Indira Gandhi National Open University
School of Sciences

BGGCT-135

ENVIRONMENTAL GEOGRAPHY

BLOCK

1

INTRODUCTION TO ENVIRONMENTAL GEOGRAPHY

UNIT 1
CONCEPTS AND SCOPE OF ENVIRONMENTAL GEOGRAPHY

UNIT 2
ECOLOGY AND ECOSYSTEMS

UNIT 3
BIOGEOGRAPHY

GLOSSARY

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BGGCT- 135
Environmental Geography

BLOCK 1 INTRODUCTION TO ENVIRONMENTAL GEOGRAPHY

BLOCK 2 HUMAN-ENVIRONMENT RELATIONSHIP

Block 3 Environmental Problems and Management

Block 4 Conservation of Environment

Block 5 Environmental Issues, Programmes and Policies

BLOCK 1: INTRODUCTION TO ENVIRONMENTAL GEOGRAPHY

Environmental geography explores the natural environment and human-nature interrelationship that is very important today within the environment along with its components. Studying an ecosystem is important to understand the relationships between organisms with their biotic and abiotic environments on the Earth is significant. Human ecology explains how humans have developed different forms of subsistence technologies for controlling environmental resources towards their food security and wellbeing since the very beginning of human evolution.

The geological and climatic processes affected the life of organisms in several ways that can be understood through historical biogeography while ecological biogeography is concerned with organisms' response to their surroundings. We explored the land extensively to observe organism's association with their natural environment that helped us to understand the complexities of natural phenomena. Interestingly, the distribution of organisms on our mother Earth is not uniform and is primarily influenced by the climatic conditions. Therefore, a distinct ecological community of plants and animals can be seen living together in particular geographical regions of the world.

This block introduces you the environmental geography dealing with the basic concepts and importance of the environment, ecology and ecosystems, and biogeography spread in three units.

Unit 1: Concepts and Scope of Environmental Geography:

This unit introduces the environment and its types, and the role of geographers in environmental studies. Environmental geography not only explains the physical and social environment but also highlights the need for environmental studies from the geographical perspective.

Unit 2: Ecology and Ecosystems:

We see several natural and human made features in our day to day life. These are arranged and interlinked in a particular way for their sustenance. To relate these interrelationships between organisms and the environment, we have introduced the ecology and explained the concept and structure of ecosystem, and human ecology.

Unit 3: Biogeography:

This unit introduces biogeography. We have explained the concept, scope, and classification of biogeography. You will also study various biogeographical regions or in other words biomes of the world.

We hope after studying this block, you will better understand the basic concepts and scope of environmental geography, ecology and ecosystems along with biogeography in particular. Our best wishes are with you in this endeavour.

UNIT 1

CONCEPTS AND SCOPE OF ENVIRONMENTAL GEOGRAPHY

Structure

1.1 INTRODUCTION

Geography has been derived from two Greek words ***'Geo'*** means *Earth* and ***'Graphy'*** means *Description* which implies description of the 'Earth'. It is indeed a discipline that describes the Earth's surface, its physical features as well as the human and their cultural features along with the spatial distribution of both the features. With the growth and development of human civilisation and advent of science, geography has been considered as a scientific interpretation of areal differentiation in the 'human-environment relationship'. Since beginning of the subject, geography as the study of the Earth's surface has focused on the natural environment on one hand and the human made cultural environment on the other. Peter Hagget (1977) in his book on "*Geography- A Modern Synthesis*" emphasised that "geography is concerned with two major interacting systems i.e. the ecological systems (Ecosystem) that links man with his environment and the other one is the 'Spatial System' that links one region of the Earth with another". Savindra Singh in his book "*Environmental Geography*" mentioned that it is the study of the inter-relationship between the living organisms and its natural environment as well as the relationship between technologically advanced "economic man and his natural environment" in the present context. Since 1970, the geography

departments of most of the universities have included environmental studies in their under graduate and post graduate level programs as '*Environmental Geography*'.

In this Unit, you will study the subject of environmental geography, types of environment and the geographer's role in environmental studies. Section 1.2 explains you about meaning and the concept of environmental geography followed by various types of environment including physical and social in Section 1.3. You will also study the role of geographers in environmental studies in Section 1.4.

Expected Learning Outcomes

After studying this unit, you should be able to:

- explain the concept and scope of environmental geography;
- describe the types of environment; and
- ascertain the role of geographers in environmental studies.

