chashma colony and Kundian in Punjab which are very essential for the country's development, prosperity, and security purpose. The plant is run and controlled by highly professional and trained staff working there with zero incidents in other countries of the world.

Advantages of nuclear power

a) Nuclear power costs about the same as coal, so it is not prohibitively expensive to produce.
b) Because it emits no smoke or carbon dioxide, it has no impact on the greenhouse effect.
c) Generates enormous amounts of energy from small amounts of fuel.
d) Generates a small amount of waste.
e) Nuclear energy is trustworthy.

Disadvantages of using nuclear power

By using nuclear power there are two main issues with nuclear power the assurance of safe operation and the safe disposal of wastes.

(i) Surety of safe operation: In nuclear plants, prevention, monitoring, and action, i.e., mitigating the consequences of failures, are used to achieve maximum safety. These are (a) superior design and construction; and (b) superior performance. (c) Continuous monitoring and testing to detect equipment or operator failure; and (d) avoidance of significant radioactive releases. Up to now, there is no negative impact on our plant with respect to failure, and safety is reported.

(ii) Safe disposal of the wastes: Radioactive waste is defined as waste containing radioactive material. Nuclear waste is a source of concern because it is not biodegradable, which means it does not decompose naturally in the presence of oxygen in the atmosphere. Second, it poses a number of health risks to anyone who comes into contact with the radiation emitted by this waste. As a result, some safety measures for nuclear waste disposal should be used, such as deep ocean disposal, deep geological burial, nuclear waste recycling, reprocessing, and solidification.

