1

INTRODUCTION TO ENVIRONMENTAL GEOGRAPHY

Unit Structures :

1.0. After going through this chapter you will be able to understand the following features:

1.1 OBJECTIVES

By the end of this unit you will be able to –

- Understand the concept, definition, nature, scope and importance of Environmental Geography
- Know about different Natural and Man-made factors of environment
- Understand the man-environment relationship

- Know about the need & importance of Environmental Geography
- Learn Ecosystem, its meaning, components as well as function
- Study about Bio-geo-chemical cycles like Hydrological, Carbon and Nitrogen
- Learn types of ecosystem such as Forest, Grassland, Desert, Fresh water and Marine

1.2 INTRODUCTION

Environment is the source of life on the earth and determines the existence, growth and development of mankind and all its activities. At present the word Environment is often used almost by everybody around us. Television and newspapers are focusing different environment related news regularly. Debate is on as how to protect our environment. Global summits are held regularly to discuss the environmental issues. In this Chapter we will study Environmental Geography its definition, nature, scope and importance. We will also learn about different Natural and Man-made factors of environment along with the man-environment relationship. The need and importance of Environmental Geography will also be studied. In the latter part of this unit Ecosystem, its meaning, components as well as function will be learnt. After that we will study about Bio-geo-chemical cycles like Hydrological, Carbon and Nitrogen. Different types of ecosystem such as Forest, Grassland, Desert, Fresh water and Marine, an interesting part of the same has also been dealt in this chapter. With the development of modern technology, there is always a growing pressure on environment. This dynamic relation between man and environment has become the primary concern for everyone for the survival of the future generation.

1.3 SUBJECT-DISCUSSION

Down the ages humans have learnt to exist in a variety of locations on the earth. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. Many times, the bad changes were caused by humans making too much of a change in the environment, by using or abusing the natural resources. Every location where people have lived contained a community of plants, animals, insects, and other natural resources. A community of organisms, other natural resources, and their influence on each other is called an ecosystem. The plants and animals existing in an ecosystem are those most adapted to that environment.

A growing human population presents increasing environmental challenges around the world. The study of Environment and Ecosystem helps in understanding the dynamics of ecology, environmental science, and conservation management of natural resources, wildlife and

sustainable ecosystems and landscapes so that applicable solutions can be sought for.

1.4 DEFINITION OF ENVIRONMENTAL GEOGRAPHY

The environment is a complex of many variables which surrounds man as well as all living organisms. This means environment includes things or events surrounding us and their interaction. It is an interaction between living beings (plants/ animals) and their environment, which includes physical non-living components like air, river, ocean or land, mountain, plateau etc. It also includes interaction among living beings. It is thus a multi directional system of interaction. The system is made up of living and non-living physical components of Earth.

Environmental geography, one of the branches of geography, comes in parts of human geography and physical geography. Although Environmental geography is basically the study of environment it is not termed as "geography of environment". This is because the term of Environmental geography puts more stress on man-environment relationships. Some other disciplines only focus on one or few of aspects of environment while environmental geography deals with the environment in its totality and analyses the time-space relationship between man and the environment. On the other hand it is the study of systematic description of different components of environment and interactions of human with these components.

A major part of environmental geography is the examination of landforms and waterway patterns resulting from the actions of water and streams. This is also referred to in geologic circles as geomorphology. Environmental geography constituting important set of analytical tools is capable of assessing the impact of human presence on the environment and measure the result of human activity on natural landforms and cycles.

After analyzing different aspects, environmental geography may be defined as that branch of geography which studies the characteristics, compositions and functions of different components of the natural environmental system as well as mutual interdependence of different components, various processes that link the components. Moreover the interactions of different components with each other and among themselves and consequent responses (environmental problems) in spatial and temporal context in terms of 'geoecosystem.' as well as interactions of technologically advanced 'economic man' with different components of natural 'geoecosystem' and resultant modifications and changes in the natural geoecosystem leading to environmental degradation and pollution, the techniques and strategies of pollution control measures and management of ecological resources are part of environmental geography.

1.5 NATURE AND SCOPE OF ENVIRONMENTAL GEOGRAPHY

The environment is very complex in nature. It is a mixture of living and non-living components that are interrelated to each other yet are independent. The environment is comprehensive in nature; as it includes everything surround us. The most important property of environment is its potential to change or dynamism. Both biotic and abiotic components have the potential to change. The other character of environment is it lies in his system. The functioning of environment always follows a systematic order. The hydrological cycle is the best example of a systematic environment.

The scope of environment lies in the components of environment. However, with alterations brought in the components, the scope has widened to include their necessary protection and sense of proper utilization. It thus enables man to accept his environmental responsibilities.

The scope of Environmental Geography is immense. Environmental science and Environmental geography are interdisciplinary because in both the subjects there is the pursuit of knowledge about the natural world and scientists try to remain objective. The studies from environmental geography help us to understand how the environment and human society are interlaced. In the last few decades there has been a noticeable growth in this area of geography as human induced environmental degradation accelerated. Environmental geographers are well associated with the functions of nature. They are also familiar with the idea that humans are a dominant agent in bringing change in nature. They realized that it is not possible to understand environmental problems without understanding the physical processes as well as the demographic, cultural, and economic processes that lead to increased resource consumption and waste. Environmental geographers have spread out along a variety of academic paths. These paths often cross, mingle, or converge with those of other disciplines. By its very inherent features, Environmental geography seeks to integrate and synthesize knowledge and this is its strength.

To study Environmental geography in a definite manner environmental geographers ask a diverse set of questions such as:

- Can the global environment cope with anticipated population growth?
- What will be the extent and impact of global warming?
- Should we protect tropical forests and why are they being destroyed?
- What causes famine and why do people die from it?

With the growing interdependence of the nations around the world and environment the role of environmental geography and employment opportunities for geographers will continue to increase. The two areas that are growing rapidly at present and creating plenty of new jobs are (a.)

Geographic Information Systems and (b.) Environmental Studies. Maps are the basic tools geographers use to present information. Computers have revolutionized mapmaking and placed geography on the forefront of research.

Catastrophes involve toxic waste, air and water pollution, loss of biodiversity and habitat as well as soil erosion. So, environmental problems have become the concern of both the geographers and ordinary citizens. Hence great care is taken to monitor the delicate balance between nature and the human use of the earth. Specialists in both the social and natural sciences are required to integrate the work of specialists in both the social and natural sciences. As a result people who are expert and trained in high-tech sub-fields such as computer assisted cartography, remote sensing and GIS have job huge opportunities.

Environmental geography gives special emphasis to how things interrelate between humans natural environment.

Following are the branches of environmental geography:

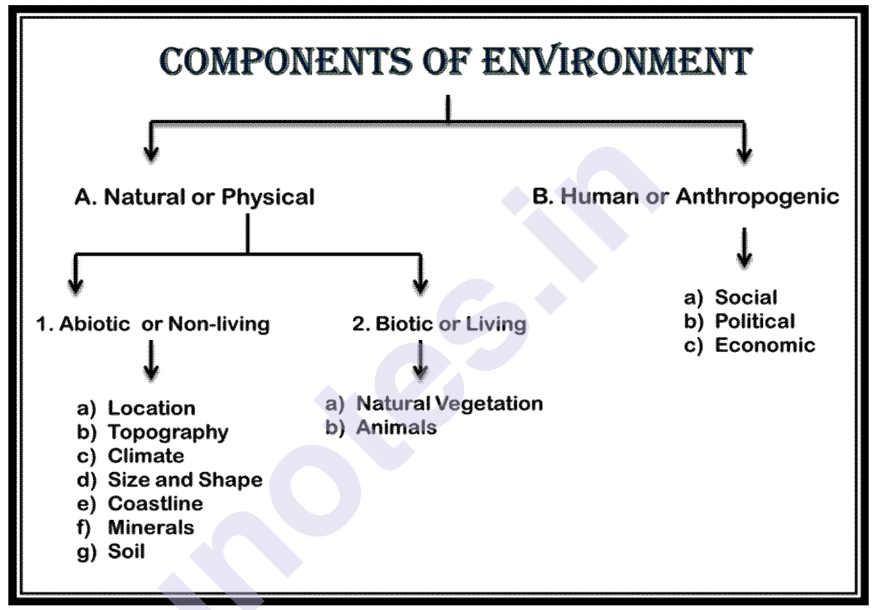
1. Hazards
2. Energy and resource geography
3. Political ecology
4. Environmental perception
5. Systems theory
6. Landscape studies
7. Marxian environmental geography
8. Sustainability
9. Environmental governance
10. Environmental justice

The scope of environmental geography may be grouped into nine major subfields.

I. Geo-ecosystem or simply ecosystem as study unit
II. The functioning of ecosystem including circulation of energy and matter and ecosystem productivity
III. Temporal changes in ecosystem
IV. Spatial ecological changes
V. Global environmental problems
VI. Environmental hazards disasters
VII. Man and environmental processes
VIII. Environmental degradation and pollution
IX. Environmental management.

1.6 FACTORS OF ENVIRONMENT

Environment is a complex phenomenon of different factors which are the product of the forces and processes of nature. Environmental factors can be anything that positively or negatively changes the environment and they can be natural or caused by outside forces. It comprises of number of factors that interact with each other in different ways to keep the planet alive and support the life on the earth. Environmental factors influence the living being in several ways. Organisms continuously take the things they need from the environment and depend entirely on their environment for their survival. Different living beings live in different habitats due to differences in needs for survival.



Environment mainly consists of atmosphere, hydrosphere, lithosphere and biosphere. But it can be roughly divided into two types such as

a. Micro environment

b. Macro environment.

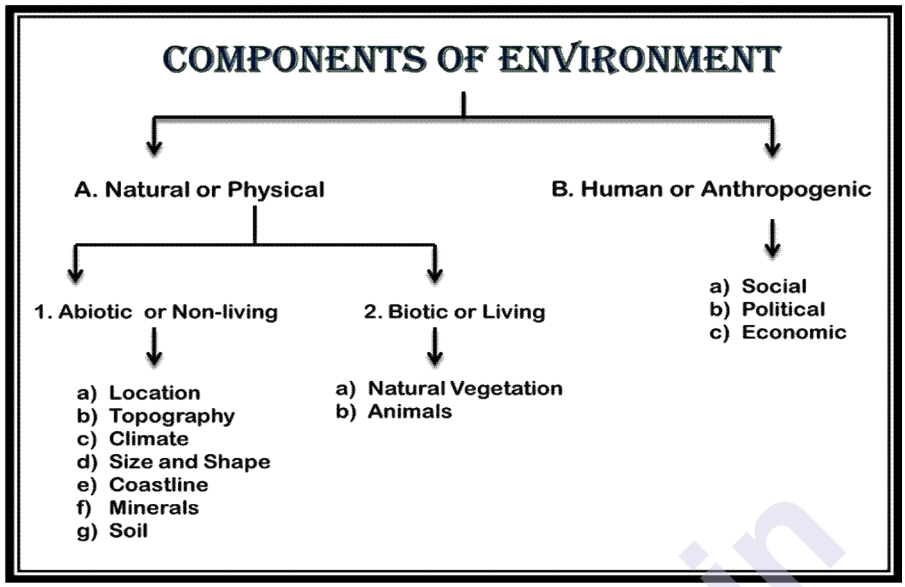
It can also be divided into two other types like

A. Physical

B. Human or Anthropogenic

a. Micro environment refers to the immediate local surrounding of the organism.

b. Macro environment refers to all the physical and biotic conditions that surround the organism externally



- **The factors of environment may broadly be classified as**:

A. Natural or Physical

B. Human or Anthropogenic

- **Physical environment** comprises of atmosphere, lithosphere and hydrosphere.

The components of the natural environment can be classified into two broad groups:

1. Abiotic or Non-Living

a. Location

b. Topography

c. Climate

d. Size and Shape

e. Coastline

f. Minerals

g. Soil

2. Biotic Or Living (Natural Vegetation and Animals)- includes all biotic factors or living forms like plants, animals, Micro-organisms.

a. Producers

b. Consumers

c. Decomposers

3. There is also a **Human or Anthropogenic** factor which is classified as

a. Social

b. Political

c. Economic

1.6.1 A) Natural or Physical

1.6.1.1 Abiotic or Non-Living Components

The abiotic or non-living components are all those physical and chemical factors which influence the life of the living beings. These are the elements of a living ecosystem that affect the viability of the system to grow or survive, but which themselves are not biological in nature and include common conditions such as temperature, air flow, available light, and the inorganic components of soil. More broad-based abiotic factors that can influence organisms include the location, topography, climate, size and shape, coastline, minerals and soil.

- The abiotic components are discussed below:

a. Location: Location is the main factor as it influences the human activities. There are two types of location viz. Absolute location and Relative location.

i. **Absolute location** is referred to the actual location on Earth's surface with respect to geographical coordinates (in terms of latitudes and longitudes).

ii. **Relative location** can be defined as the location with reference to a reference point. The references may be natural or man-made.

b. Topographic or Physiographic factors:

i. Altitude

ii. Direction of mountain chains and valleys

iii. Steepness and exposure of slopes

c. Climate:

Climatic factors include humidity, sunlight and factors involving the climate such as:

i. Light

ii. Temperature

iii. Water

iv. Rainfall

v. Humidity

vi. Atmospheric gases (wind).

d. **Size and Shape of Country**: The countries vary in their shape and size. Some of the countries are large like U.S.A, Canada, Russia and they can enjoy the large amount of resources. Smaller countries like Japan, Sri Lanka have limitation in resource utilization. Shapes of the countries may be elongated, fragmented or compact.

e. **Coastline**: The nature of the coastline also plays an important role as trade is dependent on waterways. The development of ports and harbours for international trade depends on the nature of coastline.

f. **Mineral:** A mineral is a naturally occurring chemical compound and abiogenic in origin. It is usually found in crystalline form.

g. **Soil** factors include soil and geography of the land. These deal with formation of soil, its physical and chemical properties and details of related aspects. Soil can be defined as the organic and inorganic materials on the surface of the Earth that provides the medium for plant growth. Soil develops slowly over time and is composed of many different materials.

1.6.1.2 Biotic factors

Biotic factors are all of the living things in an ecosystem, such as plants and animals. These living things interact with one another in many ways. They are sorted into three groups: producers or autotrophs, consumers or heterotrophs, and decomposers or detritivores. These are discussed under.

a. Producers:

Producers or autotrophs convert energy into food, some using photosynthesis. All plants, such as grass and trees, are producers. These organisms absorb the sun's energy and convert the energy into food for themselves, allowing them to grow larger, make flowers and seeds, etc. For example: Arctic willow, Avocado, Ball moss, Bamboo, Banana trees, Cotton grass, Fruit trees like lemon, orange, apple, Hay, Indian rice grass etc.

b. Consumers

Consumers, also called heterotrophs, rely upon producers for food. These organisms, mostly animals, eat producers and/or other animals. They may also eat decomposers. Two examples of consumers are deer (eat plants) and wolves (eat animals). Consumers that only eat plants (herbivores) are often known as primary consumers.

c. Decomposers

Decomposers are also called detritivores, break down chemicals from consumers and producers into simpler forms that are used again. Decomposers break down dead material (such as a fallen tree) into soil and return nutrients to the soil so they can be re-used by producers to create food. An example of a decomposer is a mushroom.

1.6.2 Man-Made or Human or Anthropogenic Environment

Man can modify the surroundings according to his wants. They have developed some environmental components using their intelligence, knowledge, skill and power. These environments are as follows:

a. Social

A socio-cultural environment includes population with cultural norms, demographic information and religious information. A variety of beliefs, customs, practices and behavior existing within a population is considered a part of it.

b. Political

The political environment includes the state, government and its institutions and legislations and the public and private stakeholders who operate and interact with or influence that system. The government plays a significant role in economic development of country. Different governmental systems are followed by the different countries.

c. Economic

Different economic environments like capitalism, socialism and many others are followed in different countries.

1.7 RELATIONSHIP BETWEEN MAN AND ENVIRONMENT

Man and environment has an age old relationship as both of them are interrelated. The environment influences the life of human beings and also human beings modify their environment as a result of their growth, dispersal, activities, death and decay etc. Thus all living beings including man and their environment are mutually reactive affecting each other in a number of ways. This has made possible a dynamic equilibrium between human beings (society) and environment establishing their inter dependence.

So human beings living in the realm of nature interact with it constantly. Since inception, man has been dependent on the environment for his food, clothing and shelter and other basic and luxurious needs. The nature influences man in the form of the air he breathes, the water he drinks, the food he eats, and the flow of energy and information he receives. Any change in the environment will result in devastating effects. It may also create a threat to the human race. His relationship with the environment has shown dynamism. At times, he was and is friendly with nature and at times not, but, he never destroyed the environment. Lately, with changing nature of man's activities and style of living, environment has undergone certain negative changes. Thus, the relationship between man and environment has become painful. Man started changing the natural environment to suit his needs. So, he exploited, altered and modified his natural environment. Scientific and technological advancements enabled

man to exploit his natural environment. This resulted in destruction, degradation and damage to the natural environment giving rise to disaster. The results are observed and experienced in the form of ozone depletion, global warming, threats to bio-diversity, acid rain, desertification, pollution, flooding, etc. only education, awareness and conscience can help restore the environment and stop further loss.

5th June of every year is observed as World Environment Day to emphasize the importance of green environment in our lives and promote the worldwide awareness of the environment.

1.8 NEED & IMPORTANCE OF ENVIRONMENTAL GEOGRAPHY

Study of Environmental Geography bridge the two concepts of human behaviour and the natural world. It investigates the relationship between them. It is very important because it enlightens us about the significance of protection and conservation of our indiscriminate release of pollution into the environment. The present world experiences innumerable environmental issues which have grown in size and complexity. Hence threatens the survival of mankind on earth. The need and importance of Environmental Geography studies are as follows:

I. Environment issues have international importance. It has been well recognised that environment issues like global warming and ozone depletion, acid rain, marine pollution and biodiversity are not merely national issues but are global issues and hence must be tackled with international efforts and cooperation.

II. Emergence of development has given birth to Urbanization, Industrial Growth, Transportation Systems, Agriculture and Housing etc. As a result the natural resources has been rapidly utilised and a variety of problems have cropped up. Human activities have increasingly degraded our environment. So we need to protect the environment. Study of Environmental geography prepares students for careers in environmental planning, design, and restoration, as well as in environmental assessment and monitoring, resource management, natural areas preservation, and outdoor and environmental education.

III. Students studying of Environmental geography will develop competencies in the natural and social sciences as well as complementary analytical techniques.

IV. Although man lives in modern and manufactured world he has to rely on the environment to a large extent for the ability to grow crops, the capability to stock water, and the power to prevent natural disasters. Thus the study of our environmental geography plays a vital role and helps to understand the patterns of our planet. By this we may be able to predict potential hazards and help to implement precautions in the future. Environmental geography also encourages agricultural experts

to recognized soils health problems like deficiency of micronutrients and organic matter, soil salinity and damage of soil structure.

V. Fieldwork is a key skill for geographers and Environmental Geography is broadly experiential and often involves experience-based learning. This includes practical work on a regular basis. So the reading-load of a student is lessened and the student gets more of a diverse learning experience. This subject as we know is the study of the earth and mankind, so if a student wants to have a skill and sound knowledge to the students degree, learning Environmental Geography will be of great help.

1.9 ECOSYSTEM

Ecosystems can be of different sizes consisting of a community of organisms together with their physical environment. They can be marine, aquatic, or terrestrial. Broad categories of terrestrial ecosystems are called biomes. In ecosystems both matter and energy are conserved. Energy flows through the system usually from light to heat. But matter is recycled. Ecosystems with higher biodiversity tend to be more stable with greater resistance and resilience in the face of disturbances, disruptive events. In an ecosystem each organism plays its own role.

1.9.1 Meaning of Ecosystem:

According to Woodbury, "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". An ecosystem includes all the living things such as plants, animals and organisms in a given area, interacting with each other, and also with their non-living environments like weather, earth, sun, soil and climate. Ecosystems are the foundations of the biosphere and they determine the health of the entire earth system. Although a complete self-sufficient ecosystem is rarely found in nature but all the ecosystems of the earth are very well connected to each another such as river ecosystem is connected with the ecosystem of ocean.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment"

According to R. L. Lindeman (1942), the term ecosystem applies to "any system composed of physical-chemical-biological processes within a space-time unit of magnitude."

According to Monkhouse and Small, "ecosystem is an organic community of plants and animals viewed within its physical environment or habitat".

From the above definitions of ecosystem, the following basic properties emerge:

- Ecosystem of any given spatial- temporal unit represents the sum of all living organisms and physical environment.

- It is a well-defined area.
- It is an open system characterized by continuous input and output of the energy.
- It is mainly powered by solar energy.
- It is a functional unit.
- There is a complex interaction between the biotic and abiotic components.
- Ecosystems are natural system and well organized.

1.9.2 Components and Function of Ecosystem

1.9.2.1 Components of Ecosystem

An ecosystem is a functional and structural unit of Ecology. This implies that each ecosystem has a definite structure and components where each component part of the system has a definite role to play in the functioning of the ecosystem. Ecosystems have two major components. The living or biotic components like plants and animals; and the nonliving or abiotic components like water, air, nutrients and solar energy. These two parts of the ecosystem continuously interact with one another.

- From the structure point of view all ecosystems consist of the following basic components:

1. Abiotic components
2. Biotic components

1. Abiotic Components:

Abiotic component of ecosystem includes all the physical and chemical factors that influence living organisms, like air, water, soil, rocks etc. Thus, it is an assemblage of organic and inorganic substances present in an ecosystem. Basic inorganic elements and compounds are soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds such as by-products of organic activities. The physical factors and ingredients like moisture, wind currents and solar radiation are also included in abiotic components. The various climatic factors that affect the ecosystem functioning are also a part of this. Without sunlight, water, air and minerals, life cannot exist. Hence the non-living components are essential for the living world.

2. Biotic Components:

The biotic components include all living organisms present in the environmental system. These can be classified as either producers or consumers, depending on how they get their food. From nutrition point of view, the biotic components can be grouped into two basic components:

a. Autotrophic components- The autotrophic components include all green plants which with the help of the radiant energy of sun manufacture food from inorganic substances.

b. Heterotrophic components-The heterotrophic components include non-green plants and all animals which take food from autotrophs.

- Thus biotic components of an ecosystem can be classified as under:

I. Producers (Autotrophic components)

II. Consumers

III. Decomposers or reducers and transformers

I. Producers (Autotrophic elements):

Producers can make the organic nutrients they need, using simple inorganic compounds in their environment: for instance, the green plants on land and the small algae in aquatic ecosystems produce their food by the process of photosynthesis. For this the radiant energy of sun is used in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy. Oxygen is evolved as by-product in the photosynthesis and used in respiration by all living things.

II. Consumers:

Those living members of ecosystem which consume the food synthesized by producers are called consumers. Consumers directly or indirectly depend on food provided by producers. All kinds of animals that are found in an ecosystem are called consumers. Depending on their food habits consumers can be further classified into four types such as:

a. Consumers of the first order or primary consumers

b. Consumers of the second order or secondary consumers

c. Consumers of the third order or tertiary consumers and Parasites, scavengers and saprobes.

d. Decomposers and transformers

a. Primary consumers:

These are purely herbivorous animals that are dependent for their food on producers or green plants. In a food chain, herbivores are referred to as the primary consumers. The herbivores serve as the chief food source for carnivores. Insects, goat, cow, rabbit, deer, buffalo are some of the common herbivores in the terrestrial ecosystem, and small crustaceans, molluscs, etc. in the aquatic habitat.

b. Secondary consumers:

These are carnivores and omnivores. Carnivores are flesh eating animals and they feed on herbivores (primary consumers). Examples of carnivores

are lions, tigers. Whereas the omnivores are the animals that eat both plants and herbivores, e.g. pigs, rats, cockroaches and humans.

c. Tertiary consumers:

These are the top carnivores which prey upon other carnivores, omnivores and herbivores. Lions, tigers, hawk, vulture, etc. are considered as tertiary or top consumers.

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

d. Decomposers and transformers:

Decomposers digest the complex organic molecules in dead organic matter (detritus) into simpler inorganic compounds. They absorb the soluble nutrients as their food. Some examples are bacteria, fungi, and mites. The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.