1.2 MEANING AND CONCEPT OF ENVIRONMENTAL GEOGRAPHY

Geography has inherited the concept of environmentalism from Greek philosophers that environment determines the man and his activities. Subsequently environmental focus in geography appeared in the nineteenth century significant contributions of German geographers. Alexander Von Humboldt, the founder of modern geography demonstrated the man's dependence on his environment by putting forward the doctrine of environmental determinism emphasising the role of environment on the type of life in a geographic location. Carl Ritter, a German geographer also propounded the influence of environmental factors on human activities and even on human behaviour as described in his book '***Erkunde***'. Fredric Ratzel in his classical literature '***Anthropogeography***' illustrated his thoughts on environmental impact on man. Gradually with the advent of science and technology and emergence of environmental issues and challenges across the globe, the environmental focus in geography has shifted to a branch of knowledge within the subject shown as '**Environmental Geography**'. A. N. Strahler (1977) has discussed the geographical aspects and its relationship with environment in his book "***Geography and Man's Environment***" focussing on the theme that man and land convey the essence of geography.

Now, we can understand that the environmental geography is the branch of geography that describes the spatial aspects of interactions between humans and the natural world. It is the study of systematic description of different components of environment and interactions of human with these components and their spatial variation over the Earth's surface. It is multidisciplinary in nature and is related to other disciplines like life sciences, physical sciences, ecological sciences, chemical sciences and humanities like economics, sociology and public administration etc. It is concerned with the

spatial attributes of all the phenomena related to the environment. It studies the various biomes and human influence, patterns of biodiversity at the global, national and local level, studies the spatial pattern of physical and anthropogenic degradation of environment. Various environmental issues and problems like global warming, climate change, natural hazards and disaster management, loss of biodiversity and environmental degradation and its variation across the globe are also the major thrust areas of environmental geography. Environmental conservation, management and sustainable development are also an integral part of the scope of environmental geography.

Variations in the ways how people inhabit and use environments in places, and the processes (natural and social) that operate at different scales to alter those environments and the lives of people relying on them, are strong focus areas of environmental geography. Environmental geography uses a critically important set of spatial and analytical tools for assessing the impact of human presence in the environment by measuring the result of human activity on natural systems. By its very nature, environmental geography is a discipline that seeks to integrate and synthesize knowledge of man-environment relationship in a spatial frame. Thus, the scope of environmental geography revolves around the study of the biotic and abiotic components of environment and their spatial interrelationship encompassing the four vital spheres of the Earth i.e. lithosphere, atmosphere, biosphere and hydrosphere. Given the scope and contents of the subject, environmental geography can prepare students for careers in environmental planning and conservation, environmental assessment and monitoring, resource management, environmental hazards and their management and environmental education etc. Students studying this programme will develop competencies in a broad interdisciplinary areas of the natural and social sciences, as well as complementary spatial and analytical techniques.

SAQ 1

Define environmental geography.

1.3 TYPES OF ENVIRONMENT

You have understood the scope and importance of the subject environmental geography. Let us now study the broad components of environment. Environmental geography is primarily centered around three focus areas in its study. These are:

1) environment,
2) human, and
3) human and environment interactions.

In its broadest sense, environment refers to our immediate surroundings in which all living and non-living components co-exist. It includes both the biotic

and abiotic components around us. We live in an environment which is natural as well as human-made. These are the surrounding conditions in which humans, animals and plants live. Every individual living in environment has an impact on it whereas the environment also influences an individual's behaviour and spatial activities. Environment and the organisms are two dynamic and complex components of the nature. Environment largely regulates the life of the organisms including human beings.

Environment is the sum of conditions that surrounds us at a given point of time and space. It is comprised of the interacting systems of physical, biological and cultural elements which are interlinked both individually and collectively. It is also the conditions in which an organism has to survive or maintain its life process. It influences the growth and development of living forms. It consists of atmosphere, hydrosphere, lithosphere and biosphere. The chief components of environment are soil, water, air, organisms and solar energy. It has provided us all the resources for leading a comfortable life. Thus, it can be stated that individuals and environment are interrelated and complementary to each other. The environment can be broadly classified into two major categories such as natural or physical environment and human-made social environment. You need to study the following sub-sections to understand about these two types of environments in detail.