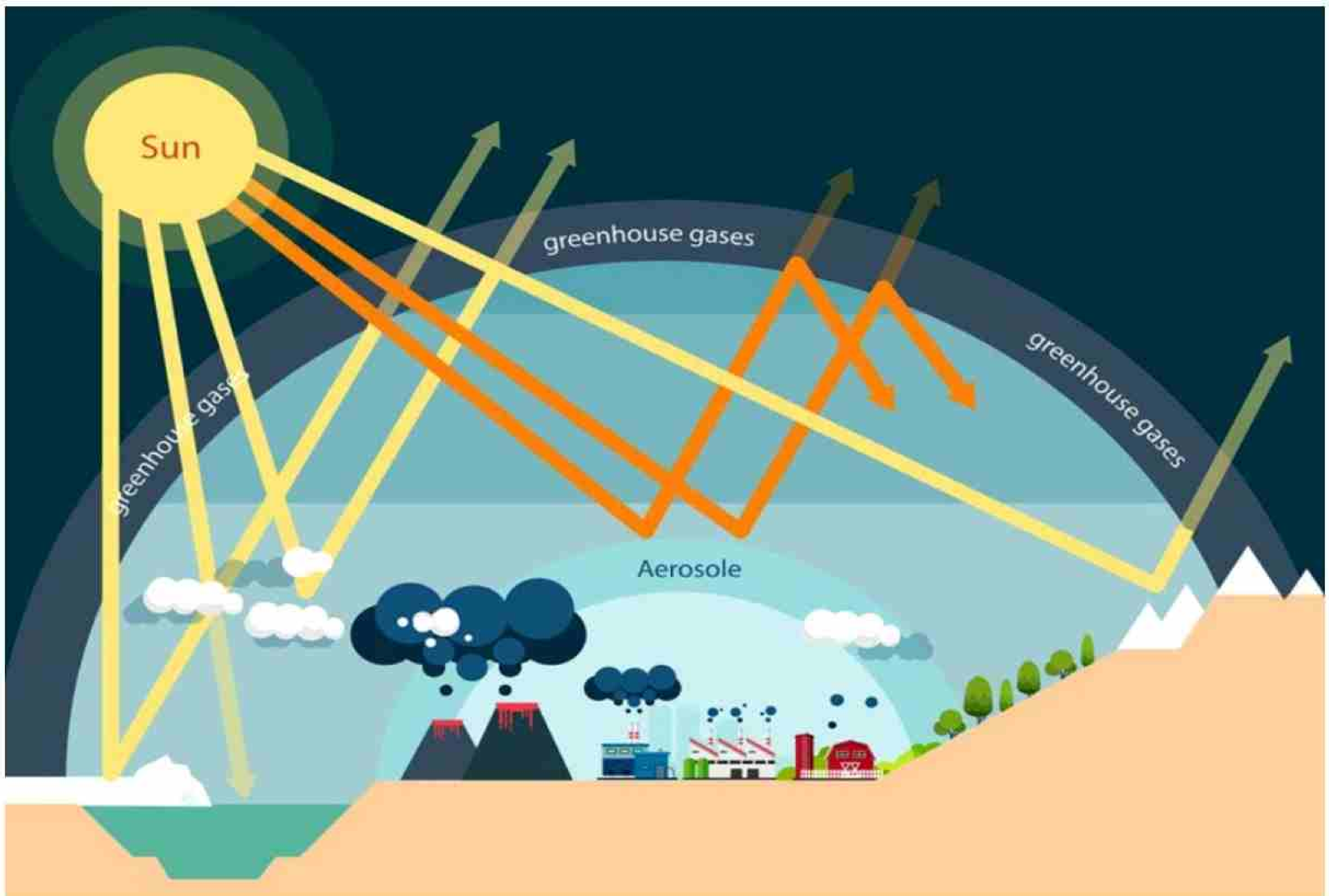

Fig: 25.9 Greenhouse effect (Global Warming)

25.5.2 Causes increasing concentration of CO_2 in the World's atmosphere

Human activities are mainly responsible for rising CO_2 levels in the atmosphere. The major sources of CO_2 emissions by humans are the combustion of fossil fuels such as coal, oil, and natural gas for industry, transportation, heating our homes, and generating electricity. The burning of wild lands and forests increases CO_2 levels in the atmosphere. Deforestation also increases CO_2 levels.

Since the industrial revolution, the percentage of CO_2 in the atmosphere has increased significantly. Though not the primary cause, humans and other animals contribute to CO_2 levels in the atmosphere by exhaling CO_2. Furthermore, the intermittent eruption of volcanoes contributes to the increase of CO_2 in the global atmosphere.

25.5.3 Carbon Dioxide Concentration and Global Warming

The amount of CO_2 in the air is quickly increasing day by day. In comparison to 0.03% in the middle of the twentieth century, it makes up around 0.04% of the air nowadays. Why is this relevant? The increased atmospheric CO_2 levels, also known as the "greenhouse effect," are most likely what are raising the planet's average temperatures. CO_2 is one of the numerous gases of greenhouse gases.

The natural greenhouse effect that keeps the Earth's atmosphere above freezing would be insufficient without carbon dioxide. People are accelerating the natural greenhouse effect and raising the earth's temperature by releasing more carbon dioxide into the atmosphere. CO_2 levels in the atmosphere are rising as a result of various human activities, such as the use of fossil fuels in automobiles and industrial processes. CO_2 absorbs high-energy radiation, causing the atmospheric temperature to rise. This temperature increase is referred to as global warming.

Long Term effects of global warming

The Earth becomes warmer and more trapped in infrared light as carbon dioxide levels increase in the atmosphere. With only a 1.3^0C increase, the earth would become warmer than it has ever been in the past 100,000 years. According to the worst-case scenario, the warming would likely be significant towards the poles. The arctic ice that melts, as a result, might progressively flood places 150 km (or more) inland by raising the sea level by an estimated 100 m. Major agricultural areas would become drier as a result of a warming trend altering the spatial distribution of precipitation.