The most important part of each ecosystem is that it will have certain representative organisms playing each of the above mentioned roles.

1.9.2.2 Function of Ecosystem

Functions of Ecosystem

An ecosystem is a functional and life sustaining environmental system. The technical term 'Ecosystem function' is generally used to define the biological, geochemical and physical processes and components that take place or occur within an ecosystem. In other words it relate to the structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within ecosystems and across ecosystems. Sometimes, ecosystem functions are called ecological processes. An ecosystem is a functional and life sustaining environmental system.

- In an ecosystem there are three functional components.

1. Inorganic constituents
2. Organism
3. Energy input

These three components interact with each other to form an environmental system. The primary producers convert inorganic constituents into organic components by photosynthesis using the energy from the solar radiations. The herbivores make use of the energy from the producers and they themselves serve as a food for the carnivores. Animals of different types accumulate organic matter in their body which is taken as food. They are known as secondary producers. The dead organic matters of plants and

animals are decomposed by bacteria and fungi which break the complex molecules and liberate inorganic components. These are known as decomposers. During this process some amount of energy is released in the form of heat. The ecosystem of different habitats is interrelated with one another.

Maintaining ecosystem function is important to maintaining the capacity of the region to supply ecosystem services. Those areas with high ecosystem function have the potential to contribute to a wide range of ecosystem services. But those areas showing few ecosystem functions are also important as they may provide important contributions to specific ecosystem services, or they may be important areas for rehabilitation.

1.10 BIO-GEO-CHEMICAL CYCLES

A biogeochemical cycle is defined as the movement of elements such as hydrogen, oxygen, carbon, nitrogen, phosphorus and sulphur through organisms and the environment. It is a pathway by which a chemical substance moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.

The term biogeochemical is a contraction that refers to the consideration of the biological, geological, and chemical aspects of each cycle. 'Bio', the first part of the word 'biogeochemical', involves biological organisms, like bacteria, plants, and animals. The next part of the word, 'geo', involves geological processes, like weathering of rocks. The last part of the word 'chemical', indicates chemical processes, such as the formation of molecules.

In other words biogeochemical cycle is the way in which an element or compound such as water moves between its various living and nonliving forms and locations in the biosphere. For example water is always recycled through the water cycle. The water undergoes evaporation, condensation, and precipitation, falling back to Earth. The other important cycles are the carbon cycle, nitrogen cycle, oxygen cycle, phosphorus cycle, sulphur cycle etc.

1.10.1 Hydrological Cycle

The natural water cycle of the Earth is known as the hydrologic cycle. This describes the continuous movement of water on, above, and below the surface of the Earth. Water always changes its states between liquid, vapour and ice.

The hydrologic cycle begins with the evaporation of water from the surface of the ocean. It gets evaporated due to heat energy provided by solar radiation and forms water vapour. As water vapour is lifted to higher altitudes it cools and condenses to form clouds and precipitate in any form like rain, hail, snow, sleet. After the water reaches the ground some of the water evaporates back into the atmosphere or the water penetrates the surface and become groundwater. Groundwater either seeps its way to into the oceans, rivers, and streams, or is released back into the atmosphere

through transpiration. The water remains on the earth's surface as runoff and empties into lakes, rivers and streams. This is carried back to the oceans. From the oceans the water cycle begins again.

Fig of Water Cycle

1.10.1 Carbon Cycle

Carbon is present throughout the natural environment in a fixed amount. Carbon is a part of the ocean, air, and rocks. In the atmosphere, carbon is attached to some oxygen in a gas called carbon dioxide. All living things are made of carbon. Hence it is an essential element in the bodies of living organisms.

Carbon takes many forms and moves through the environment via the carbon cycle. Thus the carbon cycle is the circulation and transformation of carbon back and forth between living things and the environment. The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.

Plants use carbon dioxide and sunlight to make their own food and grow. The carbon becomes part of the plant. Plants that die and are buried may turn into fossil fuels made of carbon like coal and oil over millions of years. When humans burn fossil fuels, most of the carbon quickly enters the atmosphere as carbon dioxide.

Carbon dioxide is a greenhouse gas and traps heat in the atmosphere. Without it and other greenhouse gases, Earth would be a frozen world.

Fig of Carbon Cycle

1.10.3 Nitrogen Cycle

Nitrogen is essential for the formation of amino acids in proteins. 78% of the air in our atmosphere is made of nitrogen. The nitrogen cycle is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature by which nitrogen is converted into various chemical forms as it circulates among the atmosphere, terrestrial, and marine ecosystems. Even though all animals need nitrogen to produce proteins necessary for life, animals cannot use the nitrogen in the “free” form from the atmosphere. They must consume nitrogen by eating nitrogen compounds. Four processes involved in the Nitrogen Cycle are stated under:

a. Nitrogen Fixation

b. Digestion

c. Decomposition

d. Waste production

a. Nitrogen Fixation :

The nitrogen cycle shows how the free nitrogen in the air is turned into nitrogen compounds and put into the soil by "nitrogen fixing bacteria". This process is known as Nitrogen Fixation.

Bacteria play the most important part of the cycle. When nitrogen is absorbed by the soil, different bacteria help it to change states so it can be absorbed by plants. Animals then get their nitrogen from the plants. For example, plants that soak up the nitrogen compounds in the soil are called legumes such as Oats, Peas, Beans and starchy vegetables like Corn.

b. Digestion

Animals eat the legumes to get the nitrogen compounds they need to produce protein.

c. Decomposition

When animals die, bacteria called decomposers break down the organic matter (plants, animals) chemically into all the simple elements that they are made of and these elements return back to the environment.

For example: When an animal dies all the carbon, oxygen, nitrogen, water, calcium etc. return to the soil and air during decomposition.

d. Waste Production

The bowel movement of an animal is the waste that is loaded with nitrogen. This nitrogen returns to the soil. Nitrogen is a significant fertilizer.

Fig of Carbon Cycle

1.11 TYPES OF ECOSYSTEM

There are many types of ecosystems and it is not possible to classify all of them. There are essentially two kinds of ecosystems; Aquatic and Terrestrial. Any other sub-ecosystem falls under one of these two headings.

1.11.1 Forest Ecosystem

Large group of trees shrubs, the leaf mulch on the floor and the plants that live in tandem with the trees belong to the forest ecosystem. It also includes the animals that live in the forest. For example, birds nest in the trees of a forest, members of the fungus kingdom grow on the forest floor, and a variety of insects and mammals also take up their homes in a forest. Thus a forest ecosystem is a community of organisms that lives within a forest. Forest ecosystems are very important as they are the lungs of the world. The forests release oxygen. Forest ecosystems are very rich and diverse.

There are various types of forest ecosystem throughout the world. Types of forest ecosystem are as follows:

i. **Rainforests**:

Rainforests is one of the most biodiverse ecosystems on the planet. Rainforests are often based around rivers. Amazon is an important example. The north-eastern part of India is rich in rainforests.

ii. **Mangroves**:

Mangroves are a unique mix of trees and tidal swamps.

iii. **Inland forests**:

Innumerable mainland animals and birds like foxes and owls are found in Inland forests which may be vast and ancient, or smaller like copses.

iv. **The Taiga**:

The taiga is the name for the sparse forest right towards the polar regions of the world.

v. **Lakeside forests:**

Lakeside forest ecosystems are very humid. Water birds and other water wildlife can be found here.

vi. **Mountain forests:**

The forests that grow on mountains like mountain pines create Mountain forests ecosystems like the Himalayan mountain forests in India.

- Characteristics of forest ecosystem are discussed below.

a. **Seasonality**: In countries that have seasonal climates, forest ecosystems will change with the seasons.

b. **Deciduous or evergreen**: A forest may be deciduous or evergreen, or it may be a mix of both deciduous and evergreen trees.

c. **Different levels**: Some forest ecosystems feature several distinct levels – such as the forest floor, the lower canopy, the upper canopy and the tree tops, such as rain forests.

d. **Attractive to birds and insects**: as they make their homes in forests.

e. **Homes for humans**.

f. **Protect** the Earth from desertification by providing a shield against winds.

1.11.2 Grassland ecosystems

The grassland ecosystems are composed largely of wide swathes of grass rather than trees or shrubs. A grassland ecosystem is a community of creatures such as various types of grasses, insects, and animals, etc. living together within a grassy space. Grassland ecosystems are extremely bio-diverse and are home to thriving communities of plants, animals, insects and mammals. Grassland ecosystems are present in every single continent on this planet with the sole exception of Antarctica, which is too cold to sustain a grassland ecosystem.

- Grassland ecosystems can be found throughout the world, for example:

a. In the tropics near to the equator.

b. In the temperate zones of the earth, between the equator and the polar Regions.

Grassland ecosystems are found in many shapes and sizes. However, climate change, intensive farming and urban sprawl are all threatening our beautiful grassland ecosystems.

1.11.3 Desert ecosystem

A desert is a place that is difficult to inhabit. A desert ecosystem is a community of organisms that live together in an environment that seems to be deserted wasteland. Desert ecosystems can be hot as found in the sandy Sahara or cold as on the peaks of mountains. Both in hot and cold deserts it is difficult for organisms to inhabit. A desert ecosystem generally witnesses little rainfall, resulting in less vegetation.

- In a desert ecosystem following things may be observed.

i. Numerous insects living in communities.

ii. An abundance of plant life.

iii. Mammals and birds.

iv. Micro organisms such as bacteria are also present in this ecosystem.

- There are so many different types of desert ecosystems. Types of desert ecosystems are stated under.

1. Hot deserts:

Hot deserts, for example Sahara, are found close to the equator. The plants and animals that live here have evolved in order to adapt to very hot conditions present over there.

2. Cold deserts:

When desertification exists at high altitudes the desert will be cold. A cold desert may be sandy or rocky. Here organisms have adapted the harsh environment to survive.

3. Ice deserts:

Ice deserts are another type of cold desert. This is an uninhabited region that is composed of ice. Ice deserts can be found towards the north and south poles of the planet.

1.11.4. Freshwater Ecosystems

Freshwater ecosystems are a subset of Earth's aquatic ecosystems. They include lakes and ponds, rivers, streams, springs, and wetlands**.**

- Freshwater ecosystems include:

a. sluggish waters of lakes and ponds

b. moving waters of rivers and streams

c. Wetlands which are the areas of land periodically covered by water.

a. Ponds and Lakes Ecosystems – Lakes are large bodies of freshwater surrounded by land, while ponds are smaller bodies of water surrounded by land. Lake Baikal is the biggest lake on Earth and contains about one fifth of the Earth's freshwater. Most of the time they include various types of plants, amphibians and insects and fishes.

b. River Ecosystems – Rivers always link to the sea so they are more likely to contain fish alongside the usual plants, amphibians and insects. These sorts of ecosystems can also include birds because birds often hunt in and around water for small fish or insects.

- There are 3 main groups of organisms in the freshwater ecosystem:

i. **Plankton** - organisms that float near the surface of the water

ii. **Nekton** – free-swimming organisms

iii. **Benthos** – bottom-dwelling organisms

Freshwater ecosystems are the smallest of the three major classes of ecosystems, accounting for just 1.8% of the total of the Earth's surface. The smallest living part of the food web of these sorts of ecosystems is plankton, a small organism that is often eaten by fish and other small creatures.

1.11.5 Marine Ecosystem

Earth's largest aquatic ecosystems are the Marine ecosystems. Salt marshes, intertidal zones, estuaries, lagoons, mangroves, coral reefs, the deep sea, and the sea floor are included in the Marine ecosystems. They can be contrasted with freshwater ecosystems, which have a lower salt content. Marine waters cover two-thirds of the surface of the Earth and it is the complex of living organisms in the ocean environment. Moreover such places are considered ecosystems because the plant life supports the animal life and vice versa. Marine organisms are not distributed evenly throughout the oceans. The availability of light, water depth, proximity to land, and topographic complexity all affect marine habitats.

1.12 SUMMARY

Environment is the source of life on the earth and determines the existence, growth and development of mankind and all its activities. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. The environment is a complex of many variables which surrounds man as well as all living organisms. The

environment is complex, dynamic and systematic in nature. The biotic components and abiotic components together make up the environments. There exists man made environment that is helping man to lead a smooth life.

Environmental geography is broadly experiential so students have more of a diverse learning experience. It will also help the students to understand human behaviour and the extent to which this behaviour differs in regards to the environment. Thus they will develop cultural awareness. No matter how modern and manufactured world we live in mankind will forever rely on the environment.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment". Ecosystems maintain themselves by cycling energy and nutrients obtained from external sources. There are different trophic levels that exist in an ecosystem. The ecosystem of different habitats is interrelated with one another. Important differences among the various components that make up an ecosystem like of Forest, Grassland, Desert, Fresh water and Marine tells us that ecosystems are not just habitats for animals. Many human communities live in there all over the world.

1.13 CHECK YOUR PROGRESS/ EXERCISE

1. True and false

a. The scope of environment lies in the components of environment.

b. Micro environment refers to all the physical and biotic conditions that surround the organism externally.

c. Relative location is referred to the actual location on Earth's surface with respect to geographical coordinates (in terms of latitudes and longitudes).

d. Lake Baikal is the biggest lake on Earth and contains about one fifth of the Earth's freshwater.

e. Plants use carbon dioxide and sunlight to make their own food and grow.

2. Fill in the blanks

a. The _____ cycle is the best example of a systematic environment.

b. _____ environment refers to the immediate local surrounding of the organism.

c. Physical environment comprises of _____, _____ and hydrosphere.

d. 78% of the air in our atmosphere is made of_____.

e. When nitrogen is absorbed by the soil, different _____ help it to change states so it can be absorbed by plants.

3. Multiple choice question

a. Environmental geography, one of the branches of geography,

i. comes in parts of medical geography and physical geography.

ii. comes in parts of human geography and physical geography

iii. comes in parts of human geography and economic geography

b. Relative location can be defined

i. as the location with reference to a reference point.

ii. as the actual location on Earth's surface with respect to geographical coordinates

iii. as a particular place or position usually on the outskirts of a town or city.

c. Abiotic component of ecosystem includes

i. all the physical and chemical factors that influence only soil

ii. all the physical and chemical factors that influence living organisms, like air, water, soil, rocks etc

iii. all political factors that influence living organisms, like air, water, soil, rocks etc.

d. The autotrophic components include

i. all green plants

ii. non-green plants and all animals

iii. all animals

e. All kinds of animals that are found in an ecosystem are called

i. reducers

ii. producers

iii. consumers

4. Answer the Following Questions

1. Define Environmental Geography and state its nature and scope.
2. What are the different Factors of environment?
3. Write a short note on Man-Environment relationship.
4. Define Biotic factors. Elaborate your answer with suitable examples.
5. What do you understand by the term 'Ecosystem'? State the Components and Function of ecosystem.

6. Define Bio-geo-chemical cycles. Elaborate your answer with examples.
7. Write short notes on:
   a. Hydrological cycle
   b. Carbon cycle
   c. Forest ecosystem
   d. Grassland ecosystem
   e. Physiographic factors of environment

1.14 ANSWERS TO THE SELF LEARNING QUESTIONS

1.a. True

1.b. False, Macro

1.c. False, Absolute

1.d. True

1.e. True

2.a. Hydrological
2.b. Micro
2.c. atmosphere, lithosphere
2.d. nitrogen
2.e. bacteria

3.a.ii.

3.b.i.

3.c.ii.

3.d.i.

3.e.iii.

1.15 TECHNICAL WORDS

- **Environment**: The environment is the sum total of all conditions, agencies and influences which affect the development, growth, life and death of an organism, species or race.
- **Ecosystem**-Ecosystem is an organic community of plants and animals viewed within its physical environment or habitat.
- **Biogeochemical cycles**- Biogeochemical cycle is a pathway by which a chemical substance moves through both biotic and abiotic compartments of Earth.
- **Geosphere**-any of the almost spherical concentric regions of the earth and its atmosphere, especially the lithosphere

- **Biosphere**-the regions of the surface and atmosphere of the earth or another planet occupied by living organisms
- **Pedosphere**- It is derived from the Greek word ‘pedon’, meaning "soil" or "earth" and ‘sphaira’ meaning, "sphere". It is the outermost layer of the Earth that is composed of soil and subject to soil formation processes.
- **Hydrosphere**-all the waters on the earth's surface, such as lakes and seas, and sometimes including water over the earth's surface, such as clouds
- **Atmosphere**-the envelope of gases surrounding the earth or another planet
- **Bacterium/Bacteria(plural)-**a member of a large group of unicellular microorganisms which have cell walls but lack organelles and an organized nucleus, including some which can cause disease.
- **Nitrogen fixing**-The conversion of nitrogen in the atmosphere (N2) to a reduced form (e.g., amino groups of amino acids) that can be used as a nitrogen source by organisms.
- **Primary producers**- Organisms that produce organic compounds from atmospheric or aquatic carbon dioxide, principally through the process of photosynthesis. All life on earth is directly or indirectly reliant on primary production.
- **Trophic level**-A feeding level within a food web.

1.16 TASK

- Put some useful information and support your chart with a map of the location of the marine ecosystem.
- Put some useful information and support your chart with a map of the location of the forest ecosystem.

1.17 REFERENCES FOR FURTHER STUDY

- Environmental Studies, Bagad Anjali
- Sustainable Urban Environments: An Ecosystem Approach, Beuren, Allan et. Al.
- The Sage Handbook of Environment and Society, Ward, Hugh eds.
- Environment and Sustainable Development, Sundar, I.

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2

ECOSYSTEM

Unit Structures :

2.0 After going through this chapter you will be able to understand the following features:

2.1 Objectives

2.2 Introduction

2.3 Subject discussion

2.4 Ecosystem

2.4.1 Meaning

2.4.2 Components and Function

2.4.3. Ecological Pyramids and Productivity of Ecosystem

2.4.4. Functions of Ecosystem: Food Chain & Web, Energy Transfer,

2.5 Bio-geo-chemical cycles:

2.5.1 Hydrological cycle

2.5.2 Carbon cycle

2.5.3 Nitrogen cycle

2.6 Types of ecosystem:

2.6.1 Forest

2.6.2 Grassland

2.6.3 Desert

2.6.4 Fresh water

2.6.5 Marine

2.7 Summary

2.8 Check your Progress/Exercise

2.9 Answers to the self learning questions

2.10 Technical words and their meaning

2.11 Task

2.12 References for further study

2.1 OBJECTIVES

By the end of this unit you will be able to –

- Understand the concept, definition, of ecosystem.
- Know about different factors of eosystem
- Understand the bigeochemical cycle of ecosystem
- Learn Ecosystem, its meaning, components as well as function
- Study about Bio-geo-chemical cycles like Hydrological, Carbon and Nitrogen
- Learn types of ecosystem such as Forest, Grassland, Desert, Fresh water and Marine

2.2 INTRODUCTION

Environment is the source of life on the earth and determines the existence, growth and development of mankind and all its activities. At present the word Environment is often used almost by everybody around us. Television and newspapers are focusing different environment related news regularly. Debate is on as how to protect our environment. Global summits are held regularly to discuss the environmental issues. In this Chapter we will study Environmental Geography its definition, nature, scope and importance. We will also learn about different Natural and Man-made factors of environment along with the man-environment relationship. The need and importance of Environmental Geography will also be studied. In the latter part of this unit Ecosystem, its meaning, components as well as function will be learnt. After that we will study about Bio-geo-chemical cycles like Hydrological, Carbon and Nitrogen. Different types of ecosystem such as Forest, Grassland, Desert, Fresh water and Marine, an interesting part of the same has also been dealt in this chapter. With the development of modern technology, there is always a growing pressure on environment. This dynamic relation between man and environment has become the primary concern for everyone for the survival of the future generation.

2.3 SUBJECT-DISCUSSION

Down the ages humans have learnt to exist in a variety of locations on the earth. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. Many times, the bad changes were caused by humans making too much of a change in the environment, by using or abusing the natural resources. Every location where people have lived contained a community of plants, animals, insects, and other natural resources. A community of organisms, other natural resources, and their influence on each other is called an ecosystem. The plants and

animals existing in an ecosystem are those most adapted to that environment.

A growing human population presents increasing environmental challenges around the world. The study of Environment and Ecosystem helps in understanding the dynamics of ecology, environmental science, and conservation management of natural resources, wildlife and sustainable ecosystems and landscapes so that applicable solutions can be sought for.

2.4 ECOSYSTEM

Ecosystems can be of different sizes consisting of a community of organisms together with their physical environment. They can be marine, aquatic, or terrestrial. Broad categories of terrestrial ecosystems are called biomes. In ecosystems both matter and energy are conserved. Energy flows through the system usually from light to heat. But matter is recycled. Ecosystems with higher biodiversity tend to be more stable with greater resistance and resilience in the face of disturbances, disruptive events. In an ecosystem each organism plays its own role.

2.4.1 Meaning of Ecosystem:

According to Woodbury, "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". An ecosystem includes all the living things such as plants, animals and organisms in a given area, interacting with each other, and also with their non-living environments like weather, earth, sun, soil and climate. Ecosystems are the foundations of the biosphere and they determine the health of the entire earth system. Although a complete self-sufficient ecosystem is rarely found in nature but all the ecosystems of the earth are very well connected to each another such as river ecosystem is connected with the ecosystem of ocean.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment"

According to R. L. Lindeman (1942), the term ecosystem applies to "any system composed of physical-chemical-biological processes within a space-time unit of magnitude."

According to Monkhouse and Small, "ecosystem is an organic community of plants and animals viewed within its physical environment or habitat".

From the above definitions of ecosystem, the following basic properties emerge:

- Ecosystem of any given spatial- temporal unit represents the sum of all living organisms and physical environment.
- It is a well-defined area.

- It is an open system characterized by continuous input and output of the energy.
- It is mainly powered by solar energy.
- It is a functional unit.
- There is a complex interaction between the biotic and abiotic components.
- Ecosystems are natural system and well organized.

2.4.2 Components and Function of Ecosystem

2.4.2.1 Components of Ecosystem

An ecosystem is a functional and structural unit of Ecology. This implies that each ecosystem has a definite structure and components where each component part of the system has a definite role to play in the functioning of the ecosystem. Ecosystems have two major components. The living or biotic components like plants and animals; and the nonliving or abiotic components like water, air, nutrients and solar energy. These two parts of the ecosystem continuously interact with one another.

- From the structure point of view all ecosystems consist of the following basic components:

1. Abiotic components
2. Biotic components

1. Abiotic Components:

Abiotic component of ecosystem includes all the physical and chemical factors that influence living organisms, like air, water, soil, rocks etc. Thus, it is an assemblage of organic and inorganic substances present in an ecosystem. Basic inorganic elements and compounds are soil, water, oxygen, calcium carbonates, phosphates and a variety of organic compounds such as by-products of organic activities. The physical factors and ingredients like moisture, wind currents and solar radiation are also included in abiotic components. The various climatic factors that affect the ecosystem functioning are also a part of this. Without sunlight, water, air and minerals, life cannot exist. Hence the non-living components are essential for the living world.

2. Biotic Components:

The biotic components include all living organisms present in the environmental system. These can be classified as either producers or consumers, depending on how they get their food. From nutrition point of view, the biotic components can be grouped into two basic components:

a. Autotrophic components- The autotrophic components include all green plants which with the help of the radiant energy of sun manufacture food from inorganic substances.

b. Heterotrophic components-The heterotrophic components include non-green plants and all animals which take food from autotrophs.

- Thus biotic components of an ecosystem can be classified as under:

I. Producers (Autotrophic components)

II. Consumers

III. Decomposers or reducers and transformers

I. Producers (Autotrophic elements):

Producers can make the organic nutrients they need, using simple inorganic compounds in their environment: for instance, the green plants on land and the small algae in aquatic ecosystems produce their food by the process of photosynthesis. For this the radiant energy of sun is used in photosynthetic process whereby carbon dioxide is assimilated and the light energy is converted into chemical energy. Oxygen is evolved as by-product in the photosynthesis and used in respiration by all living things.