1.3.1 Physical Environment

Physical environment is the terrestrial environment which is a creation of complex natural environmental conditions. Earth's surface features such as rivers, mountains, deserts, land, water, oceans, volcanoes and atmosphere are the examples of physical environment. Although, all these grew or developed independent of humankind, it is the outcome of direct interactions of human, society and nature. Therefore, the examples of physical environment includes all living and non-living things occurring naturally on the Earth. It is often used as a synonym for natural environment. Geography of environment is also called as the physical environment of human. Physical environment comprises of the study of the atmosphere, lithosphere, hydrosphere and biosphere (Fig.1.1). This can be called 'natural environment' as it consists of things that are provided by nature. Simultaneously, it can also be called 'physical environment' as it includes the physical conditions for the evolution and substance of life. The geographic or physical conditions exist independently of human's existence. Human has limited and often no control over them. This environment includes; the surface of the earth, natural re-sources, land and water, mountains and plains, fertile lands and deserts, oceans, storms and cyclones, weather and climatic factors, seasons, etc. It also includes biological conditions such as plants, animals together with all their complexities.

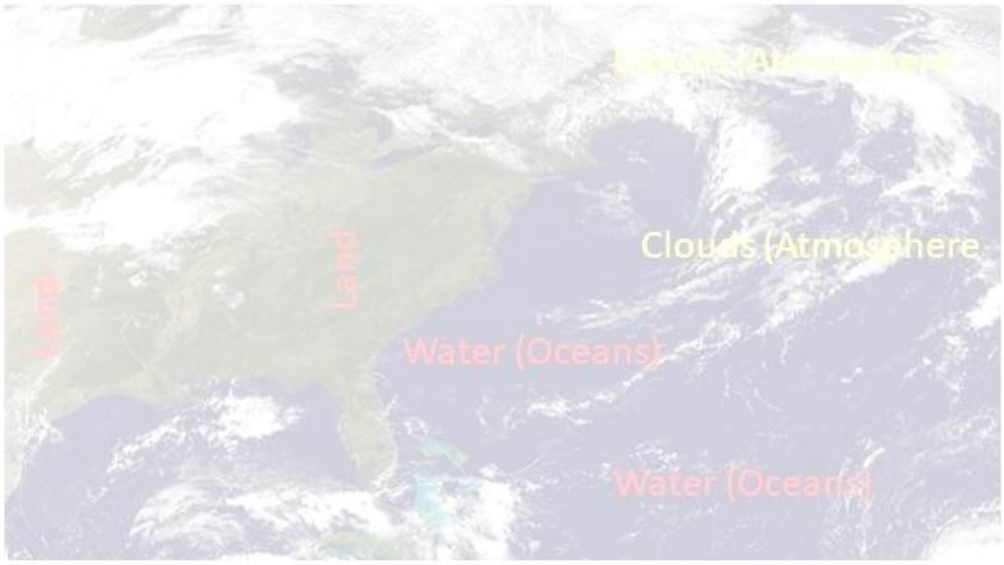

Fig. 1.1: Representation of physical environment: land, water and atmosphere.

1.3.2 Social Environment

You must be aware that human being cannot directly live in the natural physical environment. To adjust with the prevailing environmental conditions, the human beings always try to create some kind of mechanisms for suitables adjusting with their surrounding environmental conditions. The adjustment means the process of adaptation according to the prevailing environmental conditions. This can be altogether called human-made environment, a human creation. This human-made environment is also known as social environment. It refers to the immediate social settings in which people live. Social environment includes culture, language, social conditions, health, living conditions, and economic capability of the people living in an area. In order to control the conditions of his life and have a good living, human has created a new environment which can be called 'as human-made environment' and some have named it 'social-cultural environment'. It can be sub-divided into two types: (a) outer environment and (b) inner environment.