25.5.4 Acid Rain

Any precipitation that contains acidic elements, such as sulfuric acid or nitric acid, is referred to as **acid rain** or acid deposition. Scottish chemist Robert Angus Smith first used the term "acid rain" in 1852. Wet deposition refers to the type of acid rain that incorporates water. "Dry deposition" is the name for acid rain created from dust or gases. When atmospheric pollutants like oxides of nitrogen and sulphur react with rainwater and come down with the rain, then this result in Acid Rain. Sulphur dioxide and nitrogen oxides have contaminated the water in the atmosphere. When the gases and water vapor interact, the gases' contents turn into clouds. Even hundreds of kilometers from the pollution source, the water vapor condenses and falls to Earth as acid rain. When the acid precipitation reaches the surface of the ground, it also falls as snow or as dry micro-particles and mixes with water. Acid rain can impact the environment by destroying flora, aquatic habitats, buildings, and infrastructure.

Causes of Acid rain:

The causes of acid rain are sulphur and nitrogen particles which get mixed with the wet components of rain. These particles can be found in two ways: either man-made, i.e., as the emissions that are given out from industries, or by natural causes, like lightning strikes in the atmosphere releasing nitrogen oxides and volcanic eruptions releasing sulphur oxides. Although sulphur and nitrogen oxides are naturally produced during volcanic eruptions, forest fires, and eruptions. Humans are also responsible for producing more than half of these chemicals through the burning of coal in power plants, commercial boilers, and sizable smelters that extract metals from ores. Automobiles also release nitrogen oxides into the atmosphere. Anthropogenic sources refer to the causes of acid rain that result from human activity.

Effects of acid rain:

Animals, vegetation, and agriculture are all negatively impacted by acid rain. Each and every nutrient needed for plant life and growth is washed away. Aquatic ecosystems are impacted when acid rain builds up on the ground and enters ponds, rivers, and lakes. It not only pollutes the water, but it also changes the chemistry in a way that makes it difficult for aquatic ecosystems to exist. Acid rain contributes to the leaching of heavy metals like iron, lead, and copper into drinking water, as well as corroding pipes. Taj Mahal, one of the Seven Wonders of the World, is largely affected by acid rain because the city of Agra has many industries that emit sulphur and nitrogen oxides into the atmosphere.