II. Consumers:

Those living members of ecosystem which consume the food synthesized by producers are called consumers. Consumers directly or indirectly depend on food provided by producers. All kinds of animals that are found in an ecosystem are called consumers. Depending on their food habits consumers can be further classified into four types such as:

a. Consumers of the first order or primary consumers

b. Consumers of the second order or secondary consumers

c. Consumers of the third order or tertiary consumers and Parasites, scavengers and saprobes.

d. Decomposers and transformers

a. Primary consumers:

These are purely herbivorous animals that are dependent for their food on producers or green plants. In a food chain, herbivores are referred to as the primary consumers. The herbivores serve as the chief food source for carnivores. Insects, goat, cow, rabbit, deer, buffalo are some of the common herbivores in the terrestrial ecosystem, and small crustaceans, molluscs, etc. in the aquatic habitat.

b. Secondary consumers:

These are carnivores and omnivores. Carnivores are flesh eating animals and they feed on herbivores (primary consumers). Examples of carnivores are lions, tigers. Whereas the omnivores are the animals that eat both plants and herbivores, e.g. pigs, rats, cockroaches and humans.

c. Tertiary consumers:

These are the top carnivores which prey upon other carnivores, omnivores and herbivores. Lions, tigers, hawk, vulture, etc. are considered as tertiary or top consumers.

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

d. Decomposers and transformers:

Decomposers digest the complex organic molecules in dead organic matter (detritus) into simpler inorganic compounds. They absorb the soluble nutrients as their food. Some examples are bacteria, fungi, and mites. The decomposers and transformers play very important role in maintaining the dynamic nature of ecosystems.

The most important part of each ecosystem is that it will have certain representative organisms playing each of the above mentioned roles.

2.4.2.2 Function of Ecosystem

Functions of Ecosystem

An ecosystem is a functional and life sustaining environmental system. The technical term 'Ecosystem function' is generally used to define the biological, geochemical and physical processes and components that take place or occur within an ecosystem. In other words it relate to the structural components of an ecosystem (e.g. vegetation, water, soil, atmosphere and biota) and how they interact with each other, within ecosystems and across ecosystems. Sometimes, ecosystem functions are called ecological processes. An ecosystem is a functional and life sustaining environmental system.

- In an ecosystem there are three functional components.

1. Inorganic constituents
2. Organism
3. Energy input

These three components interact with each other to form an environmental system. The primary producers convert inorganic constituents into organic components by photosynthesis using the energy from the solar radiations.

The herbivores make use of the energy from the producers and they themselves serve as a food for the carnivores. Animals of different types accumulate organic matter in their body which is taken as food. They are known as secondary producers. The dead organic matters of plants and animals are decomposed by bacteria and fungi which break the complex molecules and liberate inorganic components. These are known as decomposers. During this process some amount of energy is released in the form of heat. The ecosystem of different habitats is interrelated with one another.

Maintaining ecosystem function is important to maintaining the capacity of the region to supply ecosystem services. Those areas with high ecosystem function have the potential to contribute to a wide range of ecosystem services. But those areas showing few ecosystem functions are also important as they may provide important contributions to specific ecosystem services, or they may be important areas for rehabilitation.

2.4.3. Ecological Pyramids and Productivity of Ecosystem

Ecological Pyramid Definition

An ecological pyramid is a graphical representation of the relationship between different organisms in an ecosystem. Each of the bars that make up the pyramid represents a different trophic level, and their order, which is based on who eats whom, represents the flow of energy. Energy moves up the pyramid, starting with the primary producers, or autotrophs, such as plants and algae at the very bottom, followed by the primary consumers, which feed on these plants, then secondary consumers, which feed on the primary consumers, and so on. The height of the bars should all be the same, but the width of each bar is based on the quantity of the aspect being measured.

Types of Ecological Pyramids

Pyramid of numbers

This shows the number of organisms in each trophic level without any consideration for their size. This type of pyramid can be convenient, as counting is often a simple task and can be done over the years to observe the changes in a particular ecosystem. However, some types of organisms are difficult to count, especially when it comes to some juvenile forms. Unit: number of organisms.

Pyramid of biomass

This indicates the total mass of organisms at each trophic level. Usually, this type of pyramid is largest at the bottom and gets smaller going up, but exceptions do exist. The biomass of one trophic level is calculated by multiplying the number of individuals in the trophic level by the average mass of one individual in a particular area. This type of ecological pyramid solves some problems of the pyramid of numbers, as it shows a more accurate representation of the amount of energy contained in each

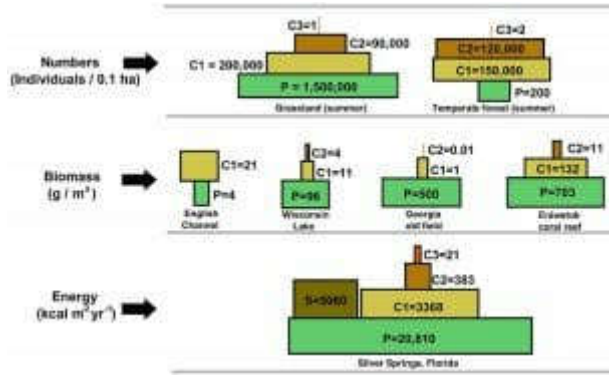
trophic level, but it has its own limitations. For example, the time of year when the data are gathered is very important, since different species have different breeding seasons. Also, since it's usually impossible to measure the mass of every single organism, only a sample is taken, possibly leading to inaccuracies. Unit: g m-2 or Kg m-2.

Pyramid of productivity

The pyramid of productivity looks at the total amount of energy present at each trophic level, as well as the loss of energy between trophic levels. Since this type of representation takes into account the fact that the majority of the energy present at one trophic level will not be available for the next one, it is more accurate than the other two pyramids. This idea is based on Lindeman's Ten Percent Law, which states that only about 10% of the energy in a trophic level will go towards creating biomass. In other words, only about 10% of the energy will go into making tissue, such as stems, leaves, muscles, etc. in the next trophic level. The rest is used in respiration, hunting, and other activities, or is lost to the surroundings as heat. What's interesting, however, is that toxins are passed up the pyramid very efficiently, which means that as we go up the ecological pyramid, the amount of harmful chemicals is more and more concentrated in the organisms' bodies. This is what we call biomagnification.

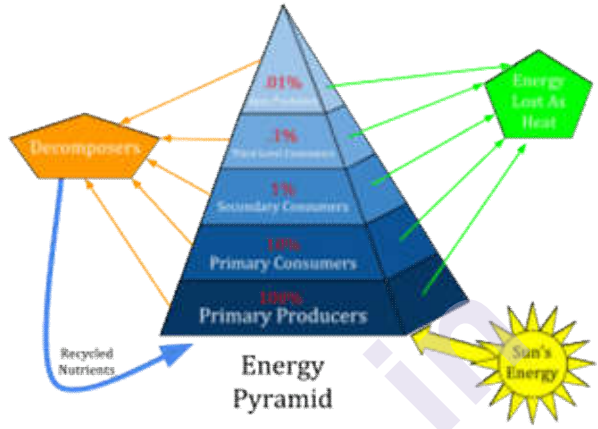
The pyramid of productivity is the most widely used type of ecological pyramid, and, unlike the two other types, can never be largest at the apex and smallest at the bottom. It's an important type of ecological pyramid because it examines the flow of energy in an ecosystem over time. Unit: J m-2 yr-1, where Joule is the unit for energy, which can be interchanged by other units of energy such as Kilojoule, Kilocalorie, and calorie.

While a productivity pyramid always takes an upright pyramid shape, number pyramids are sometimes inverted, or don't take the shape of an actual pyramid at all. To demonstrate, let's take an oak tree, which can feed millions of oakworms. If we consider this ecosystem as our focus, then the producers' level (one tree) will end up much smaller than the primary consumers' level (millions of insects). This is less likely to occur in biomass pyramids, but is not impossible. The pyramids below show the different types of pyramids and the shapes they can have in different ecosystems.



Ecological Pyramid Examples

The diagram below is an example of a productivity pyramid, otherwise called an energy pyramid. The sun has been included in this diagram, as it's the main source of all energy, as well the decomposers, like bacteria and fungi, which can acquire nutrients and energy from all trophic levels by breaking down dead or decaying organisms. As shown, the nutrients then go back into the soil and are taken up by plants.



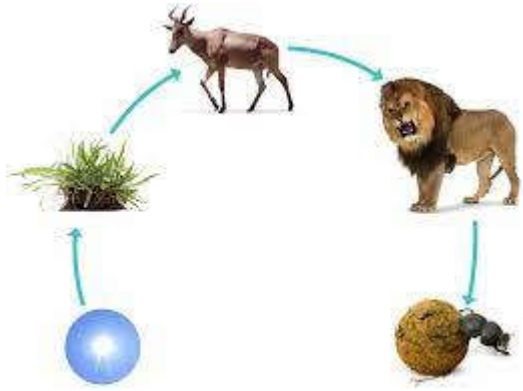
The loss of energy to the surroundings is also shown in this diagram, and the total energy transfer has been calculated. We start off with the total amount of energy that the primary producers contain, which is indicated by 100%. As we go up one level, 90% of that energy is used in ways other than to create flesh. What the primary consumers end up with is just 10% of the starting energy, and, 10% of that 10% is lost in the transfer to the next level. That's 1%, and so on. The predators at the apex, then, will only receive 0.01% of the starting energy! This inefficiency in the system is the reason why productivity pyramids are always upright.

2.4.5. Function of Ecosystem: Food Chain & Web, Energy Transfer

Food Chains

All living organisms (plants and animals) must eat some type of food for survival. Plants make their own food through a process called photosynthesis. Using the energy from the sun, water and carbon dioxide from the atmosphere and nutrients, they chemically make their own food. Since they make or produce their own food they are called producers. Organisms which do not create their own food must eat either plants or animals. They are called consumers. Some animals get their energy from eating plants while other animals get energy indirectly from plants by eating other animals that already ate the plants. Animals that eat only plants are called herbivores. Animals that eat both plants and other animals are called omnivores. Animals that eat only other animals are called carnivores. Some animals eat only dead or decaying materials and are called decomposers. In the marine food web, special producers are found. They are tiny microscopic plants called phytoplankton. Since the water is the home for these special tiny plants; it is also the home for tiny microscopic animals called zooplankton. And of course, zooplankton eat phytoplankton. Sometimes zooplankton and phytoplankton are

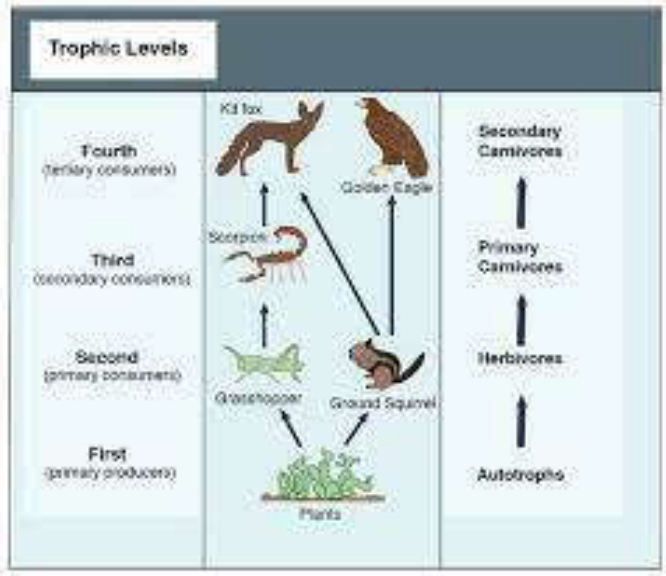
collectively referred to as plankton. Food chains show the relationships between producers, consumers, and decomposers, showing who eats whom with arrows. The arrows show the movement of energy through the food chain. For example, in the food chain shown below, the small fish (silverside) gets its energy by eating the plankton and the large fish (bluefish) gets its energy by eating the small fish. Finally, the bacteria eats the fish after it dies, getting its energy from the large fish. The bacteria also returns nutrients back to the environment for use by the phytoplankton.



Thus the food chain becomes a complete circle. Animals may eat more than one type of food. They may eat many different types of plants or many different animals. This makes everything more complicated and the food chain becomes a food web.

Food Webs

A food web is made up of interconnected food chains. Most communities include various populations of producer organisms which are eaten by any number of consumer populations. The green crab, for example, is a consumer as well as a decomposer. The crab will eat dead things or living things if it can catch them. A secondary consumer may also eat any number of primary consumers or producers. This non-linear set of interactions which shows the complex flow of energy in nature is more easily visualized in the following diagram. In a food web nutrients are recycled in the end by decomposers. Animals like shrimp and crabs can break the materials down to detritus. Then bacteria reduce the detritus to nutrients. Decomposers work at every level, setting free nutrients that form an essential part of the total food web.

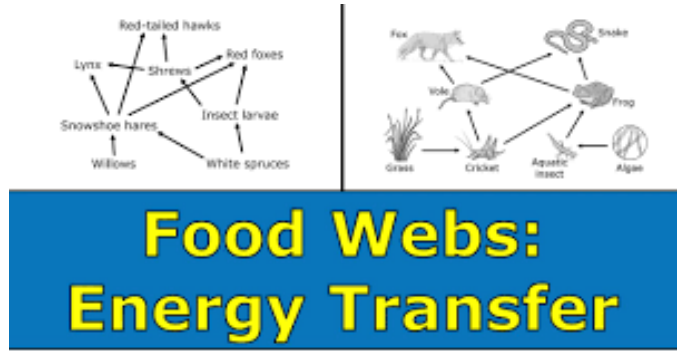


ENERGY LOSS IN THE FOOD CHAIN AND FOOD WEB

In a food chain, energy is lost in each step of the chain in two forms: first by the organism producing heat and doing work, and second, by the food that is not completely digested or absorbed. Therefore, the food web depends on a constant supply of energy from producers and nutrients that are recycled by the decomposition of organisms. As food is passed along the food chain, only about 10% of the energy is transferred to the next level. For example, 10% of the energy phytoplankton received from the sun can be used by zooplankton at the next level. From one level to the next about 90% of the energy used by the previous level is lost. This means that there has to be a lot more organisms at the lower levels than at the upper levels. The number of organisms at each level makes a pyramid shape and is called a food pyramid. To better understand this energy loss, it is helpful to look at a food pyramid.

Energy Transfer

Energy is transferred between organisms in food webs from producers to consumers. The energy is used by organisms to carry out complex tasks. The vast majority of energy that exists in food webs originates from the sun and is converted (transformed) into chemical energy by the process of photosynthesis in plants.



2.5 BIO-GEO-CHEMICAL CYCLES

A biogeochemical cycle is defined as the movement of elements such as hydrogen, oxygen, carbon, nitrogen, phosphorus and sulphur through organisms and the environment. It is a pathway by which a chemical substance moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.

The term biogeochemical is a contraction that refers to the consideration of the biological, geological, and chemical aspects of each cycle. 'Bio', the first part of the word 'biogeochemical', involves biological organisms, like bacteria, plants, and animals. The next part of the word, 'geo', involves geological processes, like weathering of rocks. The last part of the word 'chemical', indicates chemical processes, such as the formation of molecules.

In other words biogeochemical cycle is the way in which an element or compound such as water moves between its various living and nonliving forms and locations in the biosphere. For example water is always recycled through the water cycle. The water undergoes evaporation, condensation, and precipitation, falling back to Earth. The other important cycles are the carbon cycle, nitrogen cycle, oxygen cycle, phosphorus cycle, sulphur cycle etc.

2.10.1 Hydrological Cycle

The natural water cycle of the Earth is known as the hydrologic cycle. This describes the continuous movement of water on, above, and below the surface of the Earth. Water always changes its states between liquid, vapour and ice.

The hydrologic cycle begins with the evaporation of water from the surface of the ocean. It gets evaporated due to heat energy provided by solar radiation and forms water vapour. As water vapour is lifted to higher altitudes it cools and condenses to form clouds and precipitate in any form like rain, hail, snow, sleet. After the water reaches the ground some of the water evaporates back into the atmosphere or the water penetrates the surface and become groundwater. Groundwater either seeps its way to into the oceans, rivers, and streams, or is released back into the atmosphere through transpiration. The water remains on the earth's surface as runoff and empties into lakes, rivers and streams. This is carried back to the oceans. From the oceans the water cycle begins again.

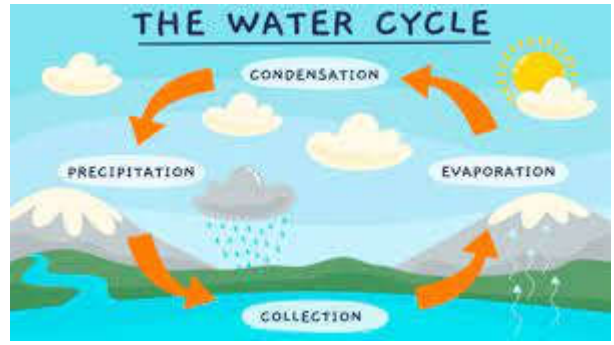


Fig of Water Cycle

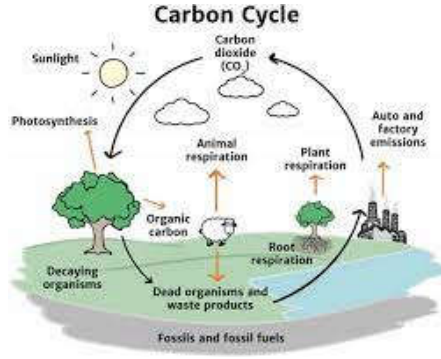
2.10.1 Carbon Cycle

Carbon is present throughout the natural environment in a fixed amount. Carbon is a part of the ocean, air, and rocks. In the atmosphere, carbon is attached to some oxygen in a gas called carbon dioxide. All living things are made of carbon. Hence it is an essential element in the bodies of living organisms.

Carbon takes many forms and moves through the environment via the carbon cycle. Thus the carbon cycle is the circulation and transformation of carbon back and forth between living things and the environment. The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.

Plants use carbon dioxide and sunlight to make their own food and grow. The carbon becomes part of the plant. Plants that die and are buried may turn into fossil fuels made of carbon like coal and oil over millions of years. When humans burn fossil fuels, most of the carbon quickly enters the atmosphere as carbon dioxide.

Carbon dioxide is a greenhouse gas and traps heat in the atmosphere. Without it and other greenhouse gases, Earth would be a frozen world.



2.10.3 Nitrogen Cycle

Nitrogen is essential for the formation of amino acids in proteins. 78% of the air in our atmosphere is made of nitrogen. The nitrogen cycle is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature by which nitrogen is converted

into various chemical forms as it circulates among the atmosphere, terrestrial, and marine ecosystems. Even though all animals need nitrogen to produce proteins necessary for life, animals cannot use the nitrogen in the "free" form from the atmosphere. They must consume nitrogen by eating nitrogen compounds. Four processes involved in the Nitrogen Cycle are stated under:

a. Nitrogen Fixation

b. Digestion

c. Decomposition

d. Waste production

a. Nitrogen Fixation :

The nitrogen cycle shows how the free nitrogen in the air is turned into nitrogen compounds and put into the soil by "nitrogen fixing bacteria". This process is known as Nitrogen Fixation.

Bacteria play the most important part of the cycle. When nitrogen is absorbed by the soil, different bacteria help it to change states so it can be absorbed by plants. Animals then get their nitrogen from the plants. For example, plants that soak up the nitrogen compounds in the soil are called legumes such as Oats, Peas, Beans and starchy vegetables like Corn.

b. Digestion

Animals eat the legumes to get the nitrogen compounds they need to produce protein.

c. Decomposition

When animals die, bacteria called decomposers break down the organic matter (plants, animals) chemically into all the simple elements that they are made of and these elements return back to the environment.

For example: When an animal dies all the carbon, oxygen, nitrogen, water, calcium etc. return to the soil and air during decomposition.

d. Waste Production

The bowel movement of an animal is the waste that is loaded with nitrogen. This nitrogen returns to the soil. Nitrogen is a significant fertilizer.

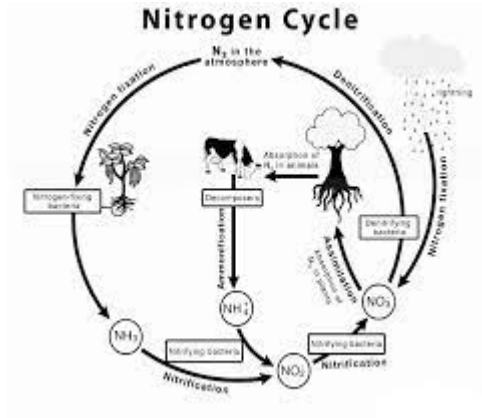


Fig of Carbon Cycle

2.11 TYPES OF ECOSYSTEM

There are many types of ecosystems and it is not possible to classify all of them. There are essentially two kinds of ecosystems; Aquatic and Terrestrial. Any other sub-ecosystem falls under one of these two headings.

2.11.1 Forest Ecosystem

Large group of trees shrubs, the leaf mulch on the floor and the plants that live in tandem with the trees belong to the forest ecosystem. It also includes the animals that live in the forest. For example, birds nest in the trees of a forest, members of the fungus kingdom grow on the forest floor, and a variety of insects and mammals also take up their homes in a forest. Thus a forest ecosystem is a community of organisms that lives within a forest. Forest ecosystems are very important as they are the lungs of the world. The forests release oxygen. Forest ecosystems are very rich and diverse.

There are various types of forest ecosystem throughout the world. Types of forest ecosystem are as follows:

i. **Rainforests**:

Rainforests is one of the most biodiverse ecosystems on the planet. Rainforests are often based around rivers. Amazon is an important example. The north-eastern part of India is rich in rainforests.

ii. **Mangroves**:

Mangroves are a unique mix of trees and tidal swamps.

iii. **Inland forests**:

Innumerable mainland animals and birds like foxes and owls are found in Inland forests which may be vast and ancient, or smaller like copses.

iv. **The Taiga**:

The taiga is the name for the sparse forest right towards the polar regions of the world.

v. Lakeside forests:

Lakeside forest ecosystems are very humid. Water birds and other water wildlife can be found here.

vi. Mountain forests:

The forests that grow on mountains like mountain pines create Mountain forests ecosystems like the Himalayan mountain forests in India.

- Characteristics of forest ecosystem are discussed below.

a. Seasonality: In countries that have seasonal climates, forest ecosystems will change with the seasons.

b. Deciduous or evergreen: A forest may be deciduous or evergreen, or it may be a mix of both deciduous and evergreen trees.

c. Different levels: Some forest ecosystems feature several distinct levels – such as the forest floor, the lower canopy, the upper canopy and the tree tops, such as rain forests.

d. Attractive to birds and insects: as they make their homes in forests.

e. Homes for humans.

f. Protect the Earth from desertification by providing a shield against winds.

2.11.2 Grassland ecosystems

The grassland ecosystems are composed largely of wide swathes of grass rather than trees or shrubs. A grassland ecosystem is a community of creatures such as various types of grasses, insects, and animals, etc. living together within a grassy space. Grassland ecosystems are extremely bio-diverse and are home to thriving communities of plants, animals, insects and mammals. Grassland ecosystems are present in every single continent on this planet with the sole exception of Antarctica, which is too cold to sustain a grassland ecosystem.

- Grassland ecosystems can be found throughout the world, for example:

a. In the tropics near to the equator.

b. In the temperate zones of the earth, between the equator and the polar Regions.

Grassland ecosystems are found in many shapes and sizes. However, climate change, intensive farming and urban sprawl are all threatening our beautiful grassland ecosystems.

2.11.3 Desert ecosystem

A desert is a place that is difficult to inhabit. A desert ecosystem is a community of organisms that live together in an environment that seems to be deserted wasteland. Desert ecosystems can be hot as found in the sandy Sahara or cold as on the peaks of mountains. Both in hot and cold

deserts it is difficult for organisms to inhabit. A desert ecosystem generally witnesses little rainfall, resulting in less vegetation.

- In a desert ecosystem following things may be observed.

i. Numerous insects living in communities.

ii. An abundance of plant life.

iii. Mammals and birds.

iv. Micro organisms such as bacteria are also present in this ecosystem.

- There are so many different types of desert ecosystems. Types of desert ecosystems are stated under.

1. Hot deserts:

Hot deserts, for example Sahara, are found close to the equator. The plants and animals that live here have evolved in order to adapt to very hot conditions present over there.

2. Cold deserts:

When desertification exists at high altitudes the desert will be cold. A cold desert may be sandy or rocky. Here organisms have adapted the harsh environment to survive.