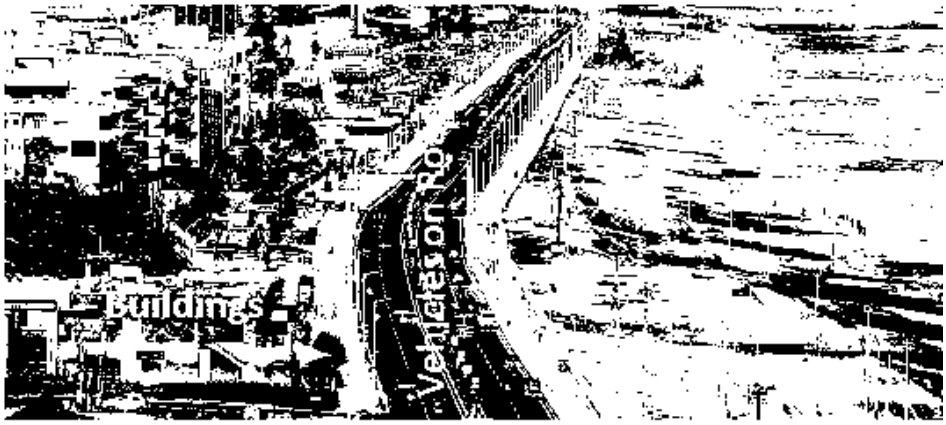

Fig. 1.2: Human-made environment representing range of spatial human activities in physical environment.

The Outer Environment

Outer environment is the part of physical environment that human has created on her/his own with the help of evolving technology. It is the modification of physical environment that has helped to cope up with the progress of humankind and the development of environment. Human while making a living on the surface of Earth has modified the physical environment through the use of science and technology. It can be understood as 'outer environment'. Whatever we are today, is a result of the modifications of physical environment introduced by human's technology, knowledge and capital. It includes our houses and cities, our means of transport and communication, our comforts and conveniences. It also includes the vast systems of industry and machinery created by the humans. It covers, in brief, the whole apparatus of our civilization.

The Inner Environment

Inner environment is the part of social environment that embraces or endures as long as the society cherishes. It has a profound impact on the human lives. It is often called social heritage as it is an important factor for humankind to exist, live and progress. Our inner environment is the society and its socio-cultural norms and traits along with itself. It is the social environment created by human. It consists of the organizations, social regulations and the traditions. It includes the religious traditions and customs which every human group has created for their own living. It should be noted that human cannot separate the outer environment from the social environment. The outer and the inner environments are blended together in the social environment of human. For example, the land which we bring under cultivation is more than a land; it is a form of property. It is often worshipped also, as the Hindus do. The houses are also homes that represent the institution of family. Thus, the various attributes of total environment (the physical, the inner and the outer) are merged together in our experience that manifests the social environment in an opt manner.

SAQ 2

Choose the following statements as True or False.

a). Environmental geography deals with the spatial variations in the human environment relationship over the Earth's surface.

b). Volcanic activity is influenced by human activities.

c). The environment which has been modified by human activities is a part of social environment.

d). Rivers and mountains are not a part of the physical environment of the Earth.

e). Religious beliefs and faiths are not a part of the social environment.

1.4 ROLE OF GEOGRAPHERS IN ENVIRONMENTAL STUDIES

You now know the types of environment including physical and social environment. It is essential to know the role of geographers in studying the environment. Environmental geographers are not only familiar with how natural systems function, but they also know that humans amongst all the organism are the most dominant agent of change in nature. They realize 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 or makeout along a variety of academic paths, which was cross, mingle, or converge with those of other disciplines. By its very nature, geography is a discipline that seeks to integrate and synthesize both the converging and diverging domains of academic knowledge. Therein lays its strength. For geographers, the Earth is the home of humans. Environmental study is an inter-disciplinary area of knowledge cutting across various disciplines of sciences and humanities as well. Geographer's study of areal differentiation of the Earth's surface as a science of integration and synthesis is well equipped to contribute towards environmental studies using their spatial analytical tools. Thus, geographers have a very significant role in studying, analysing and synthesising the spatial variations in human-environment relationship which is the prime goal of environmental geography.

SAQ 3

Explain the role of geographers in environmental studies.

1.5 SUMMARY

In this unit, you have studied so far:

- The meaning and scope of environmental geography.
- How environmental geography has emerged as an independent branch of knowledge within geography and its significance in understanding the human-environment relationships across the globe.
- The two significant branches of environment are i.e. physical environment and social environment. This unit has also attempted to explain two different types of social environment i.e. outer and inner environment.
- You have also studied the components of all these varied environment types with suitable examples.
- The role of geographers in environmental studies.

1.6 TERMINAL QUESTIONS

1. Discuss the scope of environmental geography.
2. Discuss the characteristics of physical environment.
3. Discuss how the social environment is affecting the day to day life of human beings.

1.7 ANSWERS

Short Answer Questions (SAQ)

1. Environmental geography is the branch of geography that describes the spatial aspects of interactions between humans and the natural world. It is the study of systematic description of different components of environment and interactions of human with these components and their spatial variations over the Earth's surface.
2. a) True; b) False; c) True; d) False, e) False
3. Geographers study natural systems functions, processes and their interactions with humans. They understand environmental problems by studying various physical processes of the Earth and cultural processes of human simultaneously.