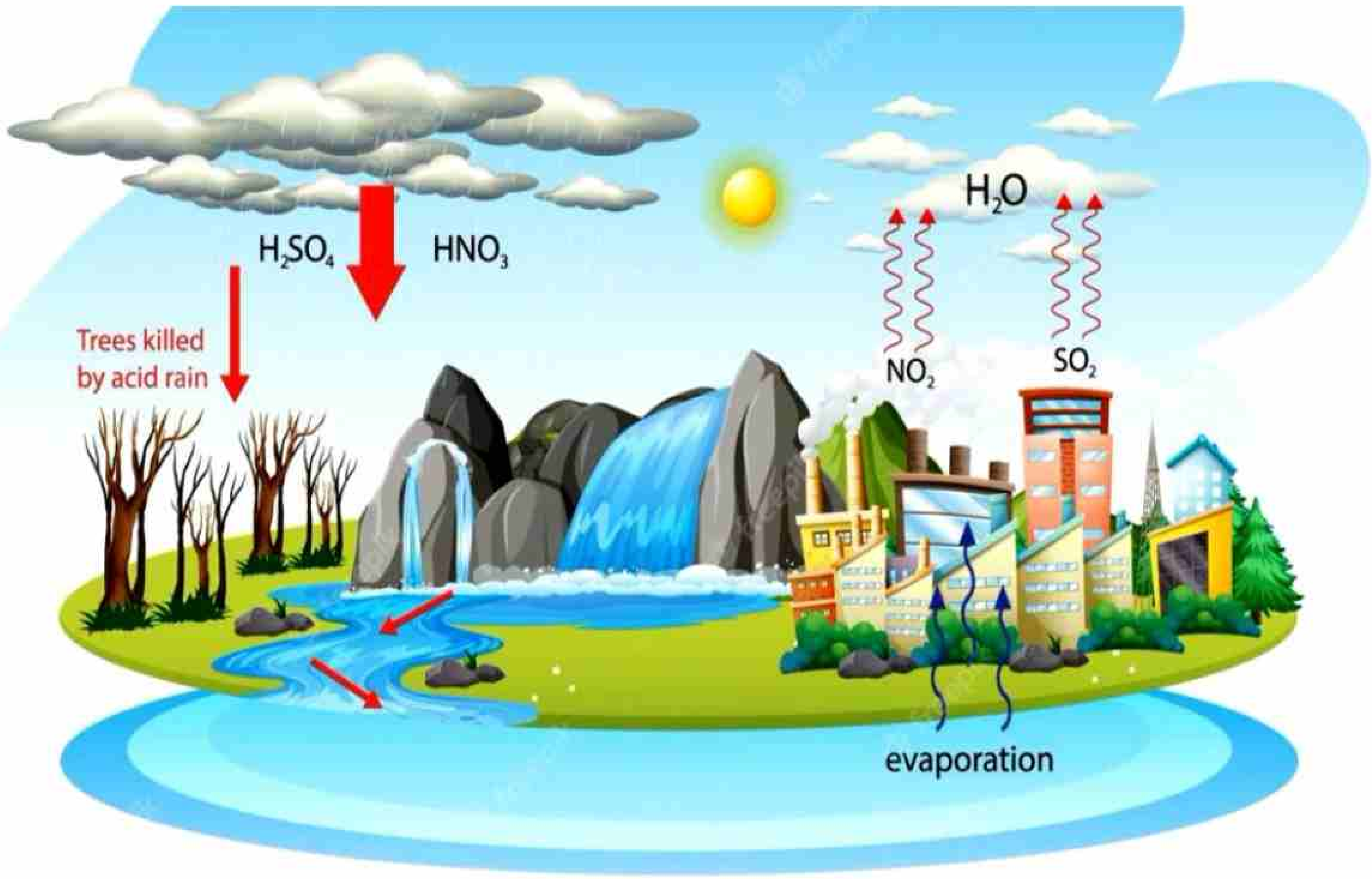

Fig. 25.10 Acid rain

Acid rain has a number of negative impacts, including the following: (a) it makes the soil more acidic; (b) it harms agriculture and forestry; and (c) it kills aquatic species and prevents their successful reproduction. (d) It also improves the properties of some metals, such as aluminum, which may be harmful to many ecological organisms. (e) Acid rain, also referred to as "stone cancer," significantly damages stone structures and monuments. India is deteriorating because of the emissions from oil refineries. (f) Acid rain has a negative impact on the nervous, respiratory, and digestive systems. Both humans and animals' are affected