3. Ice deserts:

Ice deserts are another type of cold desert. This is an uninhabited region that is composed of ice. Ice deserts can be found towards the north and south poles of the planet.

2.11.4. Freshwater Ecosystems

Freshwater ecosystems are a subset of Earth's aquatic ecosystems. They include lakes and ponds, rivers, streams, springs, and wetlands**.**

- Freshwater ecosystems include:

a. sluggish waters of lakes and ponds

b. moving waters of rivers and streams

c. Wetlands which are the areas of land periodically covered by water.

a. Ponds and Lakes Ecosystems – Lakes are large bodies of freshwater surrounded by land, while ponds are smaller bodies of water surrounded by land. Lake Baikal is the biggest lake on Earth and contains about one fifth of the Earth’s freshwater. Most of the time they include various types of plants, amphibians and insects and fishes.

b. River Ecosystems – Rivers always link to the sea so they are more likely to contain fish alongside the usual plants, amphibians and insects.

These sorts of ecosystems can also include birds because birds often hunt in and around water for small fish or insects.

- There are 3 main groups of organisms in the freshwater ecosystem:

i. **Plankton** - organisms that float near the surface of the water

ii. **Nekton** – free-swimming organisms

iii. **Benthos** – bottom-dwelling organisms

Freshwater ecosystems are the smallest of the three major classes of ecosystems, accounting for just 2.8% of the total of the Earth's surface. The smallest living part of the food web of these sorts of ecosystems is plankton, a small organism that is often eaten by fish and other small creatures.

2.11.5 Marine Ecosystem

Earth's largest aquatic ecosystems are the Marine ecosystems. Salt marshes, intertidal zones, estuaries, lagoons, mangroves, coral reefs, the deep sea, and the sea floor are included in the Marine ecosystems. They can be contrasted with freshwater ecosystems, which have a lower salt content. Marine waters cover two-thirds of the surface of the Earth and it is the complex of living organisms in the ocean environment. Moreover such places are considered ecosystems because the plant life supports the animal life and vice versa. Marine organisms are not distributed evenly throughout the oceans. The availability of light, water depth, proximity to land, and topographic complexity all affect marine habitats.

2.12 SUMMARY

Environment is the source of life on the earth and determines the existence, growth and development of mankind and all its activities. The interaction of humans with the environment (surroundings) in these locations has often brought major changes in that environment. Some changes were good, some were bad. The environment is a complex of many variables which surrounds man as well as all living organisms. The environment is complex, dynamic and systematic in nature. The biotic components and abiotic components together make up the environments. There exists man made environment that is helping man to lead a smooth life.

Environmental geography is broadly experiential so students have more of a diverse learning experience. It will also help the students to understand human behaviour and the extent to which this behaviour differs in regards to the environment. Thus they will develop cultural awareness. No matter how modern and manufactured world we live in mankind will forever rely on the environment.

The term ecosystem was coined by A.G. Tansley in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment". Ecosystems maintain themselves by

cycling energy and nutrients obtained from external sources. There are different trophic levels that exist in an ecosystem. The ecosystem of different habitats is interrelated with one another. Important differences among the various components that make up an ecosystem like of Forest, Grassland, Desert, Fresh water and Marine tells us that ecosystems are not just habitats for animals. Many human communities live in there all over the world.

2.13 CHECK YOUR PROGRESS/ EXERCISE

1. True and false

a. The scope of environment lies in the components of environment.

b. Micro environment refers to all the physical and biotic conditions that surround the organism externally.

c. Relative location is referred to the actual location on Earth's surface with respect to geographical coordinates (in terms of latitudes and longitudes).

d. Lake Baikal is the biggest lake on Earth and contains about one fifth of the Earth's freshwater.

e. Plants use carbon dioxide and sunlight to make their own food and grow.

2. Fill in the blanks

a. The _____ cycle is the best example of a systematic environment.

b. _____ environment refers to the immediate local surrounding of the organism.

c. Physical environment comprises of _____, _____ and hydrosphere.

d. 78% of the air in our atmosphere is made of_____.

e. When nitrogen is absorbed by the soil, different _____ help it to change states so it can be absorbed by plants.

3. Multiple choice question

a. Environmental geography, one of the branches of geography,

i. comes in parts of medical geography and physical geography.

ii. comes in parts of human geography and physical geography

iii. comes in parts of human geography and economic geography

b. Relative location can be defined

i. as the location with reference to a reference point.

ii. as the actual location on Earth's surface with respect to geographical coordinates

iii. as a particular place or position usually on the outskirts of a town or city.

c. Abiotic component of ecosystem includes

i. all the physical and chemical factors that influence only soil

ii. all the physical and chemical factors that influence living organisms, like air, water, soil, rocks etc

iii. all political factors that influence living organisms, like air, water, soil, rocks etc.

d. The autotrophic components include

i. all green plants

ii. non-green plants and all animals

iii. all animals

iv.

e. All kinds of animals that are found in an ecosystem are called

i. reducers

ii. producers

iii. consumers

4. Answer the Following Questions

1. Define Environmental Geography and state its nature and scope.
2. What are the different Factors of environment?
3. Write a short note on Man-Environment relationship.
4. Define Biotic factors. Elaborate your answer with suitable examples.
5. What do you understand by the term 'Ecosystem'? State the Components and Function of ecosystem.
6. Define Bio-geo-chemical cycles. Elaborate your answer with examples.
7. Write short notes on:
   a. Hydrological cycle
   b. Carbon cycle
   c. Forest ecosystem
   d. Grassland ecosystem
   e. Physiographic factors of environment

2.14 ANSWERS TO THE SELF LEARNING QUESTIONS

2.a. True

2.b. False, Macro

2.c. False, Absolute

2.d. True

2.e. True

2.a. Hydrological
2.b. Micro
2.c. atmosphere, lithosphere
2.d. nitrogen
2.e. bacteria

3.a.ii.

3.b.i.

3.c.ii.

3.d.i.

3.e.iii.

2.15 TECHNICAL WORDS

- **Environment**: The environment is the sum total of all conditions, agencies and influences which affect the development, growth, life and death of an organism, species or race.
- **Ecosystem**-Ecosystem is an organic community of plants and animals viewed within its physical environment or habitat.
- **Biogeochemical cycles**- Biogeochemical cycle is a pathway by which a chemical substance moves through both biotic and abiotic compartments of Earth.
- **Geosphere**-any of the almost spherical concentric regions of the earth and its atmosphere, especially the lithosphere
- **Biosphere**-the regions of the surface and atmosphere of the earth or another planet occupied by living organisms
- **Pedosphere**- It is derived from the Greek word ‘pedon’, meaning "soil" or "earth" and ‘sphaira’ meaning, "sphere". It is the outermost layer of the Earth that is composed of soil and subject to soil formation processes.
- **Hydrosphere**-all the waters on the earth's surface, such as lakes and seas, and sometimes including water over the earth's surface, such as clouds

- **Atmosphere**-the envelope of gases surrounding the earth or another planet
- **Bacterium/Bacteria(plural)-**a member of a large group of unicellular microorganisms which have cell walls but lack organelles and an organized nucleus, including some which can cause disease.
- **Nitrogen fixing**-The conversion of nitrogen in the atmosphere (N2) to a reduced form (e.g., amino groups of amino acids) that can be used as a nitrogen source by organisms.
- **Primary producers**- Organisms that produce organic compounds from atmospheric or aquatic carbon dioxide, principally through the process of photosynthesis. All life on earth is directly or indirectly reliant on primary production.
- **Trophic level**-A feeding level within a food web.

2.16 TASK

- Put some useful information and support your chart with a map of the location of the marine ecosystem.
- Put some useful information and support your chart with a map of the location of the forest ecosystem.

2.17 REFERENCES FOR FURTHER STUDY

- Environmental Studies, Bagad Anjali
- Sustainable Urban Environments: An Ecosystem Approach, Beuren, Allan et. Al.
- The Sage Handbook of Environment and Society, Ward, Hugh eds.
- Environment and Sustainable Development, Sundar, I.

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3

BIO-DIVERSITY

Unit Structure :

3.0 After going through this chapter you will be able to understand the following features**:**

3.1 Objectives

3.2 Introduction

3.3 Subject discussion

3.4 Bio-diversity

3.4.1 Concept

3.4.2 Types

3.4.3 Hotspots of Bio-diversity

3.4.4 Biodiversity in India with emphasis on Western Ghat

3.4.5. Threat to Biodiversity: Causes

3.4.6. Conservation of Biodiversity and Management of Biological Reserves

3.5 Summary

3.6 Check your Progress/Exercise

3.7 Answers to the self learning questions

3.8 Technical words and their meaning

3.9 Task

3.10 References for further study

3.1 OBJECTIVE

By the end of this unit you will be able to –

- Understand Bio-diversity its Concept and Types
- Learn Hotspots of Bio-diversity and Biodiversity in India with emphasis on Western Ghat

3.2 INTRODUCTION

In the previous chapter we have learnt the definition of Environmental Geography along with its Nature and Scope.

Factors of environment and the relationship between Man- Environment have also been learnt. We have discussed Ecosystem its meaning, components and function. Various types of Bio-geo- chemical cycles and ecosystem were also studied in the previous chapter. In this chapter we will study the concept of resources at first followed by the classification of resources and Environmental problems associated with Forest. Next we will learn conservation and sustainable use of resources like water, minerals. In the latter part of this second unit bio-diversity, its concept and types along with hotspots of bio-diversity and biodiversity in India with emphasis on Western Ghat will be studied.

3.3 SUBJECT DISCUSSION

The well-being of our society depends on the resources provided by the earth. Typically, resources are materials, energy, services, staff, knowledge, or other assets that are transformed to produce benefit or satisfaction of human beings. This is a neutral stuff until some technical skills are found to extract it from nature. Therefore in order to become a resource, the thing or substance must possess two properties i.e. functionality and utility. The exploitation of nature and natural resources can be dated back to the advent of mankind and the very start of civilization. But the present increase in population along with industrial growth has given rise to the unlimited use of resources. Thus disrupting ecosystems and exhausting resources.

Due to deforestation the world loses more than 23 million acres of forest area every year. Thus we should try utmost to reverse deforestation and protect the world's remaining forests intact. The plants and animals in the bits of forest that remain become increasingly vulnerable, sometimes even committed, to extinction. Water resources are playing considerable roles in the socio-economic development of any region. Water issues affect us all as it is estimated that below 900 million people lack reliable access of safe water worldwide. A thriving ecosystem depends on water immensely. Release of mining wastes can also affect habitats. Therefore we should take a conscious effort for the conservation and sustainable use of resources. From a human perspective proper utilization of natural resources will lead to the increase of wealth and meet our needs. From a broader biological or ecological perspective, a resource satisfies the needs of a living organism.

3.4 BIO DIVERSITY

Concept of biodiversity :

Our ecosystems provide us with food, medicine, clean air and water, recreation, and spiritual and aesthetical inspiration. Hence the human species cannot exist without its surrounding ecosystems. Biodiversity is the sum of all the different species of animals, plants, fungi and microbial organisms living on Earth and the variety of habitats in which they live.

3.4.1 Concept

Biodiversity is the contracted form of biological diversity that means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems. This also includes the ecological complexes of which they are a part as well as diversity within species, between species and of ecosystems. Scientists estimate that more than 10 million different species inhabit Earth.

Biodiversity being a broad term may be measured at a number of organizational levels. Traditionally, ecologists have measured biodiversity by taking into account both the number of species and the number of individuals of each species. This is known as relative abundance. On the other hand, biologists use different measures of biodiversity that includes genetic diversity to preserve the biologically and technologically important elements of biodiversity.

Biodiversity loss refers to the reduction of biodiversity due to displacement or extinction of species. The loss of a particular individual species, especially if it is not a charismatic species like the Bengal tiger, may appear as unimportant to some people. However, the current accelerated extinction rate means the loss of tens of thousands of species within our lifetimes.

Scientists have discovered and named only 1.75 million species which is actually less than 20 percent of those estimated to exist. This estimation states that the greatest value of biodiversity is yet to be known. Most biologists agree that much of Earth's great biodiversity such as species of plants, animals, fungi and microscopic organisms such as bacteria is rapidly disappearing. So scientists are putting stress on their researches and studying global biodiversity aiming at better understanding and slow the rate of loss.

Benefits of biodiversity

The following are some of the benefits of biodiversity:

- Provisioning services such as food, clean water, timber, fibre and genetic resources
- Regulating services such as climate, floods, disease, water quality and pollination

- Cultural services such as recreational, aesthetic and spiritual benefits
- Supporting services such as soil formation and nutrient cycling

3.4.2 Types of biodiversity

- Biodiversity includes three main types:

i. diversity within species or genetic diversity

ii. between species or species diversity and

iii. between ecosystems or ecosystem diversity

Genetic Diversity

Genetic diversity means the total number of genetic characteristics in the genetic makeup of a species. Every species on Earth is related to every other species through genetic connections. Each individual species possesses genes which are the source of its own unique features. Therefore the more closely related any two species are, the more genetic information they will share, and the more similar they will appear. For example in human beings the huge variety of people's faces reflects each person's genetic individuality. While all species have descended from a single, common ancestor, species diverge and develop their own peculiar attributes with time, thus making their own contribution to biodiversity.

- The two reasons for differences between individual organisms are:

a. the variation in the gene which all organisms possess and is passed from one to its offspring's

b. the influence of environment on each individual organism.

Species Diversity

The diversity of creatures roaming in our Earth is absolutely astonishing. Species diversity is defined as the number of species and abundance of each species living within a particular habitat or a region. Species are the basic units of biological classification. Hence are the normal measures of biological diversity. The number of different species in a given area is called species richness. So when we measure the species richness of a forest, we will find 20 bird species, 50 plant species, and 10 mammal species. Species endemism is another term that is used to measure biodiversity by way of assessing the magnitude of differences between species.

Abundance is the number of individuals of each species. Species diversity may be of small scale such as a forest or of a large scale such as the total diversity of species living on Earth

Ecological Diversity

Ecological diversity refers to the number of species in a community of organisms and the dynamic interplay between them. It is the variation

in the ecosystems found in a region or the variation in ecosystems over the whole planet. An ecosystem consists of organisms from many different species living together in

a region and their connections through the flow of energy, nutrients and matter. Those connections occur as the organisms of different species interact with one another. Measuring ecological diversity is difficult because each of Earth's ecosystems merges into the ecosystems around it.

3.4.3 Hotspots of Bio-diversity

There are places on Earth that are biologically rich but deeply threatened, so we must take some effort to protect them. Hotspots of bio-diversity are large regions that contain exceptional concentrations of plant endemism and experience high rates of habitat loss. By the method Biodiversity hotspots those regions of the world are identified where attention is needed to address biodiversity loss. It also guides investments in conservation. The idea was first developed by Norman Myers in 1988 to identify tropical forest 'hotspots' characterized both by exceptional levels of plant endemism and serious habitat loss. To trunk this crisis, we must protect those places where biodiversity lives. It is observed that species are unevenly distributed around the planet. Certain areas have large numbers of endemic species which are not found anywhere else. Many of these are heavily threatened by habitat loss and other human activities. These areas are the biodiversity hotspots. Currently, 35 biodiversity hotspots have been identified. Most of them occur in tropical forests and represent just 3.3% of Earth's land surface. Among them they contain around 50% of the world's endemic plant species and 42% of all terrestrial vertebrates.

3.4.4 Biodiversity in India with emphasis on Western Ghat

India is one of the 12 mega biodiversity centres of the world.

The country is divided into 10 biogeographic regions such as:

1. Trans Himalayas
2. Himalayan
3. Indian desert
4. Semi-arid zone
5. Western Ghats
6. Deccan peninsula
7. Gangetic plains
8. North-East India
9. islands
10. coasts

The hill chain of the Western Ghats constitutes the Malabar province. It runs parallel to the west coast of India. Biogeographically, the Western

Ghats represents 4% of India's land region that experiences high torrential rainfall as well as monsoon and tropical climate and high variation in wind speed. All these features have marked this region as one of the ten bio-geographic zones in India.

The Western Ghats is considered to be one among the hotspots in the world. This bioregion is highly species rich. But it is constantly facing severe threats because nearly 40% of the total number of species is endemic. In a in a 17,000 sq. km strip of forest along the seaward side of the Western Ghats in Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala there are 15,000 plant species with 5,000 endemics (33%), 4,050 plants with 1,600 endemics (40%) .

The rain forests of the Western Ghats exist in an environment where there is considerable seasonality in distribution of the rainfall. The high altitudinal zone also gives rise to a kind of forest which has primarily Lauraceous vegetation. Moreover the parent rocks in these areas have given rise to soils which are rich in nutrients and have a very high moisture holding capacity. All these elements have given rise to the tropical rain forests of the Western Ghats which has diversity in vegetation types.

Vegetation types such as Wet evergreen, Dry evergreen, Moist deciduous and Dry deciduous are classified based on mean annual rainfall. Forest tracts up to 500 m in elevation are mostly evergreen. This comprises one fifth of the entire forest expanse of the Western Ghats. The forest regions in the 500-1500 m range are semi-evergreen. Whereas, low, medium and high elevation wet evergreen forest types are distinguished by low minimum temperature with increasing altitude. Among these there are two major centres of diversity, the Agasthyamalai Hills and the Silent Valley or New Amarambalam Reserve basin.

Flora and Fauna of the Western Ghats

The area has an estimated 3,00,000 hectare (37%) under forest cover and is characterised by a rich diversity of flora and fauna.

- **Flowering plants**: 7402 species of flowering plants are known from the Western Ghats. Recent studies have suggested that there could be 2300 species of flowering plants endemic to the Western Ghats.
- **Amphibians**: Over 117 species belonging to 21 genera are recorded in the forests and coastal areas of this region, of which 76% are endemic to the region.
- **Invertebrates**: A large variety of insects including some of the spectacular butterflies and moths occur in the dense evergreen highland and lowland forests. It is estimated that India has over 1,400 species of which the Western Ghats harbour nearly 320 species including 37 endemics and 23 others shared with Sri Lanka. The area is host to a large variety of fresh water mollusca, some of which are specific to the region.

- **Fish**: There is a wide variety of fish available from fresh water montane, lowland river streams and water bodies as well as coastal lagoons and backwaters. Around 218 species of primary and secondary freshwater fishes in the Western Ghats are found. About 53% of all fish species (116 species in 51 genera) in the Western Ghats are endemic. Sixteen out of 20species of Caecilians known in India occur in the Western Ghats; all 16 being endemic.

- **Reptiles**: 157 species of reptiles are found in the Western Ghats. Majority of the reptile species are snakes. Dense forests of the region are the home of the King Cobra and Rock Python apart from other smaller reptiles. In all 97 species, representing 36 genera (2 genera of turtle/tortoise, 20 snakes, 14 lizards) are endemic. Among the tortoises the endemic cane turtle, and terrapin are found in the Western Ghats. The marsh crocodile or mugger was once widely distributed in swamps and larger water bodies of the forested areas.

- **Birds**: About 508 species of birds occur in the Western Ghats (590 if sub-species are included). Among them 144 are aquatic or coastal birds. Nineteen species are considered to be endemic to the Western Ghats. Many endemic birds are exclusive to evergreen and Shola forests.

- **Mammals**: 120 species of mammals are reported from the Western Ghats of which, 14 are considered to be endemic to the Western Ghats. The forests of the area have large herbivores such as gaur, spotted deer, sambar, barking deer, elephant, etc. Carnivores are represented by tiger, leopard, jungle cat, leopard cat, fishing cat, Malabar civet, brown palm civet, small Indian civet, two species of mongoose and wild dog.

  With rapid developmental activities, agricultural expansion and uncontrolled human population explosion, there have been significant declining trend in the diversity of both flora and fauna in the Western Ghats. As per recent records, 496 plant species, 91 amphibians, 41 mammals, 22 birds, 8 fishes, 6 reptiles 300 and 3 insect species are considered as threatened, as per IUCN Red Data List, in the Western Ghats. Further, 51 species are critically endangered, 125 are endangered and 127 are in vulnerable category.

3.4.5 Threat to Biodiversity- Causes

Some of the main threats to biodiversity are:

1. Human Activities and Loss of Habitat,
3. Deforestation,
3. Desertification,
4. Marine Environment,
5. Increasing Wildlife Trade and
6. Climate Change.

1. Human Activities and Loss of Habitat:

Human activities are causing a loss of biological diversity among animals and plants globally estimated at 50 to 100 times the average rate of species loss in the absence of human activities. Two most popular species in rich biomes are tropical forests and coral reefs.

Tropical forests are under threat largely from conversion to other land-uses, while coral reefs are experiencing increasing levels of over exploitation and pollution. If current rate of loss of tropical forests continues for the next 30 years (about 1 percent per year), the projected number of species that the remaining forests could support would be reduced by 5 to 10 percent relative to the forest in the absence of human disturbance.

The rate of decline would represent 1000 to 10,000 times the expected rate of extinction without deforestation by humans. Some studies suggest that, globally, as many as one half of all mammal and bird species may become extinct within 200 to 300 years.

Biodiversity loss can result from a number of activities, including:

(a) Habitat conversion and destruction;

(b) Over-exploitation of species;

(c) Disconnected patches of original vegetation; and

(d) Air and water pollution.

Over the coming decades, human-inducted climate change increasingly become another major factor in reducing biological/biodiversity. These pressures on biodiversity are, to a large extent, driven by economic development and related demands including the increasing demand for biological resources.

Activities that reduce biodiversity, jeopardize economic development and human health through losses of useful materials, genetic stocks, and the services of intact ecosystems. Material losses include food, wood, and medicines, as well as resources important for recreation and tourism. Losing genetic diversity, like losing species diversity, makes it even more likely that further environmental disturbance will result in serious reductions in goods and services that ecosystems can provide.

3. Deforestation:

Forest ecosystems contain as much as 80 percent of the world's terrestrial biodiversity and provide wood fiber and biomass energy as well as critical components of the global cycles of water, energy and nutrient. Forest ecosystems are being cleared and degraded in many parts of the world.

3. Desertification:

Desertification and deforestation are the main causes of biodiversity loss. Both processes are decisively influenced by the extension of agriculture. The direct cost of deforestation is reflected in the loss of valuable plants and animal species. Desertification process is the result of poor land management which can be aggravated by climatic variations. Converting wild lands to agriculture often involves ploughing the soils which leads in temperate regions to an average decline in soil organic matter between 25 and 40 per cent over twenty five years.

4. Marine Environment:

Oceans play a vital role in the global environment. Covering 70 per cent of the earth's surface, they influence global climate, food production and economic activities. Despite these roles, coastal and marine environment are being rapidly degraded in many parts of the globe.

5. Increasing Wildlife Trade:

According to Nick Barnes, "Trade is another cause of biodiversity depletion that gives rise to conflict between North and South." Global trade in wildlife is estimated to be over US $ 20 billion annually. Global trade includes at least 40,000 primates, ivory from at least 90,000 African elephants, 1 million orchids, 4 million live birds, 10 million reptile skins, 15 million furs and over 350 million tropical fish.

6. Climate Change:

As climate warms, species will migrate towards higher latitudes and altitudes in both hemisphere. The increase in the amount of CO2 in the air affects the physiological functioning of plant and species composition. Moreover, aquatic ecosystems, particularly coral reefs, mangrove swamps, and coastal wetlands, are vulnerable to changes in climate.

In principle, coral reefs, the most biologically diverse marine systems, are potentially vulnerable to changes in both sea level and ocean temperature. While most coral systems should be able to grow at a sufficient pace to survive a 15 to 95 centimeter sea-level rise over the next century, a sustained increase of several degrees centigrade would threaten the long-term viability of many of these systems.

3.4.6 Biodiversity- Conservation

Definition of Biodiversity Conservation

"Protection, restoration, and management of biodiversity in order to derive sustainable benefits for present and future generations.". Or, it can also be defined as, "the totality of genes, species, and ecosystems in a defined area.".

Conservation of Biodiversity

Biodiversity conservation refers to the protection, preservation, and management of ecosystems and natural habitats and ensuring that they are healthy and functional.

- The three main objectives of Biodiversity Conservation are as follows-
- To protect and preserve species diversity.
- To ensure sustainable management of the species and ecosystems.
- Prevention and restoration of ecological processes and life support systems.

Biodiversity Conservation Methods

Two types of methods are employed to conserve biodiversity. They are-

In situ conservation and

Ex-situ conservation.