Terminal Questions

1. Scope of environmental geography revolves around the study of the biotic and abiotic components of the environment and their spatial interrelationships encompassing the four vital spheres of the Earth i.e. atmosphere, lithosphere, biosphere and hydrosphere. Refer to the Section 1.1.
2. Physical environment is the terrestrial environment which is a creation of complex natural environmental conditions. For detailed description, you may refer to the Sub-Section 1.3.1.
3. Social environment refers to the immediate social settings in which people live. Social environment includes culture, language, social conditions, health, living conditions, and economic capability of the people living in an area. Refer to the Sub-Section 1.3.2.

1.8 REFERENCES/SUGGESTED FURTHER READING

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UNIT 2

ECOLOGY AND ECOSYSTEMS

Structure

2.1 INTRODUCTION

In the previous unit, you have studied about the concept and scope of the subject matter of environmental geography. The study of relationships of organisms with their biotic and abiotic environments on the Earth may be defined as ecology. We have introduced the concept of ecology in Section 2.2. The concept and structure of the ecosystem is also important to understand the functioning of the Earth's biosphere. You will get knowledge of the ecosystem by studying Section 2.3. Humans have developed various forms of subsistence technologies towards the management of their environmental resources to cope up with the issues and problems to their food security since human evolution. Human ecology is a part and parcel of the larger scientific field of ecology. Section 2.4 explains you the relationship between people and their environment under the theme of human ecology. You will study more about human interactions with the environment in different geographic regions of the Earth like equatorial, mountainous, desert, and coast in the next Block 2 of this course.

Expected Learning Outcomes

After studying this unit, you should be able to:

- define ecology;
- explain the concept and structure of ecosystem; and
- describe the human ecology.

2.2 ECOLOGY

We all know that several living organisms including trees, grasses, bushes, creepers, animals, birds, reptiles, fish and other aquatic animals, fungi, bacteria, etc. have been living on the Earth since millions of years. Humans are also part of this list and are not exceptional. To understand various types of relationships among the organisms and human, we have to study a special subject called ecology. **Ecology** is the scientific study of how organisms interact with one another and with the non-living components of their environment. The term ecology is derived from two Greek words **oikos** meaning *house* or *environment* and **logia** meaning '*study of*'. Ecology commonly overlaps with the biology, ethology and genetics. Those who study the affecting nature of biodiversity on ecological functions are called an ecologist. Let us now understand the concept of ecology in a geographic perspective. Ecology deals with the organisms that are adapted to their environment. During the process of interactions among the organisms, they make use of their surroundings in the form of energy and matter. You might be knowing that the survival of life depends on the constant flow of energy and matter. If it stops, then the organisms or living things will die automatically. Every organism has some type of relationship or interaction with the other organism on the planet Earth. It may be for the purpose of food or for getting energy, for providing help without any benefit from the others, etc. We shall now understand two sets of questions. Have you ever thought that the Koalas, a mammal who carry their young in a pouch, live only in Australia whereas White Tigers live in Indian wild areas? Another question is that the pine trees grow in the higher altitudinal zones of the Himalayas but not in the Ganga or Godavari plain regions. Think, what would be the reason for the distribution of specific plants or animals in a particular region? How the geological and climatic events influence and effected the life of organisms? To answer these questions, we normally think of two broad reasons including ecological reasons and historical reasons of that region. Do you know all of these can be understood by studying geography, ecology and evolution of living things, etc. We study these phenomena under the subject of biogeography. Let us now understand two broad themes of biogeography 1) historical biogeography and 2) ecological biogeography.

Historical Biogeography: The idea of historical biogeography explains the way biological organisms are distributed from its place of origin. It means species are originated at particular place, also called as centers of origins, and then distributed to other areas based on their capacity and ability for the movement. The climatic or geological changes might have remained

favorable or forcible conditions have necessitated dispersal from the centers of origins. Species were split into one or several other groups. Historical biogeography is, therefore, concerned with long term, evolutionary periods of time, on large scale, global areas of living and/or extinct species.