25.5.5 Ozone Depletion

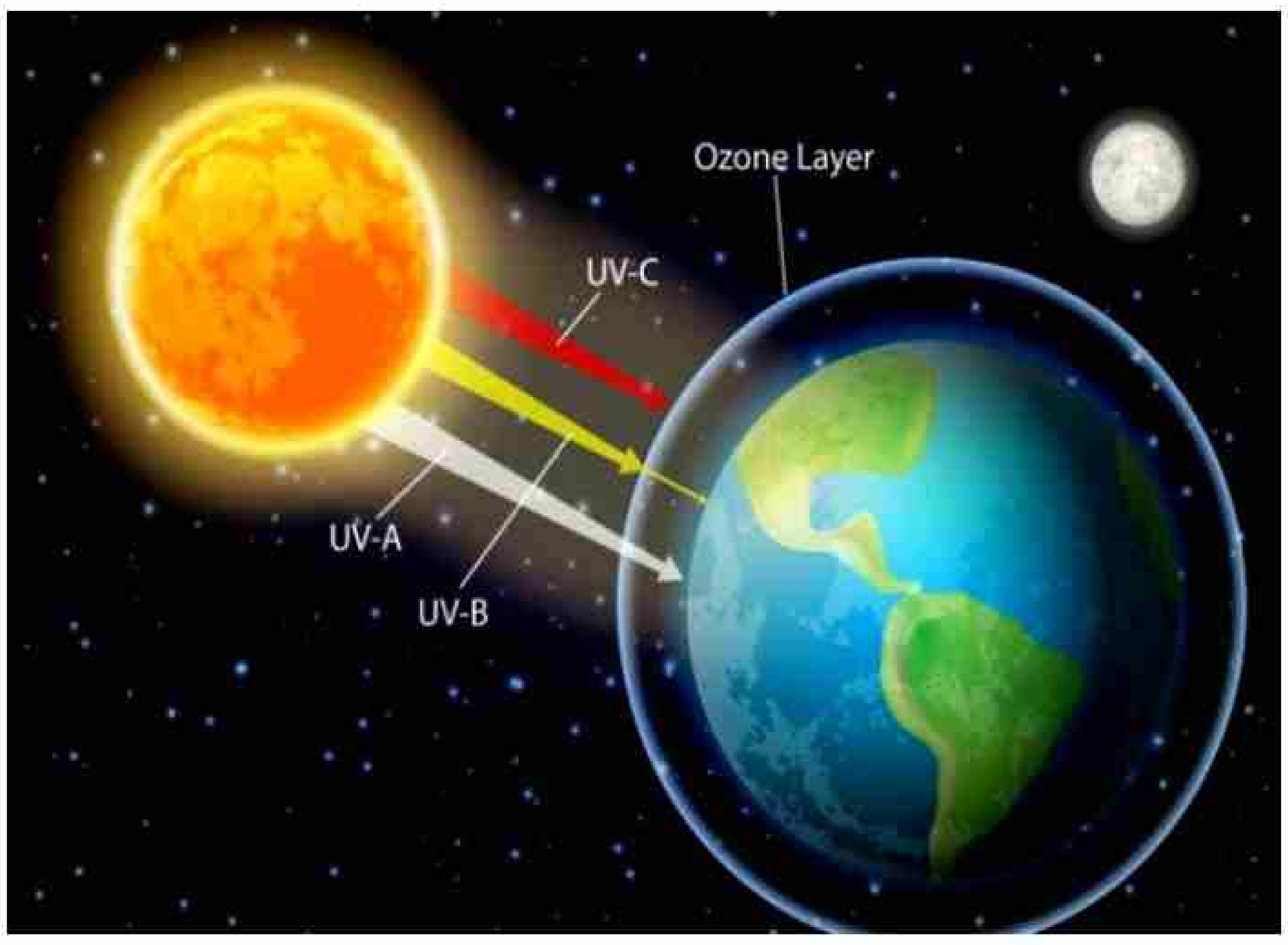

Fig: 25.11 Ozone layer depletion

Ozone layer depletion is the continuous loss of ozone from the upper atmosphere as a result of human activities. This occurs when ozone molecules come into touch with chlorine and bromine atoms in the atmosphere and are broken down. The high atmosphere's ozone layer gets thinned due to ozone layer depletion. Ozone molecules can be destroyed by one chlorine molecule. It doesn't get made as quickly as it gets destroyed. Some substances emit chlorine and bromine, which then helps to deplete the ozone layer Hydrochlorofluorocarbons, methyl bromide, and halons are all ozone-depleting compounds. The most prominent chemical that depletes the ozone layer is chlorofluorocarbons, which can lead to dangerous levels of ultraviolet light pollution.

Composition of the Ozone layer:

It is an atmospheric layer that is located between 10 and 50 kilometers above Earth’s purest form. The blue-colored, explosive, and extremely deadly gas is ozone. Three oxygen atoms make up the molecule known as ozone or O_3. Oxides of nitrogen (NOX) and volatile organic compounds (VOC), commonly referred to as hydrocarbons, perform chemical interactions that result in ozone.

Formation of the ozone layer:

When ultraviolet energy from the Sun splits an oxygen molecule into two oxygen atoms, the resulting atomic oxygen subsequently joins with another oxygen molecule to generate ozone in the atmosphere (O_3). Oxides of nitrogen (NOX) and volatile organic compounds (VOC), commonly referred to as hydrocarbons, undergo chemical interactions that result in ozone. Both near the earth and high in the atmosphere, this reaction is possible.