Following are some of the ways through which Biodiversity can be conserved:

- In-situ Conservation
- Ex-situ Conservation

In Situ Conservation

In Situ Conservation refers to the preservation and protection of the species in their natural habitat. It means the conservation of genetic resources in natural populations of plant or animal species. In situ conservation involves the management of biodiversity in the same area where it is found.

- In situ, biodiversity conservation has many advantages
- It preserves species as well as their natural habitat.
- It ensures protection to a large number of populations.
- It is economic and a convenient method of conservation
- It doesn't require species to adjust to a new habitat.

Different methods of In-situ conservation include biosphere reserves, national parks, wildlife sanctuaries, biodiversity hotspots, gene sanctuary, and sacred groves.

It is defined as the conservation of species within their natural habitat, where the natural ecosystem is protected and maintained.

- In-situ conservation possesses numerous advantages. Some of the important advantages of in-situ conservation are as follows:
- It is a cost-effective and convenient way of biodiversity conservation.
- Various living organisms can be conserved at the same time.
- They can evolve better and can easily get adapted to various environmental conditions.
- In-situ conservation occurs in places like national parks, wildlife sanctuaries, and biosphere reserves.

Biosphere Reserves

These are national governments nominated sites, large areas (often up to 5000 square km) of an ecosystem where the traditional lifestyle and natural habitat of the inhabitants of that ecosystem are protected. They are mostly open to tourists and researchers.

Example- Sundarban, Nanda Devi, Nokrek, and Manas in India.

National Parks

These are limited reserves maintained by the government for the conservation of wildlife as well as the environment. Human activities are prohibited in national parks and they are solely dedicated to the protection of natural fauna of the area. They mostly occupy an area of 100-500 square km. There are a total of 104 national parks in India, right now. The national parks may even be within a biosphere reserve. These are small reserves that are protected and maintained by the government. Its boundaries are well protected, where human activities such as grazing, forestry, habitat, and cultivation are restricted.

Example- Kanha National Park, Gir National Park, Kaziranga National Park, and so on.

Wildlife Sanctuaries

Wildlife Sanctuaries are protected areas meant only for the conservation of wild animals. A few human activities such as cultivation, wood collection, and other forest product collection are allowed here, but they must not interfere with the conservation of the animals. Tourist visits are also allowed in these areas. There are a total of 551 wildlife sanctuaries in India. These are the places where only wild animals can be found. Certain human activities like timber harvesting, cultivation, collection of woods, and other forest products are permitted unless they interfere with the conservation project. Recreation tourism is also permitted.

Example- Ghana Bird Sanctuary, Abohar Wildlife Sanctuary, Mudumalai Wildlife Sanctuary, etc.

Biodiversity Hotspots

A biodiversity hotspot are the areas of conservation where there is strictly a minimum of 1500 species of vascular plants and a habitat that has lost its 70% cover. These are protected areas for various purposes where the wildlife, inhabitant lifestyle, and domesticated plants and animals are conserved. Tourist and research activities are allowed.

Example- The Himalayas, The Western Ghats, The North East, and The Nicobar Islands.

Gene Sanctuary

Gene sanctuary is a conservation area reserved only for plants. India has its only gene sanctuary set up in Garo Hills of Meghalaya for the conservation of wild species of Citrus. Plans to open more such sanctuaries are underway.

Sacred Groves

Sacred Groves are conserved areas for wildlife protected by communities due to religious beliefs. It is mostly a part of the forest where its wildlife is given complete protection.

Ex Situ Conservation

Ex Situ Conservation means conservation of life outside their natural habitat or place of occurrence. It is the method in which part of the population or the entire endangered species is taken from its natural habitat which is threatened and breeding and maintaining of these species take place in artificial ecosystems. These artificial ecosystems could be zoos, nurseries, botanical gardens, etc. The living environments are altered in these conservation sites, so there are fewer survival struggles like scarcity of food, water, or space. Ex-situ conservation of biodiversity consists of breeding and maintenance of endangered species using artificial environments like zoos, nurseries, botanical gardens, gene banks, etc. The competition for food, water, and space among the organisms is low.

Advantages of Ex Situ Conservation Include

Essential life-sustaining conditions like climate, food availability, veterinary care can be altered and are under human control.

Artificial breeding methods can be introduced leading to successful breeding and creating many more offspring of the species.

The species can be protected from poaching and population management can be efficiently done.

Gene techniques can be applied to increase the population of the species and they can again be reintroduced into the wild.

Biodiversity Conservation Strategies

Conservation of Ecosystems- The intent of the conservation of biodiversity is to provide long term viability to the ecosystems. It is to make sure that ecological integrity is intact. The landscapes of the region which have undergone historical or evolutionary deterioration can be reinstated. The threats can be removed and the ecosystems should be able to continue with ecological processes.

Reverse the decline of species- According to this strategy, the aim of conservation is to restore the population of declined species in a particular ecosystem.

Conservation of all biological aspects- This strategy aims at giving cover and conserving food, livestock, microbial population, agricultural stock including plants and animals.

Efficient utilization of natural resources.

Strict laws on deforestation and preventions of deforestation by every means.

Poaching and killing animals in the wild should be prevented.

Creating public awareness about conservation of biodiversity and its importance.

Longer time and breeding activity of the animals are provided.

The breeding of species in captivity is reintroduced in the wild.

Genetic techniques are used to preserve endangered species.

3.5 SUMMARY

We use a variety of materials derived from the environment. Nature has given us abundant resources in form of water, air, soil, wild animals, metals, fossils, fuels etc. and man by his technical skill and knowledge using resource from the dawn of civilization. Resource is the ability to perform the work of satisfying the needs or wants of human being. Resource can be classified on the basis of their nature, durability, ownership and distribution pattern. All the resources are derived from the environment. Many natural resources are essential for human survival, while others are used for satisfying human desire. Conservation is the protection, improvement, and wise use of natural resource to provide the greatest social and economic value for the present and the future. “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. On September 25th 2015, countries adopted a set of goals to end poverty, protect the planet, and ensure prosperity for all as

part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years. For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and people.

3.6 CHECK YOUR PROGRESS/ EXERCISE

1. True and false

a. In order to become a resource, the thing or substance must possess two properties: functionality and utility.

b. Resources form the backbone of the economy of a nation.

c. Ancient man knew the use of resources is related to the development of science and technology.

d. Abiotic Resources are composed of non-living things, e.g., rocks and metals.

e. When an area is deforested, no animals or insects lose their habitats.

2. Fill in the blanks

a. Mining contaminates forest ecosystems with _____ and _____.

b. Wild fires results from _____weather.

c. _____ resources are found everywhere, e.g., sunshine, air water, etc.

d. Rainwater can be collected from _____ or _____.

e. Water systems in the sphere of _____ development not only include the use of water, but also the systems where the use of water has traditionally been required.

3. Multiple choice question

a. Zimmerman defines resources as,

i. “features of the environment which is considered to be capable of serving man's needs."

ii. "natural resources may be defined as those resources which are provided by nature and which are useful to man."

iii. "anything that can be used to satisfy a need or desire."

b. Selective logging is the practice of

i. removing all trees by controlled burning.

ii. removing certain trees for tourism purpose.

iii. removing certain trees while preserving the balance of the woodland.

c. Commercial felling of trees is one of the main reasons of

i. afforestation

ii. forest fire

iii. deforestation

d. A common cause of thermal pollution is the use of water

i. as a coolant by power plants and industrial manufacturers.

ii. as a coolant by mines and industrial manufacturers.

iii. as a coolant by plantation.

e. Water efficiency means thinking about

i. the way we use mineral.

ii. the way we use water.

iii. the way we use forest.

4. Answer the Following Questions

1. Define Resource. State the classification of resources.
2. What are the different environmental problems associated with forest?
3. State different methods associated with the conservation of forest.
4. What do you understand by the term‘Sustainable use of Forest’?
5. What are the differences between Conservation of Water and Sustainable use of water?
6. State the problems Environment problem related with minerals
7. How will you conserve minerals?
8. Write short notes on
   a. Environmental problems associated with Water
   b. Sustainable use of Minerals

3.7 ANSWERS TO THE SELF LEARNING QUESTIONS

1. a. true

1. b. true

1. c. false, Ancient man did not know how to use resources.

1. d. true

1. e. false, When an area is deforested, many animals and insects lose their habitats.

2. a. pollution and runoff

3. b. warmer

3. c. Ubiquitous

3. d. rivers or roofs

3. e. sustainable

3. a. i.

3.b.iii.

3.c.iii.

3. d. i.

3.e.ii.

3.8 TECHNICAL WORDS

- **Resources**: a stock or supply of money, materials, staff, and other assets that can be drawn on by a person or organization in order to function effectively.
- **Conservation**: Conservation is the preservation or efficient using of resources in an efficient or ethical manner.
- **Exploitation**: The action of making use of and benefiting from resources, over use
- **Beneficiation**: the treatment of raw material (such as iron ore) to improve physical or chemical properties especially in preparation for smelting.
- **Logging**-the activity or business of felling trees and cutting and preparing the timber
- **Ecological diversity** – It is a type of biodiversity. It is the variation in the ecosystems found in a region or the variation in ecosystems over the whole planet. Ecological diversity includes the variation in both terrestrial and aquatic ecosystems.
- **IUCN**: The International Union for Conservation of Nature (IUCN) is a membership Union uniquely composed of both government and civil society organisations.

3.9 TASK

- Spread awareness about minimum resource use and conservation of the resources

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4

ENVIRONMENTAL CHALLENGES IN INDIA

Unit Structure :

4.0 After going through this chapter you will be able to understand the following features:

4.1 Objectives

4.2 Introduction

4.3 Subject discussion

4.4 Concept of Pollution

4.5 Types of Pollution

4.6 Causes of Pollution

4.7 Air pollution

4.7.1 Concept

4.7.2 Types

4.7.3 Causes

4.7.4 Impacts

4.7.5 Measures

4.8 Water pollution

4.8.1 Concept

4.8.2 Types

4.8.3 Causes

4.8.4 Impacts

4.8.5 Measures

4.9 Land pollution

4.9.1 Concept

4.9.2 Types

4.9.3 Causes

4.1 OBJECTIVES

By the end of this unit you will be able to –

- Understand the concept of pollution
- Learn the types of pollution
- Know about the causes of pollution
- Understand the concept, types, causes, impacts and measures of air pollution
- Study about the concept, types, causes, impacts and measures of water pollution
- Learn about the concept, types, causes, impacts and measures of land pollution and
- Know the concept, types, causes, impacts and measures of noise pollution

4.2 INTRODUCTION

In the first unit we have learnt the definition of Environmental Geography along with its Nature and Scope. Factors of environment and the relationship between Man-Environment have also been learnt. We have

discussed Ecosystem also. In the previous chapter we have studied the concept of resources, classification of resources and Environmental problems associated with forest, water and minerals. Bio-diversity, its concept and types along with hotspots of bio-diversity and biodiversity in India with emphasis on Western Ghat have also been studied. In this chapter we are going to study pollution in details. Concept of pollution, types of pollution, and causes of pollution will be studied in the first part of this unit. In the latter part of this third unit we will study impacts and measures of air, water, land and noise pollution.

4.3 SUBJECT-DISCUSSION

The term 'pollution' is widely used and sometimes misunderstood. Pollution is anything that makes the earth dirty and unhealthy. Land, air, and water are all affected by pollution. Trucks, cars, buses and other vehicles leak smoky exhaust from their engines and fill the air we breathe with pollutants. Water bodies such as lakes, rivers, oceans, aquifers and groundwater get polluted with cleaners, paints, and chemicals that are directly or indirectly discharged into them. Pollutants dumped into the ocean can hurt sea creatures also. Human beings are affected too. They get sick when they eat the poisoned fish. Moreover all polluted water must be cleaned before we drink it. There are three kinds of pollution namely water pollution, land pollution and air pollution. Modern society is also concerned about specific types of pollutants, such as noise pollution, light pollution, and even plastic pollution. With the advent of time and introduction of modern technology pollution have grown. But ways to combat it have grown too. For example people use solar energy and wind energy as alternative ways to power their homes. When these alternative forms of energy are used less carbon dioxide is released into the environment.

4.4 CONCEPT OF POLLUTION

Definition of pollution

Innumerable definitions of the term pollution have been examined and alternatives suggested. Pollution is the addition of any substance to the environment in excess to what is normally present thereby making the environment impure. The introduction of contaminants into the natural environment has harmful or poisonous effects. It causes adverse change and is known as pollution. Therefore any change in the physical, chemical, or biological characteristics of the air, water, or soil that affects the health, survival or activities of humans or other forms of life in an undesirable way is pollution. Pollution is often called environmental pollution. The addition of any substance (solid, liquid, or gas) or any form of energy (such as heat, sound, or radioactivity) to the environment at a rate faster than it can be dispersed, diluted, decomposed, recycled, or stored in some harmless form leads to pollution. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. The major kinds of pollution are air

pollution, water pollution, and land pollution. Modern society is also concerned about specific types of pollutants, such as noise pollution, light pollution, and even plastic pollution.

Sources of Pollution:

Direct or indirect human activities lead to environmental pollution.

- There are six major sources of environmental pollution:

i. Industrial sources

ii. Agricultural sources

iii. Biogenic sources

iv. Anthropogenic sources

v. Unnatural sources

vi. Extra-terrestrial sources.

4.4.2. Nature of Pollutants:

The pollutants occurring in the environment are usually chemical, biological and physical in their nature.

- Chemical pollutants include:

a. Gaseous pollutants such as sulfur dioxide, nitrogen dioxide,

b. toxic metals

c. pesticides

d. herbicides

e. hydrocarbons

f. toxins

g. acidic substances

h. carcinogens

- Biological pollutants include:

a. Pathogenic organisms

b. products of biological origin

- Physical pollutants include:

a. Heat, thermal

b. Sound

c. Odours

d. Radiation and

e. Radioactive substances

4.5 TYPES OF POLLUTION

Pollution is of many kinds, but the commonly known are air, land and water pollution. There are various other types of pollution too which are listed below.

a. Water Pollution.

b. Air Pollution.

c. Soil Pollution.

d. Thermal Pollution.

e. Radioactive Pollution.

f. Noise Pollution.

g. Light Pollution.

4.6 CAUSES OF POLLUTION

There are numerous causes of pollution and the number of which is growing day by day. They impair the quality and beauty of the environment. Some of them directly hit the environment while some others have negative impact on the balance of eco system. All of them deprive us from taking breath in fresh air, drinking pure water and walking on clean land.

The three main causes of pollution are effluents, wastes and emissions. They can be further divided into several sub-causes pointed. Here are they:

i. Effluents

- Industrial effluent
- Civic wastewater
- Fuel affluent
- Agricultural wastewater

ii. Wastes

- Civic waste
- Hospital waste
- Industrial waste
- Nuclear waste

iii. Emissions

- Vehicular emissions
- Industrial emissions
- Dust emissions

i. Effluents

All types of liquids that affect the chemical composition of water or soil are called effluents. It pollutes the water in one way or the other. This is one of the lethal causes of pollution. For example whatever spills over from factories and flows untreated into the river, sea or any other water body is called industrial effluent.

ii. Wastes

Many types of solid wastes are dumped instead of proper disposal. These affect the features of land and soil. The waste may be from houses, industries, offices, hospitals or even dangerous waste of nuclear plants. It is one of the main causes of pollution on land.

iii. Emissions

The chimney of factory and the silencer of vehicle are the two pipes which are considered as the main sources of emissions. They pollute the air by emitting poisonous gases beyond the limits set by various environmentalists. Thus make it too bad for breathing.

4.7 AIR POLLUTION

4.7.1 Concept of air pollution

Air Pollution: Air pollution can be defined as the presence of toxic chemicals or compounds (including those of biological origin) in the air, at levels that pose a health risk.

4.7.2 Types of Pollutants:

In order to understand the causes of Air pollution, several divisions can be made. Primarily air pollutants can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulphur-dioxide emitted from factories. Secondary pollutants are the ones that are

caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

4.7.3 Causes of Air pollution:

- There are two types of sources that we will take a look at:

Natural sources:

Natural sources of pollution include dust carried by the wind from locations with very little or no green cover, gases released from the body processes of living beings. For example Carbon dioxide is released from humans during respiration, Methane is released from cattle during digestion and Oxygen is released from plants during Photosynthesis.

Smoke from the combustion of various inflammable objects, volcanic eruptions etc along with the emission of polluted gases also make it to the list of natural sources of pollution.

Man-made sources:

While looking at the man-made contributions towards air pollution, smoke again features as a prominent component. The smoke emits from various forms of combustion like in bio mass, factories, vehicles, furnaces etc. Wastes used to create landfills generate methane that is harmful in several ways. The reactions of certain gases and chemicals also form harmful fumes that can be dangerous to the well-being of living creatures.

- Following are the man-made sources of air pollution:

i. Burning of Fossil Fuels:

Sulphur dioxide emitted from the combustion of fossil fuels like coal, petroleum and other factory combustibles is one the major cause of air pollution. Pollution emitting from vehicles including trucks, jeeps, cars, trains, airplanes cause immense amount of pollution. We rely on them to fulfil our daily basic needs of transportation. But, there overuse is killing our environment as dangerous gases are polluting the environment. Carbon Mono oxide caused by improper or incomplete combustion and generally emitted from vehicles is another major pollutant along with Nitrogen Oxides, which is produced from both natural and manmade processes.

ii. Agricultural activities:

Ammonia is a very common by product from agriculture related activities and is one of the most hazardous gases in the atmosphere. Use of insecticides, pesticides and fertilizers in agricultural activities has grown quite a lot. They emit harmful chemicals into the air and can also cause water pollution.

iii. Exhaust from factories and industries:

Manufacturing industries release large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals into the air thereby depleting the quality of air. Manufacturing industries can be found at every corner of the earth and there is no area that has not been affected by it. Petroleum refineries also release hydrocarbons and various other chemicals that pollute the air and also cause land pollution.

iv. Mining operations:

Mining is a process wherein minerals below the earth are extracted using large equipment. During the process dust and chemicals are released in the air causing massive air pollution. This is one of the reasons which are responsible for the deteriorating health conditions of workers and nearby residents.

v. Indoor air pollution:

Household cleaning products, painting supplies emit toxic chemicals in the air and cause air pollution. Have you ever noticed that once you paint walls of your house, it creates some sort of smell which makes it literally impossible for you to breathe. Suspended particulate matter popular by its acronym SPM, is another cause of pollution. Referring to the particles afloat in the air, SPM is usually caused by dust, combustion etc.

4.7.4 Impacts of Air pollution

I. Respiratory and heart problems:

The effects of Air pollution are alarming. They are known to create several respiratory and heart conditions along with Cancer, among other threats to the body. Several millions are known to have died due to direct or indirect effects of Air pollution. Children in areas exposed to air pollutants are said to commonly suffer from pneumonia and asthma.

II. Global warming:

Another direct effect is the immediate alterations that the world is witnessing due to Global warming. With increased temperatures worldwide, increase in sea levels and melting of ice from colder regions and icebergs, displacement and loss of habitat have already signalled an impending disaster if actions for preservation and normalization aren't undertaken soon.

III. Acid Rain:

Harmful gases like nitrogen oxides and sulphur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combines with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to human, animals and crops.

IV. Eutrophication:

Eutrophication is a condition where high amount of nitrogen present in some pollutants gets developed on sea's surface and turns itself into algae and adversely affects fish, plants and animal species. The green coloured algae that are present on lakes and ponds are due to presence of this chemical only.

V. Effect on Wildlife:

Just like humans, animals also face some devastating effects of air pollution. Toxic chemicals present in the air can force wildlife species to move to new place and change their habitat. The toxic pollutants deposit over the surface of the water and can also affect sea animals.

VI. Depletion of Ozone layer:

Ozone exists in earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere. As ozone layer will go thin, it will emit harmful rays back on earth and can cause skin and eye related problems. UV rays also have the capability to affect crops.

4.7.5 Measures of Air Pollution

a. Use public mode of transportation:

Encourage people to use more and more public modes of transportation to reduce pollution. Also, try to make use of car pooling. If you and your colleagues come from the same locality and have same timings you can explore this option to save energy and money.

b. Conserve energy:

Switch off fans and lights when you are going out. Large amount of fossil fuels are burnt to produce electricity. You can save the environment from degradation by reducing the amount of fossil fuels to be burned.

c. Understand the concept of Reduce, Reuse and Recycle:

Do not throw away items that are of no use to you. In-fact reuses them for some other purpose. For e.g. you can use old jars to store cereals or pulses.

d. Emphasis on clean energy resources:

Clean energy technologies like solar, wind and geothermal are on high these days. Governments of various countries have been providing grants to consumers who are interested in installing solar panels for their home. This will go a long way to curb air pollution.

e. Use energy efficient devices:

CFL lights consume less electricity as against their counterparts. They live longer, consume less electricity, lower electricity bills and also help you to reduce pollution by consuming less energy.

Several attempts are being made worldwide on personal, industrial and governmental levels to curb the intensity at which Air Pollution is rising and regain a balance as far as the proportions of the foundation gases are concerned. This is a direct attempt at slacking Global warming. We are seeing a series of innovations and experiments aimed at alternate and unconventional options to reduce pollutants. Air Pollution is one of the larger mirrors of man's follies, and a challenge we need to overcome to see a tomorrow.

4.8 WATER POLLUTION

4.8.1 Concept of water pollution

Water pollution is the act of contaminating water bodies such as rivers, oceans, lakes, streams, aquifers, and groundwater. It occurs when foreign harmful materials like chemicals, waste matter, or contaminated substances are directly or indirectly discharged into water bodies. The presence of these harmful materials in sufficient quantity in water measurably degrades water quality. Therefore any alterations in the chemical, physical, or biological water properties qualify as water pollution.

4.8.2 Types of water pollution:

Water resources like huge oceans, lakes, and rivers are called surface waters. The most obvious type of water pollution affects surface waters. For example, a spill from an oil tanker creates an oil slick that can affect a vast area of the ocean. Not all of Earth's water sits on its surface, however. A great deal of water is held in underground rock structures known as aquifers, which we cannot see and seldom think about. Water stored underground in aquifers is known as groundwater. Aquifers feed our rivers and supply much of our drinking water. Surface waters and groundwater are the two types of water resources that pollution affects. There are also two different ways in which pollution can occur. If pollution comes from a single location, such as a discharge pipe attached to a factory, it is known as point-source pollution. Other examples of point source pollution include an oil spill from a tanker, a discharge from a smoke stack (factory chimney), or someone pouring oil from their car down a drain. A great deal of water pollution happens not from one single source but from many different scattered sources. This is called non point-source pollution.