Ecological Biogeography: Ecological biogeography is concerned with organisms' response to their surroundings. The biological organisms or a population generally responds to its physical surroundings and its living surroundings. Everything that affects an organism is collectively called environment. Various factors affect the physical surroundings also known as abiotic environment such as temperature, light, topography, soil, geology, water, oxygen, salt and acidity levels, and so on. On the other hand, factors that continuously affects, the biotic environment includes competing species, parasites, predators and humans. We must understand that each and every species can have a certain tolerance levels of environmental factors due to which they are able to sustain in the environment. No species lives in isolation from other species. They are characteristically different from each other in terms of reproductive rate, behavior, movement and so on. In short, the ecological biogeography is concerned with short-term periods of time, at a smaller scale, with local, and within habitat of living animal or plant. You will study more about biogeography in the next Unit 3.

You now know about the ecology which deals with the organism-environment interactions across ecosystems of all sizes. The ecosystems can be microbial communities to animals to forest to the Earth as a whole. Let us now understand the ecosystem.

SAQ 1

Why do you need to study ecology?

2.3 ECOSYSTEM

You are now studying this unit in a very interesting manner. To complete the entire unit, you may essentially need to sit and concentrate for considerable time. For this, you supposedly require some kind of energy. To complete any task or physical work one should have energy. For getting the energy, we need to feed our stomach with food. If we are eating food more and more, and not utilizing the supplied levels of energy then what will happen? You may gain extra weight, because of the stored energy. It is not only applied to humans but it is also valid for all living organisms of the ecosystem in several ways.

2.3.1 Concept of Ecosystem

We know that the life is associated with the interactions of many organisms. The living organisms and other components of the earth like land, soil, water, and atmosphere, etc. are functioning together in a particular relationship. Therefore, the life is possible on the planet earth. "The system resulting from

the integration of all the living and non-living factors of the environment" is called **ecosystem** which is defined by Tansley in 1935. The word ***Eco*** is implied to the *environment* and ***System*** means *interaction*. The biosphere of the Earth can be considered as a very big ecosystem in which both abiotic and biotic components are continuously interacting with each other that results into structural and functional changes in it. The ecosystem can be divided as terrestrial ecosystem which includes mountainous, forest, grassland, desert, etc. and aquatic ecosystem for example river, swamp, delta, marine, etc. The concept of ecosystem is also involved in understanding the complexity of environment. There are several factors influencing the environment.

Let us understand the basic characteristics of ecosystems. There are two fundamental characteristics of ecosystems such as ***structure*** and ***process***.

2.3.2 Ecosystem Structure

We understand that an ecosystem is organized into non-living and living parts. The non-living part is the physical-chemical environment, including the land, water, atmosphere, and soil. The living part, called the ecological community, contains the set of species interacting within the ecosystem. Figure 2.1 explains you about the broad structure of ecosystem.

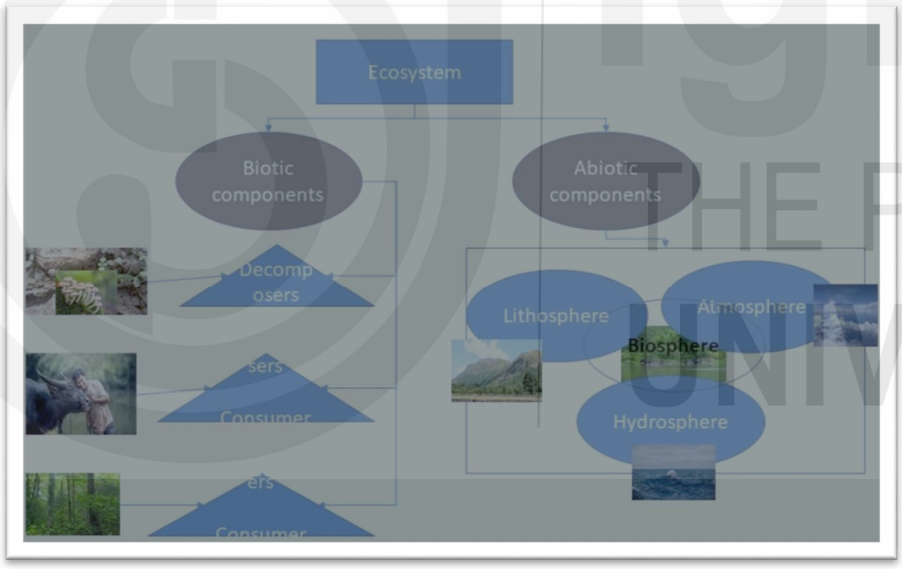

Fig. 2.1: Components of ecosystem (draft).

a) Biotic Components

The living or organic component is also known as **biosphere** that deals with the all forms of life. You will also study about non-living components or physical components spread into three vital spheres viz. atmosphere, lithosphere, and hydrosphere of the Earth in the forthcoming sub-section. You must remember that life on the Earth can broadly be divided into three types as producers, consumers and decomposers.