Causes of ozone layer depletion:

The ozone in the stratosphere blocks off the majority of UV rays. Chlorofluorocarbons (CFCs) are a class of commercially significant chemicals that are found in the stratosphere. These have been employed as cleansers in the electronic sector; coolants (like Freon) in air conditioners and refrigerators; foam (like Styrofoam) for packing and insulation; and propellants in aerosol cans. CFCs and related chemicals are broken down into chlorine, fluorine, and carbon by ultraviolet radiation. Chlorine and fluorine can interact with ozone under certain stratospheric circumstances to produce molecular oxygen.

25.5.6 Role of the Ozone layer in protecting life on Earth

It was discovered in 1985 that the amount of stratospheric ozone had decreased over Antarctica in the springtime by more than 40% since 1977. The protective shield surrounding the Earth had a breach in it. The ozone layer is found in lower levels of the stratosphere. All ultraviolet radiation is absorbed by it, preventing it from reaching the earth's surface and protecting all organisms from the negative effects of UV radiation. The ozone layer maintains the oxygen and ozone in their regular cycles by absorbing radiation.

25.5.7 Effects of Ultraviolet Radiation on human health

UV rays can now reach the Earth's surface as the ozone layer thins. A few health problems linked to excessive UV radiation exposure in humans include sunburn, early aging of the skin, skin cancer, and cataracts. Variations in the earth's temperature and stratospheric ozone often have an impact on UV radiation. More UVB (the higher-frequency, more dangerous type of UV) is now reaching the Earth's surface as ozone levels are declining. On the other side, the penetration of UV radiation is reduced by a rise in cloud cover, pollution, dust, wildfire smoke, and other airborne and aquatic particles connected to climate change. Additionally, ultraviolet radiation affects and reduces the ability of phytoplankton to perform photosynthesis.

25.5.8 Chernobyl nuclear power incidence

The Chernobyl disaster was the result of a nuclear accident. It happened on April 26, 1986, at Ukraine's Chernobyl Nuclear Power Plant. A fire and explosion released large amounts of radioactive contamination into the atmosphere, which spread across much of the Western USSR and Europe. Aside from the 57 direct deaths in the accident, approximately 500.000 workers were affected. In 2005, the United Nations Scientific Committee on the effects of atomic radiation predicted that up to 4,000 additional cancer deaths from the accident would occur among the 600,000 people who received more significant exposures.

25.6 ENVIRONMENTAL RESOURCES AND THEIR DEPLETION

Resources are useful items that can be used by humans to meet their needs and desires in any climate. Natural or environmental resources are those that come directly from the environment of living things and can be utilized. Everywhere that humans have gone, they have changed the environment according to their needs. Living things are valuable natural resources. The Earth is a standalone entity. The smart utilization of Earth's resources will determine how long humanity will exist. Natural resources play a significant role in a country's economic growth. Without their consumption adjustment, there will be irreversible climate change, declining economic growth, and higher social, economic, and environmental costs due to lower productivity. Resource depletion is the process of using either of these types of resources faster than they can be replaced.

25.6.1 Kinds of Natural Resources

The environment is a vast collection of resources. These resources are the natural components of the world that are essential to human existence. These as renewable and non-renewable resources.

(i) Renewable Environmental Resources

On a human-time scale, resources like direct solar energy, wind, and tides that are unconditionally renewable are known as permanent resources. A conditionally renewable resource is one that can be renewed, reproduced, or expanded in quantity by natural processes. Examples include freshwater, fresh air, fertile soil, and trees in a forest, gases in grassland, fruits, and fibers. The majority of biotic and complex resources that are obtained from living organisms are conditionally renewable resources. Natural systems that replace themselves quickly enough to keep up with consumption provide renewable resources. Living things make use of them. Natural cycles like the water cycle, carbon cycle, oxygen cycle, nitrogen cycle, etc. are continually replacing them.