4.8.3 Causes of water pollution

i. Sewage:

With billions of people on the planet, disposing of sewage waste is a major problem. According to 2015 and 2016 figures from the World Health Organization, some 663 million people (9 percent of the world's population) don't have access to safe drinking water, while 2.4 billion (40 percent of the world's population) don't have proper sanitation (hygienic toilet facilities); although there have been great improvements in securing access to clean water, relatively little progress has been made on improving global sanitation in the last decade. Sewage disposal affects people's immediate environments and leads to water-related illnesses such as diarrhea that kills 525,000 children under five each year. In developed countries, most people have flush toilets that take sewage waste quickly and hygienically away from their homes. Yet the problem of sewage disposal does not end there. When you flush the toilet, the waste has to go somewhere and, even after it leaves the sewage treatment works, there is still waste to dispose of. Sometimes sewage waste is pumped untreated

into the sea. In theory, sewage is a completely natural substance that should be broken down harmlessly in the environment: 90 percent of sewage is water. In practice, sewage contains all kinds of other chemicals, from the pharmaceutical drugs people take to the paper, plastic, and other wastes they flush down their toilets. When people are sick with viruses, the sewage they produce carries those viruses into the environment. It is possible to catch illnesses such as hepatitis, typhoid, and cholera from river and sea water.

ii. Nutrients/ Agricultural runoff:

Suitably treated and used in moderate quantities, sewage can be a fertilizer: it returns important nutrients to the environment, such as nitrogen and phosphorus, which plants and animals need for growth. The trouble is, sewage is often released in much greater quantities than the natural environment can cope with. Chemical fertilizers used by farmers also add nutrients to the soil, which drain into rivers and seas and add to the fertilizing effect of the sewage. Together, sewage and fertilizers can cause a massive increase in the growth of algae or plankton that overwhelms huge areas of oceans, lakes, or rivers. This is known as a harmful algal bloom (also known as an HAB or red tide, because it can turn the water red). It is harmful because it removes oxygen from the water that kills other forms of life, leading to what is known as a dead zone. The Gulf of Mexico has one of the world's most spectacular dead zones. Each summer, according to studies by theNOAA, it grows to an area of around 5500–6000 square miles (14,000–15,500 square kilometers), which is about the same size as the state of Connecticut.

iii. Industrial Effluents:

A few statistics illustrate the scale of the problem that waste water (chemicals washed down drains and discharged from factories) can cause. Around half of all ocean pollution is caused by sewage and waste water. Each year, the world generates perhaps 5–10 billion tons of industrial waste, much of which is pumped untreated into rivers, oceans, and other waterways. Factories are point sources of water pollution.

iv. Domestic waste:

Lot of water is polluted by ordinary people from non point sources; this is how ordinary water becomes waste water in the first place. Virtually everyone pours chemicals of one sort or another down their drains or toilets. Even detergents used in washing machines and dishwashers eventually end up in our rivers and oceans.

v. Highway runoff:

A lot of toxic pollution also enters waste water from highway runoff. Highways are typically covered with a cocktail of toxic chemicals—everything from spilled fuel and brake fluids to bits of worn tires (themselves made from chemical additives) and exhaust emissions. When it rains, these chemicals wash into drains and rivers. It is not unusual for

heavy summer rainstorms to wash toxic chemicals into rivers in such concentrations that they kill large numbers of fish overnight. It has been estimated that, in one year, the highway runoff from a single large city leaks as much oil into our water environment as a typical tanker spill. Some highway runoff runs away into drains; others can pollute groundwater or accumulate in the land next to a road, making it increasingly toxic as the years go by.

vi. Chemical waste:

Detergents are relatively mild substances. At the opposite end of the spectrum are highly toxic chemicals such as polychlorinated biphenyls (PCBs). They were once widely used to manufacture electronic circuit boards, but their harmful effects have now been recognized and their use is highly restricted in many countries. Nevertheless, an estimated half million tons of PCBs were discharged into the environment during the 20th century. In a classic example of trans boundary pollution, traces of PCBs have even been found in birds and fish in the Arctic. They were carried there through the oceans, thousands of miles from where they originally entered the environment. Although PCBs are widely banned, their effects will be felt for many decades because they

last a long time in the environment without breaking down. Another kind of toxic pollution comes from heavy metals, such as lead, cadmium, and mercury. Lead was once commonly used in gasoline (petrol), though its use is now restricted in some countries. Mercury and cadmium are still used in batteries (though some brands now use other metals instead). Until recently, a highly toxic chemical called tributyltin (TBT) was used in paints to protect boats from the ravaging effects of the oceans. Ironically, however, TBT was gradually recognized as a pollutant: boats painted with it were doing as much damage to the oceans as the oceans were doing to the boats. The best known example of heavy metal pollution in the oceans took place in 1938 when a Japanese factory discharged a significant amount of mercury metal into Minamata Bay, contaminating the fish stocks there. It took a decade for the problem to come to light. By that time, many local people had eaten the fish and around 2000 were poisoned. Hundreds of people were left dead or disabled.

vii. Radioactive waste:

People view radioactive waste with great alarm and for good reason. At high enough concentrations, it can kill; in lower concentrations, it can cause cancers and other illnesses.

viii. Oil pollution:

When we think of ocean pollution, huge black oil slicks often spring to mind, yet these spectacular accidents represent only a tiny fraction of all the pollution entering our oceans. Even considering oil by itself, tanker spills are not as significant as they might seem: only 12 percent of the oil that enters the oceans comes from tanker accidents; over 70 percent of oil pollution at sea comes from routine shipping and from the oil people

pour down drains on land. However, what makes tanker spills so destructive is the sheer quantity of oil they release at once. The concentration of oil they produce in one much localized part of the marine environment. The biggest oil spill in recent years (and the biggest ever spill in US waters) occurred when the tanker Exxon Valdez broke up in Prince William Sound in Alaska in 1989. Around 12 million gallons (44 million liters) of oil were released into the pristine wilderness. Estimates of the marine animals killed in the spill vary from approximately 1000 sea otters and 34,000 birds to as many as 2800 sea otters and 250,000 sea birds. Several billion salmon and herring eggs are also believed to have been destroyed.

ix. Plastics:

Plastic is one of the most common materials, used for making virtually every kind of manufactured object from clothing to automobile parts; plastic is light and floats easily so it can travel enormous distances across the oceans; most plastics are not biodegradable (they do not break down naturally in the environment), which means that things like plastic bottle tops can survive in the marine environment for a long time. (A plastic bottle can survive an estimated 450 years in the ocean and plastic fishing line can last up to 600 years.)While plastics are not toxic in quite the same way as poisonous chemicals, they nevertheless present a major hazard to seabirds, fish, and other marine creatures. For example, plastic fishing lines and other debris can strangle or choke fish. (This is sometimes called ghost fishing.) About half of the entire world's seabird species are known to have eaten plastic residues.

4.8.4 Impacts of water pollution

a. Health Aspects of Water Quality:

Water pollution adversely affects the health and life of man, animals and plants alike. Polluted water is also harmful for agriculture as it adversely affects the crops and the soil fertility. Pollution of sea water damages the oceanic life. Consumption of polluted water is a major cause of ill health in India. Polluted water causes some of the deadly diseases like cholera, dysentery, diarrhea, tuberculosis, jaundice, etc. About 80 per cent of stomach diseases in India are caused by polluted water.

b. Effect of Organic Pollution on Water Quality:

All organic materials can be broken down or decomposed by microbial and other biological activity (biodegradation). Organic and some of the inorganic compounds exhibit a biochemical oxygen demand (BOD) because oxygen is used in the degradation process. Oxygen is a basic requirement of almost all aquatic life. Aquatic life is adversely affected if sufficient oxygen is not available in the water. Typical sources of organic pollution are sewage from domestic and animal sources, industrial wastes from food processing, paper mills, tanneries, distilleries, sugar and other agro based industries.

c. Effect of Nutrients on Water Quality:

Water supports aquatic life because of the presence of nutrients in it. Here the primary focus is on fertilizing chemicals such as nitrates and phosphates. Although these are important for plant growth, too much of nutrients encourage the overabundance of plant life and can result in environmental damage called 'entrophication'. This can occur at both microscopic level in the form of algae and macroscopic level in the form of aquatic weeds. Nitrates and phosphates are contributed by sewage, agricultural run-off and run-off from un-sewered residential areas.

d. Effect of High Dissolved Solids (TDS) in Water Quality:

Water is the best solvent and can dissolve a large variety of substances which come in its contact. The amount of dissolved solid is a very important consideration in determining its suitability for drinking, irrigation and industrial uses. In general, waters with total dissolved solids of less than 500 mg/litre are most suitable for drinking purposes. Higher quantity of dissolved solids may lead to impairment of physiological processes in human body. Dissolved solid is a very important criterion for irrigation. This is due to the fact dissolved solid accumulates on the ground resulting in salinization of soil. In this way, it renders the agricultural land non-productive. Dissolved solids are harmful for industries also because they form scales, create foaming in boilers, accelerate corrosion and interfere with the colour and taste of many finished products.

e. Effect of Toxic Pollutants on Water Quality :

Toxic pollutants mainly consist of heavy metals, pesticides and other individual xenobiotic pollutants. The ability of a water body to support aquatic life, as well as its suitability for other uses depends on many trace elements. Some metals e.g., Mn, Zn and Cu present in trace quantity are important for life as they help and regulate many physiological functions of the body. Some metals, however, cause severe toxicological effects on human health and the aquatic ecosystem.

4.8.5 Measures of water pollution

a. Practice Responsible Use of Fertilizer, Herbicides & Pesticides

b. Minimize Storm water Runoff

c. Filter Runoff

d. Contain Spills

e. Protect Curb Inlets and Drains

f. Capture and Dispose of Floating Pollution in Waterway

g. Capture and Filter Sediment Laden Water in Waterways

We can take individual action to help reduce water pollution by using environmentally friendly detergents, not pouring oil down drains, reducing pesticides, and so on. We can take community action too, by helping out

on beach cleans or litter picks to keep our rivers and seas that little bit cleaner. And we can take action as countries and continents to pass laws that will make pollution harder and the world less polluted. Working together, we can make pollution less of a problem—and the world a better place.

4.9 LAND POLLUTION

4.9.1 Concept of Land pollution

Land is being polluted and abused constantly but we are unable to calculate the damages incurred. We must collectively battle land Pollution. Land pollution means degradation or destruction of earth's surface and soil, directly or indirectly as a result of human activities. When solid or liquid waste materials are deposited on land or underground in such a manner that it contaminates the soil and threats public health is known as land pollution. Usually it occurs when waste is not disposed of properly. Moreover when humans throw chemicals onto the soil in the form of pesticides, insecticides and fertilizers during agricultural practices they pollute the land. Exploitation of minerals through mining has contribution to the destruction of the earth's surface. Anthropogenic activities that are conducted for development affects the land drastically. In other words the degradation of land is land pollution. We survive on land and it is the base of our ecosystem so we should take interest in nurturing our land in proper way.

4.9.2 Types of land pollution

There are different types of land pollution. Following are the four main types:

I. Solid Waste

All the different kinds of rubbish produced at home, school, hospitals, market and workplaces make solid waste. Things like

paper, plastic containers, bottles, cans, food and even used cars and broken electronic goods, broken furniture and hospital waste are all examples of solid waste. Some of these, such as food droppings, paper products as well as vegetation like grass and twigs, are biodegradable while others are not and they include plastics, metals and aluminium cans, broken computer, car parts etc.

II. Environmental pollution and land pollution

Landfills stay for thousands of years. These bring great harm to the land and people around it.

III. Pesticides and Fertilizers

Many farming activities apply fertilizers, pesticides and insecticides for higher crop yield. No doubt that it increases the yield but sometimes insects and small animals are killed and bigger animals that eat tiny

animals are also harmed. Moreover when the chemicals are washed down when it rains they end up in the water table below. Hence causes water pollution.

IV. Chemicals

Chemical and nuclear power plants produce waste materials that have to be stored somewhere. Fertilizer, insecticides, pesticides, pharmaceuticals manufacturers also produce lots of solid and liquid waste. In many cases, they are stored in an environmentally safe way, but there are some that find their way into landfills and other less safe storage facilities. Sometimes they also find their way into leaking pipes and gutters. They end up polluting soils and making crops harmful to our health.

V. Deforestation

Trees absorb carbon dioxide from the air and enrich the air with Oxygen, provide wood for humans and a habitat to many land animals, insects and birds. Trees replenish soils and help retain nutrients being washed away. We have cut down trees for wood, construction, farming and mining purposes without planting a new tree back. This is a type of land pollution.

4.9.3 Causes of Land Pollution

Land pollution is caused by both natural factors and human activities. Below are the sources of land pollution:

A. Natural factors:

The natural factors that cause soil erosion include volcanic eruptions, changes in rainfall pattern, earthquakes, topographic changes, wind and glacier movements. Natural factors of soil erosion (like rainfall, wind, topography, etc.) are further increased by human activities.

B. Human activities:

Soil pollution is further increased by human-activities. Some of the human activities that cause land or soil pollution include the following:

a. Deforestation and soil erosion:

The main factors of land pollution are increasing rate of soil erosion caused due to deforestation. Deforestation carried out to create dry lands is one of the major sources of land pollution. Even if various measures to redeem a Land, that has been converted into a dry or barren land once is taken, it can never be made fertile again. This hampers the land immensely. Also there is a constant waste of land. Unused available land over the years turns barren; this land then cannot be used. So in search of more land, potent land is hunted and its indigenous state is compromised with.

b. Faulty agricultural practices:

In most of the developing countries increasing rate of soil erosion is due to deforestation and faulty agricultural practices. This has degraded land to a large scale because the fertile top soil is washed out. Furthermore with growing human population, demand for food has increased considerably. Farmers often use highly toxic fertilizers and pesticides to get rid of insects, fungi and bacteria from their crops. The overuse of these chemicals results in contamination and poisoning of soil.

c. Mining activities:

During extraction and mining activities, several land spaces are created beneath the surface.

d. Overcrowded landfills:

Each household produces tonnes of garbage like aluminium, plastic, paper, cloth, wood etc. each year. These are collected and sent to the local recycling unit. But items that cannot be recycled become a part of the landfills. This causes land pollution.

e. Land pollution by biological agents :

The excreta of birds, animals and humans are source of land pollution by biological agents. Sewage used as manure causes land pollution.

f. Acid rains :

Acid rains increase the acidity of soils that is injurious to plant growth.

g. Industrialization:

Due to increase in demand for food, shelter and house, more goods are produced. This resulted in creation of more waste that needs to be disposed of. To meet the demand of the growing population, more industries were developed which led to deforestation. Research and development paved the way for modern fertilizers and chemicals that were highly toxic and led to soil contamination. The toxic chemicals in the form of solid and liquid wastes that are disposed by industries and factories are the major source for soil pollution.

h. Nuclear waste:

The nuclear power plants are responsible for producing radioactive wastes. Nuclear plants when produce huge amount of energy through nuclear fission and fusion the leftover is radioactive material. This material contains harmful and toxic chemicals that can affect human health. They are dumped beneath the earth to avoid any casualty. These are harmful for the soil.

i. Construction activities:

Due to urbanization, large amount of construction activities are taking place which has resulted in large waste articles like wood, metal, bricks, plastic that can be seen by naked eyes outside any building or office which is under construction.

j. Sewage treatment:

Large amount of solid waste is leftover once the sewage has been treated. The leftover material is sent to landfill site which end up in polluting the environment.

4.9.4 Effects of Land Pollution

I. Soil pollution:

Soil pollution is another form of land pollution in which the upper layer of the soil is damaged. This is caused by the overuse of chemical fertilizers along with various other pest control measures and running water. As a result there is loss of fertile land for agriculture. Forest cover is also lost. Fodder patches for grazing are affected too.

II. Change in climate patterns:

The effects of land pollution are very hazardous and can lead to the loss of ecosystems.

III. Environmental Impact:

Due to deforestation there is loss of tree cover. This leads to a steep imbalance in the rain cycle. A disturbed rain cycle affects a lot such as reduction in green cover. This again leads to problems like Global warming, green house effect and imbalances like irregular rainfall and flash floods. All these have their share of effects on human health. The land when contaminated with toxic chemicals and pesticides lead to problem of skin cancer and human respiratory system. The toxic chemicals can reach our body through foods and vegetables that we eat as they are grown in polluted soil.

IV. Cause Air pollution:

As a result of rapid urbanisation landfills throughout the city keep on growing. This leads to the increase of waste which becomes home for rodents, mice etc. These in turn transmit diseases. The waste is later burnt and leads to air pollution. Tourists are distracted because landfills do not attract them. It leads to loss of revenue for the state government.

V. Effect on wildlife:

The animal kingdom comes across with serious threats when there is loss of habitat and natural environment. Continuous human activity on land leave it polluted and force several species to move further away from the original region and adapt to new ones, where they often die while

trying to adjust. Several species are pushed to the verge of extinction, due to loss of their homeland.

VI. Other issues:

Other issues like increased temperature, unseasonal weather activity, acid rains etc. also have adverse effects. The discharge of chemicals on land makes it dangerous for the ecosystem. These chemicals are consumed by the animals and plants and thereby make their way in the ecosystem. This process is called bio magnification and is a serious threat to the ecology.

4.9.5 Measures for Land Pollution

Disrupting the harmony of the land is disrupting the habitat of several creatures that survive under the land. Hence several creatures have reached the endangered status. The Gilbert's Potoroo in Australia is an example. Following are measures which may lessen land pollution.

a. We should make people aware about the concept of Reduce, Recycle and Reuse.

b. We must reduce the use of pesticides and fertilizers in agricultural activities.

c. All of us should avoid buying packaged items. These will end up their journey in garbage as well as in landfill sites.

d. We must also ensure that we do not litter on the ground instead do proper disposal of garbage.

e. We should consciously buy biodegradable products.

f. Doing organic gardening without the use of pesticides and eating organic food will definitely reduce the use of pesticides.

g. Our dumping ground must be created away from residential areas.

4.10 NOISE POLLUTION

4.10.1 Concept of Noise Pollution

Noise Pollution is harmful levels of noise. It is actually a form and level of environmental sound that generally annoys, distracts or even harms other people. As noise is a physical form of pollution it is not directly harmful to the life supporting systems such as air, soil and water. It affects more directly on the receiver i.e. man.

This unwanted sound, released into the environment, disturbs human being and cause an adverse effect on the mental and psychological well being of them. The noise which is more than

115 dB (decibel) is tolerant. According to the world health organization the industrial limit of sound in the industries must be 75 dB. Noise

pollution is the result of modern industrialized urban life and congestion due to over population.

The most common source of noise pollution by far, the one that affects the most people on the planet is motor vehicles. Aircraft and industrial machinery are also major sources. Additional noise pollution is contributed by office machines, sirens, power tools, and other equipment.

4.10.2 Types of noise pollution

When we think about noise pollution, we usually think of environmental sources of noise:

- Traffic noise (cars, buses, trucks)
- Planes
- Lawn mowers, leaf blowers, snow blowers
- Construction noise

4.10.3 Causes of Noise Pollution:

- Major causes of noise pollution are as follows:

I. Industrial Sources:

With the advancement in technology and industrialization noise has polluted our environment. Textile mills, printing presses, engineering establishments and metal works etc. contribute heavily towards noise pollution. Industrial cities like Kolkata, Ludhiana, Kanpur etc., experience the bad effects of noise pollution. This is mostly because often the industrial zones are not separated from the residential zones of the city. Especially the small scale industries are found operating from workshops situated on the ground floors of the residential areas and the noise that is inevitably produced cause annoyance, discomfort and irritation to the residents who are exposed to it. The circumstance is quite better in modern planned cities like Chandigarh because here the industrial area is kept away from the residential areas. Moreover both the zones are separated from each other by adequate wide green belt.

II. Transport Vehicles:

Transportation causes of noise pollution predominantly encompass noise from traffic, rails, and aircraft. Automobile revolution in urban settings has proved to be a big source of noise pollution. So the increased numbers of automobiles on the roads has given rise to traffic jams in congested areas where the repeated hooting of horns by impatient drivers further exacerbated the problem of transport noise. Noise intensity in most residential places neighbouring towns is always high because of widespread vehicular noise pollution. Heavy trucks, buses trains, jet planes, motorcycles, scooters, mopeds, jeeps etc.are the source of noise pollution. In big cities like Delhi and Mumbai where airport is situated in the vicinity of population centres the air planes pass over residential areas. As a result noise from airplanes constitutes an increasing serious problem.

III. Household:

In residential areas, an acceptable level of household noise for one person may be unacceptable to another. This acceptance also depends on the time of the day and the nature of the noise. Gadgets like food mixer, grinder, vacuum cleaner, washing machine and dryer, cooler, air conditioners can be very noisy and injurious to health. Others indoor noises include loud speakers of sound systems and TVs, iPods and ear phones, banging of doors, noise of playing children, crying of infants, moving of furniture, loud conversation of the inhabitants etc. Another example may be one of the neighbour's dogs barking all night every day.

IV. Public Address System:

In India use loud speakers for religious function, birth, death, marriage, elections, demonstration or may be just for commercial advertising. Hence public system plays a significant role its own way towards noise pollution.

V. Agricultural Machines:

With the introduction of tractors, thrashers, harvesters, tube wells, powered tillers etc. agriculture has become highly mechanical but simultaneously extremely noisy. Noise level 90 dB to 98 dB due to running of farm machines have been recorded in the state of Punjab.

VI. Defence Equipment:

A lot of noise pollution is added to the atmosphere by artillery, tanks, launching of rockets, explosions, exercising of military airplanes and shooting practices. Screams of jet engines and sonic booms have a deafening impact on the ears and in extreme cases have been known to shatter the window panes and old dilapidated buildings.

VII. Miscellaneous Sources:

Construction works, blasting, stone crushing, bulldozing, welding, automobile repair activities, quarrying and so on are other sources of noise pollution. The residents of areas usually complain of unpleasant and intense noise.

4.10.4 Impacts of noise pollution

Noise has negative consequences on human health and behaviour. Unwanted sounds can damage physiological and psychological health. In a study, it was found that construction workers suffer from hearing deficiencies caused by noise, which is one of the most important occupational diseases.

Adverse Effects of Noise Pollution are as follows:

i. It interferes with speech.

Rising levels of noise in Indian cities has been affecting people's hearing capability, which is deeply disturbing as the ability to hear sounds is closely linked to mental development. In the presence of noise we may not able to follow, what the other person is saying. It is because the development of vocal skills is dependent on normal hearing. Of late, the problem of deafening noise pollution is on the increase worldwide.

ii. Noise is a problem especially for patients who need rest.

Prolonged exposure to noise results in several adverse effects like sleep disturbance, irritability, stress, tension, distraction, risk of heart disease, influence on quality of life, interference with communication, health and well-being outcomes, behavioural and mental health effects and diminished performance.

iii. Noise leads to **emotional and behavioral stress**.

A person may feel disturbed in the presence of loud noise such as produced by heating of drums.

iv. Noise may **permanently damage hearing.**

A sudden loud noise can cause severe damage to the eardrum. Unwanted noise may also lead to tinnitus that is the hearing of sound when no external sound is present.

v. Other diseases.

- Noise increases the chances of occurrence of diseases such as headache, blood pressure, heart failure, etc.
- Noise leads to increased heart beat, constriction of blood vessels and dilation of pupil
- Noise may cause damage to liver, brain and heart.
- Unwanted noise leads to annoyance, aggression, hypertension, high stress levels and sleep disturbances.

vi. Problems faced by marine animals form noise pollution.

Many marine animals face problems due to excessive noises used by oil drills, submarines and other vessels on and inside the ocean. Whales use hearing to find food, communicate, defend and survive in the sea. Excessive noises cause many injuries and deaths to whales.

vii. Wildlife also faces many problems form noise pollution.

Wildlife also faces many problems form noise pollution since they are more dependent on sound. Animals develop a better sense of hearing than the human beings since their survival depends on it. Domestic animals react more aggressively in households where there is the constant noise.

4.10.5 Measures of noise pollution

Noise pollution can be effectively controlled by taking the following measures:

1. Control at Receiver's End

People engaged in installing noisy equipments must be provided with ear-protection aids like ear-plugs, ear-muffs, noise helmets, headphones to reduce occupational exposure.

2. Suppression of Noise at Source:

This is achievable only if working methods are improved.

These methods are stated under:

a. Designing, fabricating and using of quieter machines replacing the noisy ones is an important method.

b. Proper lubrication and better maintenance of machines will reduce noise.

c. Installation of noisy machines in sound proof chambers is another significant way to reduce noise pollution.

d. Industries must take measures by covering noise-producing machine parts with sound-absorbing materials to check noise production. Measures taken in industry are as follows:

- Personal Protective Equipment: earmuffs, earplugs, and other similar devices can be physically placed on the ears to reduce overall exposure to noise pollution.
- Engineering Control: Workers can be isolated from the noise hazard by working to control an automated noisy machine from an insulated room nearby.
- Administrative Control: Sometimes a worker may have their schedule adjusted or modified as a way to limit noise exposure from a particular activity.

e. Reducing the noise produced from a vibrating machine by vibration damping i.e. making a layer of damping material (rubber, neoprene, cork or plas-tic) beneath the machine.

f. Using silencers to control noise from automobiles, ducts, exhausts etc. and convey systems with ends opening into the atmosphere.

g. Using glass wool or mineral wool covered with a sheet of perforated metal for the purpose of mechanical protection.

3. Acoustic Zoning:

Distance between source and receiver must be increased by zoning of noisy industrial areas, bus terminals and railway stations, aerodromes etc. away from the residential areas. By this noise pollution may be minimised. There should be silence zones near the residential areas, educational institutions and near hospitals.