(ii) Non-renewable Environmental resources

The creation of non-renewable materials occurs considerably more slowly than their environmental usage. These are depletable and once lost, they cannot be replaced. Various metals, non-metallic minerals, coal, oil, and natural gas are a few examples. Mostly they consist of minerals and fossil fuels, which cannot be renewed again. These are finite, exhaustible resources that are gradually replaced when they are used up (in stock) (e.g., coal and oil). These biotic resources cannot be regenerated because they were created by plants' photosynthetic activities millions of years ago. In modern times, neither the supply of gasoline nor the supply of iron ore is reproduced or increased. They are basically lost forever once consumed.

25.6. 2 Depletion of Environmental resources

The exhaustion of raw materials within a region is referred to as a resource of depletion. Renewable resources and non-renewable resources are commonly distinguished. The use of either of these types of resources beyond this level of replacement is commonly known as the depletion of resources. Sustainable use of resources is suggested by the experts.

Causes of resource depletion: Man is the primary cause of resource depletion; his activities consume natural environmental resources at a rate that exceeds their rate of renewal. Overconsumption or excessive or unnecessary use of resources, inequitable distribution of resources, overpopulation, slash-and-burn agricultural practices; technological and industrial development; erosion; irrigation; mining for oil and minerals, and pollution or contamination of resources are all factors that contribute to the depletion of natural resources.

25.6.3 Conventional and Non-conventional Energy resources

There are two types of energy sources: conventional and non-conventional.

(a) Conventional energy sources

Conventional sources of energy are those that have been in use since prehistoric times. Traditional energy sources include the fossil fuels coal, natural gas, and oil. Coal, oil, wood, peat, and uranium are sources of energy (electricity), as well as fuel for fire. The benefits of traditional energy sources, such as fossil fuels, include their low production cost and the requirement for well-established technology that can produce energy continuously. The drawback of traditional energy sources is that they have a limited quantity because nuclear energy and fossil fuels will ultimately run out. Burning fossil fuels also contributes to acid rain and releases large volumes of greenhouse gases.

Fossil fuels: Coal, oil, and gas are examples of fossil fuels. They meet 95% of the electricity demand. They cannot be regenerated. Fossil fuels are so-called because they are the remains of plants and animals that lived millions of years ago.

Nuclear energy is generated by the fission of radioactive atoms. This energy is used in nuclear reactors to make electricity. U235 is the primary nuclear fuel. Nuclear energy has the advantage of emitting a large amount of energy. The disadvantages are that it produces radioactive waste and is costly.

(b) Non-conventional energy sources

Non-conventional energy sources or unusual sources of energy are new energy sources that are still not widely used. Their contribution to national power is not significant. These are: Solar and hydroelectric power (dams in rivers). Wind energy, tidal energy, and ocean wave energy, Geothermal energy (heat from deep under the ground), Thermal energy from the sea (the difference in heat between shallow and deep water), Biomass (burning vegetation to prevent methane production), Bio-fuel (producing ethanol (petroleum) from plants), Bio-gas It is also referred to as renewable energy sources.

The benefits of non-conventional energy sources include their abundance in nature, lack of pollution, and environmentally friendly nature. The disadvantages of nonconventional energy sources are that they are often limited to producing energy only under certain conditions, such as sunny days for solar panels and windy days for windmills.

25.6.4 Protection of Environmental Resources

Natural resources are essential to our survival. The quality of our air, water, soil, and biological resources has a direct impact on our health and well-being. Our surroundings Seascapes and wildlife are inextricably linked to our culture, inspiring art, and literature. Our economy and key industrial sectors rely on healthy ecosystems both directly and indirectly. Many people believe that natural resources have intrinsic value; that is, they are valuable in and of themselves regardless of their functional value.

25.6.5 Role of government departments and NGOs

The governments of different countries control and develop the country's forests, dams, major irrigation systems, power plants, railways, ports, roads, mines, and industries. The environment ministry is in charge of planning, protecting, and coordinating environmental and forestry programs. The Ministry of Environment is in charge of assessing the environmental impact of any project that has the potential to harm the environment. Every year on April 22nd, Earth Day and Tree Plantation Week are observed to educate the public.