4. Sound Insulation at Construction Stages:

- Sound travels through the cracks that are present between the door and the wall. So during construction if any gap is left between them that space must be packed with sound absorbing material to reduce noise.
- Sound insulation can be done by constructing windows with double or triple panes of glass and filling the gaps with sound absorbing materials.
- Acoustical tiles, hair felt, perforated plywood etc. can be fixed on walls, ceil-ings, floors etc. to reduce noise (especially for sound proof recording rooms etc.)

5. Planting of Trees:

Planting green trees and shrubs along roads, hospitals, educational institutions etc. help in noise reduction to a considerable extent.

6. Legislative Measures:

Enforcement of strict legislative measures will curb the danger of noise pollution. Some of these measures could be:

- Minimum use of loudspeakers and amplifiers especially near silence zones.
- Banning pressure horns in automobiles.
- Framing a separate Noise Pollution Act.

7. Turn off Appliances at Home and offices appliances

Home and office appliances such as TV, games, computers create unnecessary stress on ears. So when not in use they should be turned off.

ENVIRONMENT ISSUES RELATED TO HIGH/ LARGE DAMS

Development projects are essential for the development oe society but at the same time there are many severe consequences of these projects on the environment and the local people. Large scale development projects include.

1) Construction of huge dams.
2) Establishment of MNC in the underdeveloped / developing countries.
3) Construction of new planned city / Amusement Park etc.

Let us consider two major displacement events in India.

1) **Displacement of People due to Tehri Dam Project:**

Tehri dam is in the Tehri district of Uttarakhand. It is a river Ganga below the confluence of its two head streams - the Bhagirathi & the Bhilangana. It is the highest rock - fill dam in India Ht. 260 m). The capacity of this dam is 245 million cubic meters. An area of 465 sq. kilometers is submerged due to this dam.

About 125,000 people from 172 villages are displaced due to this dam. These poor people are familiar with the hilly & forest environment. When they are shifted to the plain areas - which are unknown to them - they will find it difficult to survive as their lifestyle will change. This will create many socio-economic problems. It will deprive them from fuel wood, forest products, drinking & irrigation water etc.

This dam project will cause severe environmental problems - ecological destruction, submergence of valley ecosystem, siltation of the reservoir etc.

The Himalayan region is geologically unstable & so construction of this dam is very dangerous. In case of failure of Their Dam the flood water can reach up to Rishikesh and Hardwar, Kanpur, Patna & Allahabad. It can also affect Narora Atomic power station.

2) Sardar Sarovar Project (Gujarat):

It is the world's biggest river valley project. It started in 1961. River Narmada rises in the Amarkantak hills in Madhya Pradesh. It flows to the west through Maharashtra & Gujarat & joins Arabian Sea. The length of R. Narmada is 1312 kms. & the basin area is about 98,796 sq. kms.

The Sardar Sarovar Project has an installed power generation capacity of about 1400 M.W. & it will provide irrigation facilities to about 1.8 million hectares of land.

Environmentalists and activists have raised objections against the project. Ms. Medha Patkar - Post Graduate social worker from TISS played leading role to protect the rights of the people displaced by this project.

Sardar Sarovar Project has displaced about 90,000 people from 237 villages of M.P, Gujarat & Maharashtra. Gujarat Govt. provided proper benefits to these people in Gujarat. But such benefits were not provided properly by the M.P. & Maharashtra govt. hence many displaced people became environmental refugee who migrated to the nearby towns to seek daily wage labour.

The Sardar Sarovar Project has submerged about 42,000 hectares of land under forest leading to the massive extinction of native species of wildlife. The problem of sanitation will develop in the coastal districts of Gujarat due to water logging from canal irrigation.

ENVIRONMENTAL MOVMENTS IN INDIA

1) Chipko Movement - (1973):

This environmental movement started in Garhwal Himalayas which was led by Chandni Prasad Bhatt and Sunderlal Bahuguna.

It was people's revolt against reckless deforestation by the contractors by hugging trees. Hence it is known as Chipko movement.

2) Save silent valley movement (1978):

Govt. of Kerala decided to construct dam and hydro-electric project to provide electricity to the many villages in Kerala.

The silent valley hydroelectric project was to dam the Kunthipuzha River in Kerala.

The silent valley has an evergreen tropical forest in the Palakkad district of Kerala. This forest is about four million years old. To stop submerging the entire biosphere reserve 'save silent valley movement' started in 1974.

In 1980 the M.G.K. Menon Committee set up to review the project, came out with a recommendation to scrap it.

3) Jungle Bachao Andolan (1982):

It began in Bihar & later spread to states like Jharkhand & Orissa.

Govt. of Bihar, decided to replace natural 'sal' forests with highly priced teak. This was considered as a move that was termed as a 'Greed Game and political populism.

The tribals of Singhbhum district of Bihar started Jungle Bachao Andolan to oppose this activity.

4) Navdanya Movement for Earth Democracy:

'Navdanya' is a movement for Earth Democracy based on the philosophy of Vasudhair Kutumbakam (The Earth as one family).

- This organisation protect India's biodiversity based food heritage through

1) Bija Swaraj

2) Anna Swaraj

3) Bhu Swaraj

4) Gyan Swaraj

1) Bija Swaraj: They have created 122 community seed banks in 18 states of India & Bhutan. These seeds are distributed to disaster affected people.

2) Anna Swaraj: They promote organic farming & supply product to urban areas - connecting seed to cooked food.

3) Bhu Swaraj: They protect living soil, our mother earth which is the basis of our life & our livelihoods.

4) Gyan Swaraj: They promote knowledge, democracy scientific research and agro-ecology. Dr. Vandana Shiva founded Navdanya in 1982.

5) **Narmada Bachao Andolan (1985):** Narmada Bachao Andolan is a social movement consisting of environmentalists, adivasis, farmers, and human right activists against the number of large dams being built across the river Narmada.

Sardar Sarovar Project on river Narmada has displaced about 90,000 people from 237 villages of M.P., Gujarat & Maharashtra. Many of them are jobless & have migrated to the cities for getting jobs.

Ms. Medha Patkar has played leading role in Narmada Bachao Andolan.

6) Development Alternatives (1983):

Labeled the Green Doer

Ashok Khosla empowered people by creating jobs, through Development alternatives an NGO that he formed in 1984.

He began working towards financial, social & environmental sustainability at the grass root level.

Over the years his 15 environmentally sound & commercially viable technologies have generated more than 3 lakh jobs across India.

7) Tarun Bharat Sangh (1985) :

Rajinder Singh - Founder of Tarun Bharat Sangh & winner of the 2001 Ramon Magsaysay Award.

He brought water to about 850 parched villages in Rajasthan & motivated villagers to harvest rainwater.

He advocated small ponds & check dams but did not oppose big dams or canal network blindly.

8) Saving the Western Ghats :

Western Ghat - Home to sanctuaries like Bandipur & agarhole - having rich biodiversity was struck by an epidemic - deforestation in the 1980's.

The Govt. Forest Dept. estimated that within the last 3 decodes 4.5 million hectares of forests (an area the size of Tamil Nadu) has vanished.

The Kailash Malhotra led save the Western Ghat March, a100 day padayatra across the hills succeeded in importing the message of environmental degradation & human rights.

9) Pani Adva, Pani Jirva :

(Obstruct flowing water to increase percolation of water)

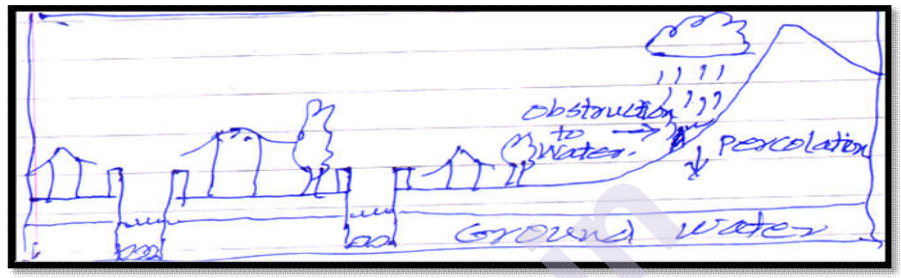
Shri Anna Hajare (Shri Kisan Baburao Hajare) born on 15 June 1937, promoted this environmental movement. He was in Indian Army. After his retirement he developed his village Ralegansiddhi. He implemented various programmes for the conservation of water.

Pani Adva, Pani Jirva means instead of building big dams obstruct water flowing along the slopes so that more water will percolate in the ground. This groundwater reserve of water becomes sufficient to provide water to the wells throughout the year. Shri Anna Hajare also promoted following social movements.

1) Indian Anti - corruption movement.

2) Right to Information

He received prestigious Padma Shri (1990) and Padma Bhusan (1992) awards.



10) Save Taj Movement :

Taj Mahal is located on the banks of river Yamuna in Agra, U.P. It was constructed in the period 1635-1653 and is one of the Seven Wonders of the World. In 1983 UNESCO has declared it as world Heritage site. About 14,00,000 tourists visit this place every year.

Agra has been identified as a 'Pollution intensive zone' by WHO. Mathura oil refinery is at a distance of 50 kms. There are more than 2000 factories in this zone which contribute to pollution.

About 95,000 vehicles pass through this zone every day.

Population of this area is 5.5 million & tourist population is 14,00,000 annually.

About 50,000 diesel generators are used in this area. Poor local people use Kerosene stoves, coal & wood for cooking hence & smoke contribute to pollution.

Prof. Dave of JNU was first to express his views about this problem of white marble of Taj Mahal is becoming yellow due to pollution.

Govt. has declared an area of about 10,400 sq. kms. around Taj as protected area.

11) Target Soft Drinks (2003) :

Sunita Narain - Director, Centre for Science & Environment (CSE) threw two cola giants - Coca Cola & Pepsico in the line of fire as 12 major brands of soft drinks in Delhi showed 15 to 87 times more levels of deadly pesticides known to cause cancer & other diseases.

12. Environmental Movements in Maharashtra:

1) Narmada Bachao Andolan

2) Save Western Ghat

3) Pani Adva, Pani Jirva

4.11 SUMMARY

Life is ultimately about choices and so is pollution. Our environment is a complex, variable and extensive system. Hence protecting the environment is a hard and enduring task. Much is being done to control, monitor and rectify damage done by pollutants. The problems are diverse and some are only being recognised. So it is very important to keep a close control over pollutants so that we can maintain the environment in an acceptable condition for future generations. We can live with sewage-strewn beaches, dead rivers, and fish that are too poisonous to eat. Or we can work together to keep the environment clean so the plants, animals, and people who depend on it remain healthy. By educating the citizens and making them aware in environmental protection, consumption motives and commuting habit we may hope to breathe fresh air, taste clean drinking water and experience a comfortable natural environment.

4.12 CHECK YOUR PROGRESS/ EXERCISE

9. True and false

a. Trees absorb Oxygen from the air and enrich the air with carbon dioxide.

b. The three main causes of pollution are effluents, wastes and emissions.

c. A classic example of a primary pollutant would be the sulphur-dioxide emitted from factories.

d. Oxygen is released from cattle during digestion and Methane is released from plants during Photosynthesis.

e. Sewage disposal affects people's immediate environments and leads to water-related illnesses such as pneumonia.

10. Fill in the blanks

a. _____of land is land pollution.

b. Overabundance of plant life can result in environmental damage called '_____'.

c. Waters with total dissolved solids of less than _____ per litre are most suitable for drinking purpose.

d. Fodd droppings, paper products as well as vegatation like grass and twings, are _____ while others are not and they include plastics, metals and aluminium cans, broken computer, car parts etc.

e. In most of the developing countries increasing rate of soil erosion is due to _____ and _____ agricultural practices.

11. Multiple choice question

a. Water pollution is the act of contaminating

i. water bodies such as rivers, oceans, lakes, streams, aquifers, and groundwater.

ii. vehicles that carry drinking water from one place to another.

iii. water stored in the tanks in a township.

b. Harmful gases like nitrogen oxides and sulphur oxides are released into the atmosphere during

i. the burning of paper

ii. the burning of fossil fuels

iii. the burning of cooking gas

c. The major kinds of pollution are

i. food pollution, water pollution, and land pollution.

ii. air pollution, water pollution, and land pollution

iii. air pollution, food pollution, and light pollution

d. Following are some of the major sources of environmental pollution:

i. sound sources, agricultural sources, biogenic source

ii. pesticides, odours and biogenic sources

iii. industrial sources, agricultural sources, biogenic sources

e. One of the reasons responsible for the deteriorating health conditions of workers in a mine is

i. during mining dust and chemicals are released in the air causing massive air pollution.

ii. during mining polluted water is released from the mine causing massive land pollution.

iii. during mining chemicals are released in the water causing water pollution.

12. Answer the Following Questions

1. What is pollution? Elaborate your answer classifying pollution.

2. Describe the sources of pollution.

3. What do you understand by the term pollutants? State its nature.
4. State the major causes of pollution.
5. What is air pollution? How does burning of fossil fuels affect air pollution?
6. What are the impacts of air pollution?
7. State different types of water pollution. What are factors that cause water pollution?
8. What are the impacts of water pollution?
9. What are the measures of noise pollution?
10. Write short notes on:

a. Effect of toxic pollutants on water quality

b. Causes of Noise Pollution

c. Industrial waste

d. Dust emissions

e. Indoor air pollution

4.13 ANSWERS TO THE SELF LEARNING QUESTIONS.

1. a. false, Trees absorb carbon dioxide from the air and enrich the air with Oxygen

1. b. true

1. c. true

1. d. false, Methane is released from cattle during digestion and Oxygen is released from plants during Photosynthesis.

1. e. false, Sewage disposal affects people's immediate environments and leads to water-related illnesses such as diarrhoea.

2. a. Degradation

2. b. entrophication

2. c. 500 mg

2. d. biodegradable

2. e. deforestation, faulty

4.a.i.

4.b.ii.

4.c.ii.

4.d.iii.

4.e.i.

4.14 TECHNICAL WORDS:

- **Pollution**-the presence in or introduction into the environment of a substance which has harmful or poisonous effects.
- **Air pollution**-the presence in or introduction into the air of a substance which has harmful or poisonous effects.
- **Land pollution**-is degradation or destruction of earth's surface and soil, directly or indirectly as a result of human activities
- **Noise pollution**-harmful or annoying levels of noise.
- **Landfill**-the disposal of waste material by burying it, especially as a method of filling in and reclaiming excavated pits.
- **Trophic level**-A feeding level within a food web
- **Sewage**-waste water and excrement conveyed in sewers.

4.15 TASK

- In a chart draw a table and define pollution and state its classification with examples.

4.16 REFERENCES FOR FURTHER STUDY

- Concepts of Environmental Science Paperback – 2017 by Sugandha Mishra and Dhirendra Kumar
- Textbook of Environmental Studies for Undergraduate Courses Paperback – by Erach Bharucha
- Encyclopaedia of Teaching Environmental Sciences by A. K. Singh

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5

SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL MANAGEMENT

Unit Structure :

5.1 OBJECTIVES

By the end of this unit you will be able to

- Understand the concept and need of sustainable development
- Learn the environmental issues and sustainable development
- Know about sustainable agriculture
- Understand the energy crisis
- Study about eco-friendly life style

5.2 INTRODUCTION

In the first unit we have learnt the definition of Environmental Geography along with its Nature and Scope. We have discussed ecosystem also. In the second unit we have studied the concept of resources, classification of resources and environmental problems associated with forest, water and minerals. Bio-diversity, its concept and types along with hotspots of bio-diversity and biodiversity in India with emphasis on Western Ghat have also been studied. In the third unit we studied air, water, land and noise pollution in details. In the present unit we are going to study the concept and need of sustainable development along with environmental issues and sustainable development. We will also learn sustainable agriculture. In the latter part of this third unit we will study energy crisis and eco-friendly life style.

5.3 SUBJECT-DISCUSSION

In our common home earth, survival and development are not possible without the environment. Our environmental resources are limited. With technological discoveries and industrialisation an increasing trend in human needs is noted. A new approach to living is called for because old models of consumption and industrialization are not going to support the world's increasing population. Moreover we should make our development activities enable in such a way that it can continue in the long term. If we wish the water, materials and natural resources to thrive, new ways to deal with this situation must be sorted out. In that way we will leave what we have got for the generation to come. So we must use the resources wisely, carefully and responsibly to let the future generation live the comfort we lived. This is called sustainable development.

Sustainability is a balancing act. The United Nation's 1987 Report of the World Commission on Environment and Development: Our Common Future noted that sustainable development meets the needs of the present without compromising the well-being of future generations. To achieve these lofty goals, humans will have to re-examine their policies on:

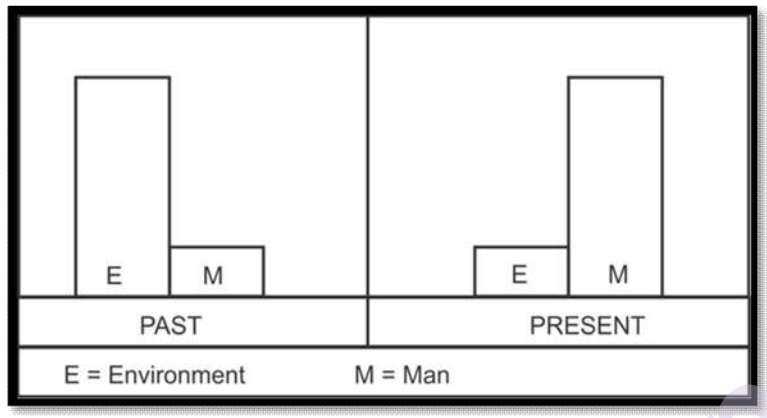
- Environmental protection.
- Social responsibility.
- Economic practice.

5.4 CONCEPT AND NEED OF SUSTAINABLE DEVELOPMENT

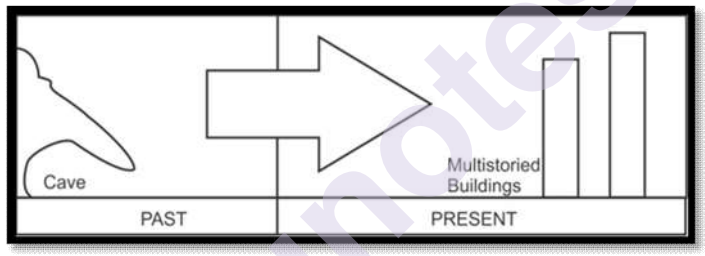
Our Earth was formed about 4600 million years ago. All forms of life like Plants, Animals, Fish, Birds, and Insects etc. appeared on the earth much before the emergence of man. Man appeared on the earth about 2 million years ago.

In the initial stage of development man was dominated by the nature. Man has ability to think and find cause - effect relationship. Thus he found the

secrets behind the environmental forces; through the development of science and technology. Now he has started dominating on the environmental. He is using environmental resources for his own benefit. His activities have become harmful to the nature.

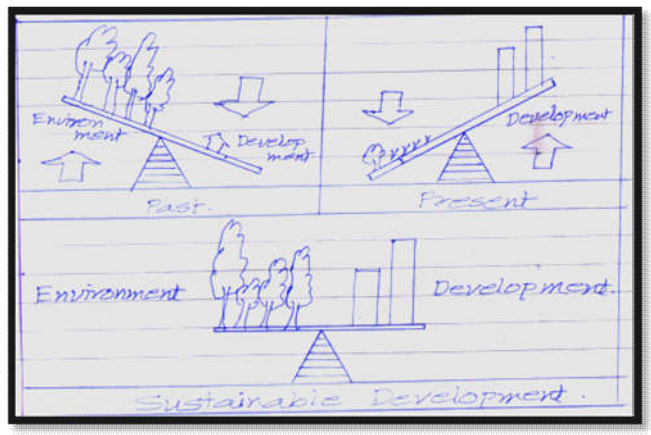


In the initial stages of development man was living in the caves. Today he has modern home with many amenities. Hence we say that modern man is more developed than the man in the past.



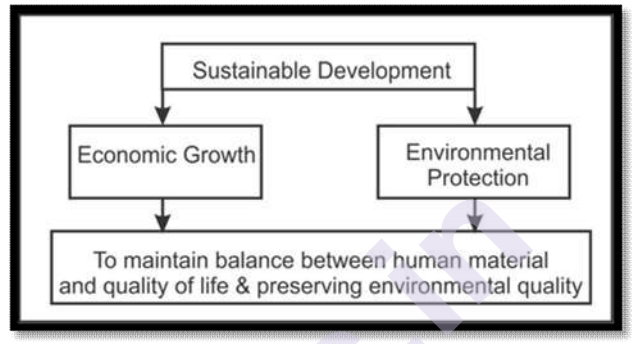
The development of man depends on the environmental resources which are exploited by man on very large scale. So it will be difficult to continue similar type of development in the future without the environmental resources.

Hence we require sustainable development that means our development should continue for a longer period of time. If is possible we must understand this concept and control our greed of exploiting environment.



Sustainable Development is a balance between environmental conservation and development. G.H. Harlem (1987) has defined sustainable development as follows. Sustainable development means to meet the needs and aspiration of the present without compromising the ability to meet those of future.

According to W.E. Cunningham and M.A. Cunningham (2000) - Sustainable development means progress in human well being that we can extend or prolong over many generations rather than just few years. The benefits of sustainable development must be available to all humans & not just to a privileged group.



There is an urgent need to implement the concept of sustainable development immediately at all levels of the society, otherwise our future generations may face severe problems, which may affect their survival. To achieve this we can conserve our environmental resources.

5.5 ENVIRONMENTAL ISSUES AND SUSTAINABLE DEVELOPMENT

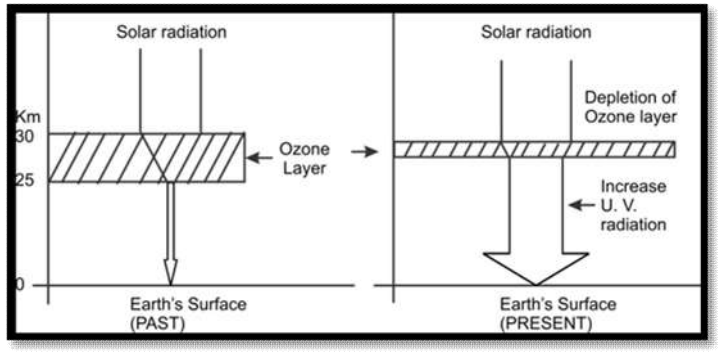
5.5.1 Environmental Issues:

1) Depletion of Ozone layer
2) Global warming - Greenhouse effect
3) Acid rain
4) Desertification
5) Deforestation
6) Conservation of Bio diversity
7) Uncontrolled use of resources

1) Depletion of Ozone layer:

Ozone layer is found at the height of 25 to 30 kms from the Earth's surface. This layer obstructs U.V. radiation coming from the sun. Hence the amount of U.V. radiation reaching earth's surface is controlled. This layer of Ozone is depleting due to manmade gases like CFC. One molecule of CFC can destroy more than 1000 molecules of Ozone. Ozone

hole has formed over Antarctica, which is enlarging due to depletion of Ozone.



CFC is used in refrigeration and different types of sprays e.g. body sprays etc. We can avoid using such products in which CFC is used. We cannot stop using refrigeration because it is essential but at least we can avoid using body sprays.

2) Global warming - Green House Effect:

Earth receives solar radiation. Earth surface is heated & it emits radiation. Hence the balance is maintained between incoming & outgoing radiation - heat. So for many centuries temperature of the earth was constant.

Due to intensive human activities, increase in population, development in science & technology different Green House gases like Methane, CFC, CO_2 etc. were released into atmosphere o a large scale. These gases absorb outgoing radiation & thus are responsible for increasing temperature of the earth. Though the increase in the temperature of the earth is very gradual, it can have very hazardous effects.

- Some of the evidences of Global Warming are as follows:

1) Melting of the glaciers.

2) Records of temperature

3) Rise in the sea level

4) Warming of ocean waters

5) Upward shifting of snowline in tropical & sub-tropical areas

6) Changes in the climatic conditions - variations in the rainfall.

7) Spread of tropical diseases in the temperate & polar areas

Deforestation has reduced capacity of the atmosphere to absorb CO_2 so we should plant more trees to restore capacity of atmosphere to absorb CO_2.

We should use bicycles instead of motorcycles & cars to reduce pollution & emission of CO & CO_2 into atmosphere.

We can spread awareness about this important issue in the society.

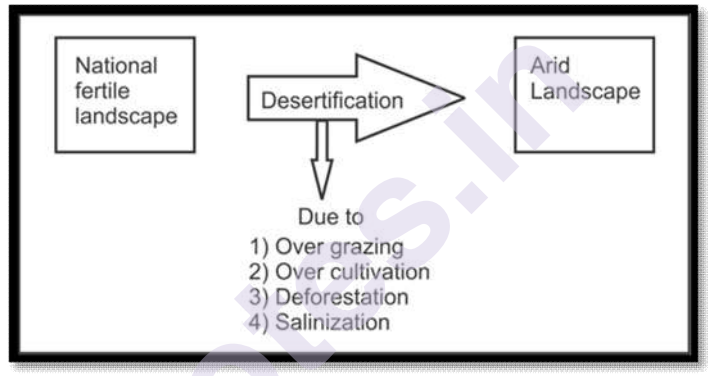
3) Acid Rain:

Industrial pollutants like Sulphur dioxide, nitrogen oxides are dissolved in rain water and the rain water becomes acidic (sulphuric acid). The acid rain is hazardous for the aquatic life in the ponds, fish population has decreased tremendously. It is also harmful to plants, crops and human beings.

Acid rain is a global problem and hence we can spread awareness about this problem and help environmentalist to reduce the level of pollution and hazardous gases from the industries.

4) Desertification:

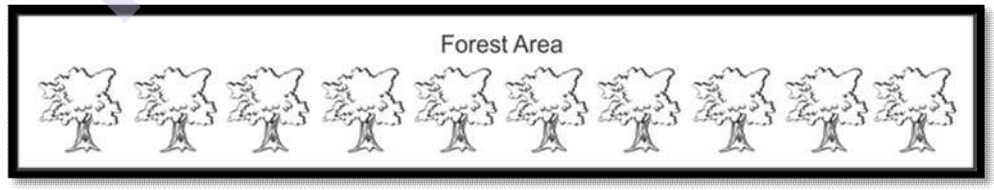
The term desertification refers to the conversion of natural fertile landscape into arid - desert like landscape due to human activities.

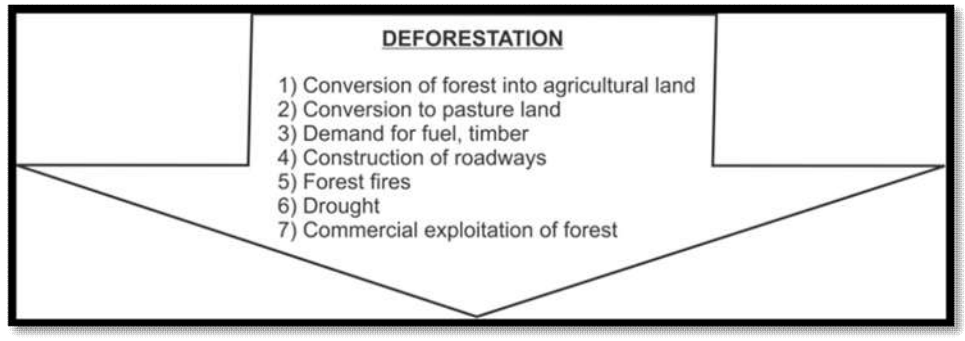


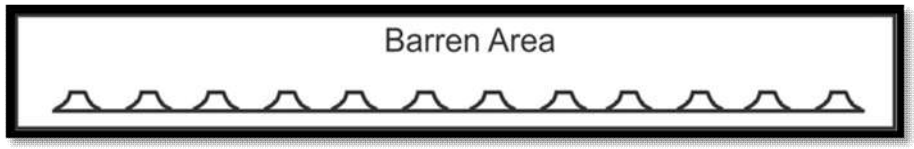
According to U. N. estimate about 40% non desert land of Africa, 33% of Asia & 20% of South America is likely to be converted into desert.

Desertification can be controlled by reducing over grazing, over cropping, deforestation and over irrigation.

5) Deforestation - Cutting of trees / forest on a large scale:







Deforestation is a serious problem in Brazil & India.

We should reduce the use of wood in our daily life. We can use other substitutes like plastic. At the same time we should plant more trees to compensate loss done by the deforestation.

6) Conservation of Biodiversity:

We find variation w.r.t. relief, climate vegetation, and animal life in different parts of the world. Flora & fauna found in a particular region are unique in character & hence it is our duty to conserve Biodiversity (Plants, animals, insets etc) of the region.

The major cause of the loss of biodiversity is expansion of human activities. We should control our greed of superimposing cultural landscape. Many species of plans & animals have already become extinct. This loss is irreversible. Many plants are unknown to use they have wonderful properties and can help in various problems related to man. Hence we should conserve our diversity of plants & animals by protecting them and spreading awareness about this issue in the society.

7) Uncontrolled use of resources:

The root cause of all environmental problems is the human greed & his uncontrolled use of resources. Human wants are unlimited. They are never satisfied. As Mahatma Gandhi said, 'Our Earth has sufficient resources to fulfill the needs of everyone but not the greed of anyone.'

Charity begins at home & so we should start reducing our requirements, unwanted purchases & our greed. We can spread awareness about this issue in the society.

5.6 SUSTAINABLE AGRICULTURE

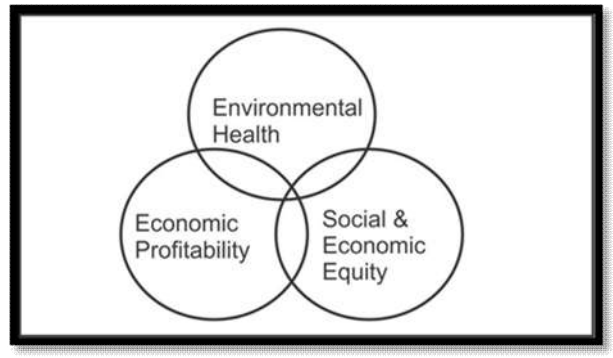
Sustainable agriculture means the production of food, animal products, fiber etc. using farming techniques that protect the environment, public health, human communities and animal welfare.

5.6.1 Sustainable agriculture integrates three main goals -

1) Environmental health

2) Economic profitability

3) Social and economic equity



Sustainable agriculture

5.6.2 There are many techniques used by the people working in the field of sustainable agriculture. They are as follows:

1) Promote soil health by using organic fertilizers.

2) Restrict use of water by using minimum amount of water which is essential for the crops

3) Reduce Pollution level by using Organic fertilizers & pesticides.

Sustainability means the principle that we must meet the needs of the present without compromising the ability of future generations to meet their own needs. Hence stewardship of both natural & human resources is very important. Stewardship of natural resources means maintaining & enhancing the vital resource base for the long term. Stewardship of human resources means consideration of social responsibilities such as working & living conditions of labourers, the needs of rural communities & consumer health & safety both in the present & the future.

Everyone of use can play a crucial role in creating a sustainable food system. → Food Production → Processing → Distribution → Marketing → Consumption → Waste recovery. Etc.

Sustainable agriculture normally requires a series of small and realistic steps.

5.7 ENERGY CRISIS

In the initial stages of development man was living in the cave. He was using fire for his energy needs. With the development in science and technology man developed many alternative sources of energy. At the same time he developed many modern types of equipment which require different forms of energy.

Each source of energy has some advantages and some drawbacks. Many of these energy sources are localized in a particular area. Their distribution is not same everywhere.

With increase in population and poverty the distribution of energy has become very uneven. Developed countries & rich people in the developing

countries have less problem of energy but the poor people in the underdeveloped countries face the problem of energy crisis.

An energy crisis is defined as any significant battlement in the supply of energy resources to an economy.

Over population, unequal distribution of existing energy and wastage of energy are the major causes of energy crisis.

In order to avoid energy crisis in the future we should control our growing population, find out ways for equal distribution of energy and reduce wastage of energy.

Coal & Oil resources are termed as fund resources. These are limited in supply. Hence we must use these resources carefully. At the same time we should give more emphasis on renewable sources of energy as solar energy, wind energy, tidal energy & geothermal sources of energy.

We should use energy only when it is essential. We can switch off the fan & lights when not required - at homes, offices, railway etc. We can also develop equipments which consume less energy. e.g. instead of ordinary bulbs we can use CFL bulbs.

5.8 ECO-FRIENDLY LIFESTYLE

Eco-friendly lifestyle means all actions of all individuals which are useful for the environment. e.g. It also includes using alternative energies as solar energy, wind energy, or hydro electricity instead of using energy from crude oil or coal.

We can reduce our requirements, recycle & reuse our resources.

5.8.1 Some simple solutions for adopting eco-friendly lifestyle are stated under:

1) Grow your own food if possible.
2) Eat less meat, consume more vegetables.
3) Avoid processed food.
4) Open windows for fresh air.
5) Use maximum day light.
6) Use energy efficient appliances and electronics.
7) Take short showers - avoid tub - baths.
8) Dry clothes using natural sunlight.
9) Use waste water of bathroom & kitchen for plants in the garden.
10) Switch off fans & lights when not in use.
11) Close water tap while brushing your teeth or shaving.
12) Use washing machine only when there is full load.

13) Use public transportation instead of private car.
14) Use bicycle.
15) Avoid chemical cleaners, use natural materials.
16) Use less photocopies.
17) Avoid use of wooden furniture.
18) Recycle newspapers, bottles, cans etc.
19) Use cotton bags for grocery items.
20) Avoid food wastage.
21) Practice composting waste food.
22) Plant more trees.
23) Opt for paperless billing & other processes.
24) Go cashless - use card for payments.
25) Avoid leakage of water.
26) Use old clothes for cleaning floor.
27) Read newspapers, books online.
28) Avoid disposable products (one time use)
29) Give your old clothes & other items to the poor needy persons.
30) Spread awareness about the eco-friendly lifestyle in the society.

5.9 BIOSPHERE RESERVE IN INDIA AND MANAGEMENT

In india 18 Biosphere Reserves in India. A Biosphere Reserve is an area of land and/or sea designated by UNESCO as being of outstanding universal value because of its ecological features. The article explains that these reserves are important for the conservation of biological diversity and the sustainable use of natural resources. Firstly, there are 18 Biosphere Reserves in India, among which 12 Biosphere reserves in India find their place in UNESCO's List of Man & Biosphere Reserves Programme. This article contains the Map of all the Biosphere reserves in India. The table below shows the exact details of every Biosphere Reserve in India, its year of formation, and the biosphere reserve area.

What is Biosphere?

The Biosphere includes all the living components of the Earth. It consists of all plants and animals, including all the micro Organisms that live on Earth and their interactions with the surrounding environment.

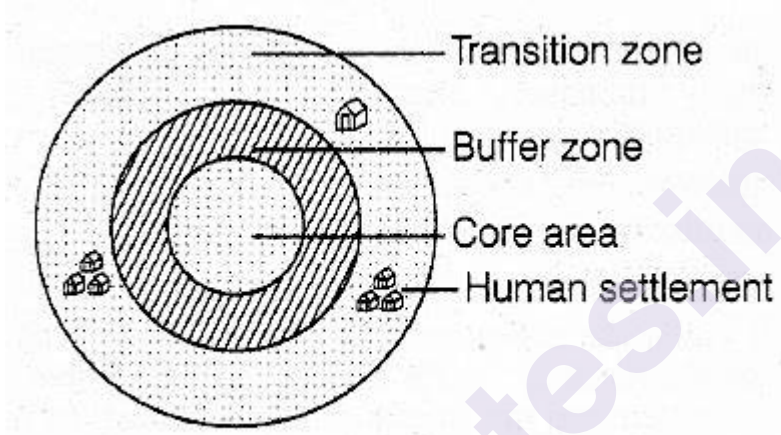
Most of the organisms exist in the lithosphere, the hydrosphere, and the atmosphere. Many organisms move freely from one realm to the other. All these together constitute the Biosphere.

What is Biosphere Conservation?

Since 1986, the Government of India has been implementing a programme known as Biosphere Reserve, which provides financial assistance in the proportions of 90:10 to the Northeastern Region States and three Himalayan states and 60:40 to other states for the upkeep, improvement, and advancement of certain components. The Central MAB Committee reviews and approves the Management Action Plan drafted by the State Government.

Zoning Schemes of Biosphere:

The zonation of each biosphere reserve in India or any other Biosphere reserve should include:



Zonation in terrestrial biosphere

Core area

Human interference in the core area is restricted.

The core area of Biosphere Reserves generally consists of national parks and sanctuaries protected under the wildlife protection act 1972.

Core areas of the biosphere reserve are securely protected sites for conserving biological diversity. Monitoring these minimally disturbed ecosystems and undertaking non-destructive research and other low-impact uses such as education.

In addition to its conservation function, the core area of the reserves contributes to a range of ecosystem services, e.g. carbon sequestration, supply of clean water and air, soil stabilization.

Buffer zone

Buffer zone generally surrounds or adjoins the core regions and can be used for activities compatible with sound environmental practices, such asenvironmental education, recreation, Ecotourism applied and basic research.

The buffer zone of the biosphere reserve also has a critical connectivity function in a larger spatial context as they connect biodiversity components within core areas with those in transition areas.

Buffer zones also have intrinsic functions of maintaining anthropogenic, biological, and cultural diversity in the biosphere reserves.

Transition area

It is the outermost area of the Biosphere Reserves.

Transition Area plays a central function in sustainable development. Transition Areas may contain a variety of agricultural activities, settlements, and other uses.

Local communities, management agencies, scientists, NGOs, cultural groups, and other stakeholders work together to manage and sustainably develop the area's resources.

5.10. ENVIRONMENTAL IMPACT ASSESMENT

Environmental Impact Assessment (EIA) is a tool used to assess the significant effects of a project or development proposal on the environment.

EIAs make sure that project decision makers think about the likely effects on the environment at the earliest possible time and aim to avoid, reduce or offset those effects. This ensures that proposals are understood properly before decisions are made.

Stages of the EIA process

EIA has 5 main stages. If an EIA is required, an Environmental Assessment Impact Report will be written and submitted with the application for development consent. The public will have the chance to comment. This makes sure you're given a chance to be involved in decision making.

The following points highlight the ten main stages of environmental impact assessment. The stages are:

1. Identification

2. Screening

3. Scoping and Consideration of Alternatives

5. Impact Prediction

5. Mitigation

6. Reporting To Decision-Making Body

7. Public Hearing 8. Review (EIA Report)

9. Decision-Making

10. Post Project Monitoring & Environment Clearance Condition.

Stage # 1. Identification:

The first step is to define a project and study all the likely activities involved in its process so as to understand the range and reach of the project. This helps in deciding the possible zones of environmental impacts.

Stage # 2. Screening:

Screening is done to see whether a project requires environmental clearance as per the statutory notifications.

Screening criteria are based upon:

(i) Scales of investment

(ii) Types of development

(iii) Location of development

A project will have several ramifications biophysical or environmental, economic and social. Hence, it requires some degree of public participation. The law for EIA varies from country to country. If screening shows that a project necessitates EIA, it moves to the next stage. Some projects may not require EIA. It is generally determined by the size of the project and is sometimes based on the site-specific information.

The output of the screening process is a document known as "Initial Environmental Examination or Evaluation (IEE)", based on which the decision is taken whether an EIA is needed and if so, to what extent.

Stage # 3. Scoping and Consideration of Alternatives:

Scoping is the procedure of identifying the key environmental issues and is possibly the most important step in an EIA. Scoping means the scope or range of the EIA report.

It undertakes the project's effect on the air, water, soil, noise level, air quality and physical impact.

Stage # 5. Impact Prediction:

Impact Prediction is a way of 'mapping' the environmental consequences of the signifi-cant aspects of the project and its alternatives.

There are two steps in impact analysis:

(i) Identification:

Identification of the impacts would have been initiated in the scoping stage itself. These initial identifications may be confirmed and new ones are added as and when the investigations reveal.

(ii) Prediction of Impacts:

Predication of impacts is both qualitative and quantitative. The scale and severity of an impact is determined by whether it is reversible or irreversible. If the impact is reversible, then it may be taken as low impact. If the adverse impact cannot be reversed then the impact is said to be high.

Stage # 5. Mitigation:

This stage includes recommended actions that can offset the adverse impacts of the project. This is done with the idea of lessening the negative effects and improving the scope for project benefits.

Stage # 6. Reporting To Decision-Making Body:

The project authorities have to furnish the following documents for environmental appraisal of a development project.

(i) Detailed project report (DPR)

(ii) Filled in questionnaire

(iii) Environmental impact statement (EIS): EIS should provide the possible impact (positive and negative) of the project.

Stage # 7. Public Hearing:

After the completion of EIA report the law requires that the public must be informed and consulted on a proposed development after the completion of EIA report.

Any one likely to be affected by the proposed project is entitled to have access to the executive summary of the EIA.

Stage # 8. Review (EIA Report):

Once the final report is prepared, it may be reviewed based on the comments and inputs of stakeholders.

Stage # 9. Decision-Making:

The final decision is based on the EIA to approve or reject the project. This is open to administrative or judicial review based on procedural aspects.

Stage # 10. Post Project Monitoring & Environment Clearance Condition:

Once a project is approved, then it should function as per the conditions stipulated based on environmental clearance. These conditions have to be strictly monitored and implemented.

Monitoring should be done during both construction and operation phases of a project. This is not only to ensure that the commitments made are complied with, but also to observe whether the predictions made in the EIA reports were correct or not.

5.11 SUMMARY

The concept of sustainable development is new. The environmentalists have become worried knowing about the excessive utilization of the natural resources. Due to destruction of natural resources in the recent times they started to advocate for better exploitation of nature. However, the term was first used in 1980 by the World Conservation Strategy which explained sustainable development as a path to human progress that has the capacity to continue in the long term. As a result of expansion of human activities there have been great losses of biodiversity. Many species of plans & animals have already become extinct. This loss is irreversible.

After going through this unit we have learnt that the need and importance of sustainable development are to balance our economic, environmental and social needs, allowing well-being for present and future generations.

5.12 CHECK YOUR PROGRESS/ EXERCISE

1. True and false

a. Our Earth was formed about 4600 million years ago.

b. The development of man depends on the environmental resources which are exploited by man on very small scale.

c. Oxygen layer is found at the height of 25 to 30 kms from the Earth's surface.

d. Deforestation has reduced capacity of the atmosphere to absorb CO2 so we should plant more trees to restore capacity of atmosphere to absorb CO2.

e. Desertification can be controlled by increasing grazing, cropping and deforestation.

2. Fill in the blanks

a. Sustainable Development is a balance between environmental _____and development.

b. One molecule of CFC can destroy more than _____ of Ozone.

c. We should use _____ instead of motorcycles & cars to reduce pollution & emission of CO & CO2 into atmosphere.

d. The term _____ refers to the conversion of natural fertile landscape into arid - desert like landscape due to human activities.

e. Over population, unequal distribution of existing energy and wastage of energy are the major causes of _____.

3. Multiple choice question

a. Some of the evidences of Global Warming are as follows:

i. Melting of the glaciers, Records of temperature, Rise in the sea level

ii. Spread of polar diseases in the temperate and tropical areas, cooling of ocean waters, Rise in the sea level

iii. No changes in the climatic conditions, fall of temperature, Rise in the sea level

b. Due to intensive human activities, increase in population, development in science and technology different Green House gases like

i. Oxygen, CFC, CO2 etc. were released into atmosphere o a large scale

ii. Nitrogen, CFC, oxygen etc. were released into atmosphere o a large scale

iii. Methane, CFC, CO_2 etc. were released into atmosphere o a large scale

c. There are many techniques used by the people working in the field of sustainable agriculture. They are as follows:

i. Promote soil health by using chemical fertilizers, use maximum amount of water which is essential for the crops, large scale use of organic fertilizers and pesticides.

ii. Promote soil health by using organic fertilizers, minimise the use of water by using ice which is essential for the crops, lessen Pollution level by using chemical fertilizers and pesticides.

iii. Promote soil health by using organic fertilizers, Restrict use of water by using minimum amount of water which is essential for the crops, Reduce Pollution level by using Organic fertilizers and pesticides.

d. Some simple solutions for adopting eco-friendly lifestyle are

i. Grow your own food if possible, eat less green vegetables, consume more meat, avoid processed food, and open windows only during rainy season, use energy efficient appliances and electronics.

ii. Grow your own food if possible, eat less meat, consume more vegetables, avoid processed food, open windows for fresh air, use maximum day light, use energy efficient appliances and electronics.

iii. Buy your own food from shops, eat more meat, consume less vegetables, eat processed food, do not open windows at home, use minimum day light, use energy efficient appliances and electronics.

e. Ozone hole formed over Antarctica

i. is decreasing due to depletion of Ozone layer.

ii. is enlarging due to depletion of Ozone layer.

iii. is enlarging due to depletion of Thermosphere.

4. Answer the Following Questions

1. What do you understand by the term Sustainable Development? Elaborate your answer with suitable examples.
2. State the need of Sustainable Development,
3. How are the Environmental Issues and Sustainable Development related?
4. Write a short note on:
   a. Sustainable Agriculture
   b. Energy crisis
   c. Eco-friendly life style

5.13 ANSWERS TO THE SELF LEARNING QUESTIONS

1.a. true

1.b. false, The development of man depends on the environmental resources which are exploited by man on very large scale.

1.c. false, Ozone layer is found at the height of 25 to 30 kms from the Earth's surface.

1.d. true

1.e. false, Desertification can be controlled by reducing over grazing, over cropping, deforestation and over irrigation.

2.a. conservation

2.b. 1000 molecules

2.c. bicycles

2.d. desertification

2.e. energy crisis.

3.a.i.

3.b.iii.

3.c.iii.

3.d. ii.

3.e.ii.

5.14 TECHNICAL WORDS:

- **Sustainable development**-economic development that is conducted without depletion of natural resources
- **Acid Rain:** The precipitation of dilute solutions of strong mineral acids, formed by the mixing in the atmosphere of various industrial pollutants (primarily sulphur dioxide and nitrogen oxides) with naturally occurring oxygen and water vapour.
- **Biodegradable:** Used to describe the properties of items that will naturally decompose if left in exposed outdoor environments.
- **Biodiversity**: The propensity in ecosystems (when untouched) to have a vast variety of plant, animal and other living species. Biodiversity encompasses habitat diversity, species diversity and genetic diversity.

- **Chlorofluorocarbons** (CFCs): Stable, artificially created chemical compounds containing carbon, chlorine, fluorine and sometimes hydrogen.
- **Emissions**: Emissions are particles and gases released into the air as byproducts.
- **Fossil Fuel**: Used to define a wide range of fuels derived from geologic extraction. Oil, Coal, Oil Shale, Natural Gas, etc.
- **Global Warming**: Refers to the increase in average temperatures the earth has experienced since the mid-twentieth century.

5.15 TASK

- In a chart draw a table and write down the simple solutions for adopting eco-friendly lifestyle.

5.16 REFERENCES FOR FURTHER STUDY

- "Environmental Ecology, biodiversity And Climate Change: Towards Sustainable Development" by H.M. Saxena
- "Sustainable Development: Linking Economy, Society, Environment" by Tracey Strange and Anne Bayley
- "Ecology And Sustainable Development" by P S Ramakrishnan
- "Management of Resources for Sustainable Development" by Sushma Goel
- "Energy, Environment and Sustainable Development: Issues and Policies" by S. Ramaswamy and Sathis G. Kumar

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QUESTION PAPER PATTERN

Time: 3hours		**Marks;100**
N.B.1.All questions are compulsory and carry equal marks. 2. Use of Map Stencils is permitted. 3. Draw sketches and diagrams wherever necessary.		
Q.1	Long answer question on Unit-I	20Marks
	OR	
	Long answer question on unit –I for 20 Marks or Two short answer questions each 10Marks	20Marks
Q.2	Long answer question on Unit-II	20Marks
	OR	
	Long answer question on unit –II for 20 Marks or Two short answer questions each 10Marks	20Marks
Q.3	Long answer question on Unit-III	20Marks
	OR	
	Long answer question on unit –III for 20 Marks or Two short answer questions each 10Marks	20Marks
Q.4	Long answer question on Unit-IV	20Marks
	OR	
	Long answer question on unit –IV for 20 Marks or Two short answer questions each 10Marks	20Marks
Q.5	Long answer question on Unit-V	20Marks
	OR	
	Long answer question on unit –V for 20 Marksor Two short answer questions each 10Marks	20Marks