Role of NGOs: None Government Organizations can play an important role in environmental protection conservation and management, as well as in raising public awareness about environmental issues. They have raised public awareness of environmental issues caused by neglect and uncontrolled exploitation of natural resources. Some of the NGOs are involved in environmental empowerment, while others are involved in research work at different levels.

SUMMARY

- Water is a very important abiotic factor in our ecosystem.
- The water cycle begins with the process of evaporation.
- Aquifers are necessary for a wide range of human activities, including agriculture, industry, and domestic water supplies.
- The nitrogen cycle is a complex biogeochemical process that ensures the availability and recycling of nitrogen in the Earth's ecosystems.
- When ammonia (NH_3) is converted into nitrate (NO_2) compounds by nitrifying bacteria through a process called Nitrification.
- Ammonification is the process by which microbes break down organic materials to produce ammonia or ammonium molecules.
- The ecosystem is the basic fundamental unit of ecology in which living and non-living things interact and influence each other.
- An energy pyramid shows how much energy is contained in the biomass of each trophic level.
- The process of ecological succession involves a series of stages, known as seral stages,
- Primary succession occurs in areas that are barren of life and lack soil, such as newly formed land or bare rock surfaces.
- Ecological succession occurs in arid environments like deserts, mountains, or dunes known as xerarch succession.
- Phytoplanktons are microscopic, photosynthetic organisms, primarily consisting of algae and cyanobacteria.
- A transitional stage in the ecological growth of a freshwater ecosystem is known as the sedge meadow stage of a lake.
- The quality of our air, water, soil, and biological resources has a direct impact on our health and well-being.

EXERCISE

1. Encircle the correct choice.

i) Which one of these mainly causes the greenhouse effect?
(a) Acid rain (b) Ozone layer depletion
(c) Global warming (d) Forest fire

ii) Factors that affect the flow of energy at the trophic level are
(a) Non-predatory deaths (b) Growth & Reproduction
(c) Heat loss (d) Sunlight

iii) The main cause of the increase in the amount of CO_2 in the Earth's atmosphere is
(a) Rapidly growing human population
(b) Burning of a large number of fossil fuels
(c) Increase in the number of industries
(d) Decrease in the forested resources.

iv) All is positive for which of the following processes?
(a) Oxidation of Nitrogen
(b) Melting of ice and evaporation of water
(c) Oxidation of gold
(d) Burning of chlorine

v) Which of the following dietary requirements is involved in nitrogen balance?
(a) Carbohydrates (b) Vitamins
(c) Proteins (d) Essential fatty acids

vi) Which of the following cycle is not a gaseous type of cycle?
(a) Carbon cycle (b) Nitrogen cycle
(c) Phosphorus cycle (d) Oxygen cycle

vii) The source of carbon to plants in the carbon cycle is
(a) Carbonate rocks (b) atmospheric carbon dioxide
(c) Fossil fuels (d) all of the above

viii) Conversion of nitrates to nitrogen is called
(a) Nitrification (b) Denitrification
(c) Ammonification (d) Nitrogen fixation

ix) what is the only source of energy for all ecosystems on Earth?
(a) Water (b) Sun
(c) Animals (d) Plants

x) The pioneers in xerarch succession are the
(a) Foliose lichens (b) Mosses
(c) Crustose lichens (d) Shrubs

2. Write short answers of the following questions.

i) Why biogeochemical cycle is named so?
ii) Differentiate between nitrification and de-nitrification?
iii) How does energy flow between trophic levels?
iv) What are the major producers in a terrestrial ecosystem?
v) How does ecological succession affect the community?
vi) What are the causes of ozone layer depletion?
vii) Why should we conserve biodiversity?
viii) Differentiate between renewable and non-renewable resources.

3. Write the details answers of the following questions:

i) What is a biogeochemical cycle? Explain nitrogen cycle in detail.
ii) Describe the effects of Carbon dioxide and global warming on human health.
iii) What is succession? Describe different stages of secondary succession with examples.
iv) What factors determine the growth rate of the human population? Give their reason also