Producers: Plants, algae, and other tiny aquatic organisms, also called phytoplankton, are categorized as *producers*. Producers receive energy from the Sun and use it in the process called as photosynthesis for their needs drawn from the environment. During this process, they use chlorophyll to absorb light energy for making sugar or glucose from carbon dioxide and water. Glucose contains stored chemical energy. In turn, they release oxygen into the air as a byproduct. These organisms produce food for all other organisms. Producers are also termed as ***autotrophs***.

Consumers: The producers store their energy in various forms like stems, roots, leaves, flowers, fruits, grains, and seeds, etc. The stored energy of producers is used by all other organisms as a source of food, either directly or indirectly, for their growth and movement. These are called *consumers* for example, animals, fungi, and bacteria. Consumers are also known as ***heterotrophs***.

Consumers can further be sub-divided into three categories as **primary consumers** or **herbivores**, **secondary consumers** or **carnivores,** and **omnivores**. Primary consumers eat producers as a source of food for example leaf-eating insects, birds, and animals. Secondary consumers commonly capture and eat other animals. In numerous ecosystems, herbivores serve as food for the carnivores. **Omnivores** eat both plants and animals in their diet, for example, humans and rats. **Parasites** are also consumers that live in or thrive on another living organism for example tapeworm, bacteria, and viruses. These are caused to disease.

Decomposers: Organisms such as fungi, and bacteria convert the non-living organic matter into inorganic material are called decomposers. They live on dead, excrete, waste products or decaying organisms.

You will know the living components or physical components in the complex environment of the Earth that plays a prominent role in the biosphere. You will also understand other components of the Earth which supports life forms.

b) Abiotic Components

Abiotic components are non-living things that influence an organism. As we know that our planet Earth supports the life or biosphere and other spheres of the Earth including atmosphere, lithosphere, and hydrosphere. These are also very important for sustaining life on the Earth.

Life on this earth may not be possible without **atmosphere**. It acts as a protective layer for all organisms. Atmosphere consists of many gases including nitrogen, oxygen, carbon dioxide, etc., that envelops the environment. Atmosphere is able to separate the Earth from outer space. The **lithosphere** is composed of different kinds of rocks and minerals. Earth's crust in the lithosphere forms mountains, plateaus and plains, etc. Often, we call the Earth as a blue planet. Because, water covers nearly 70% of Earth's surface. We can observe the water in gaseous form of water vapour which is present in the atmosphere, liquid form in streams and underground, and solid state as ice caps. Water is, therefore, ubiquitous and the study of water

comes under the subject of **hydrosphere**. All these three spheres are known to support various layers of the life.

So, abiotic factors includes energy, non-living matter, living space, and processes that involve the interactions of non-living matter and energy. We can further classify the components as energy, climate, weather, minerals, water, air, pH, salinity, temperature, soil, sunlight, etc. under abiotic or physical environment. It is important for you to study about energy and matter because they are vital components in any ecosystem.

2.3.3 Ecological Processes

You might be knowing that any living organism on the Earth requires energy and matter to grow and function. Where do they get energy from? Yes, the primary source of **energy** for almost all organisms is the Sun. Even beneath the ocean waters, the algae can survive because of the Sun's energy. For example, plants obtain the energy from the Sun and they grow. These plants are eaten by animals to get the energy. Animals are eaten by the other animals. Based on the Sun's energy which is received by plants, algae, and bacteria in a particular region, we can assess the existence of living components. In an ecosystem, both the prey and predator get the energy from their source of food, but the energy as well as matter are essential to build their body structure in which tissues and cells play an important role. You can further explore what happens to energy and matter as they move through the biosphere by studying any book of Environmental Sciences or Physical Sciences.

Matter may be defined as anything like solids, liquids, gases and all living and non-living organisms that occupies space. Obviously, matter is having mass. It is composed of atoms such as carbon, nitrogen, and phosphorus, and molecules for example water (H_2O). All the biological organisms get these atoms and molecules from their environment and are jointly settled as part of organism's body structure. After some time, they again return to the environment through respiration, excretion, or death and decay processes.

Atoms simply are made up of protons (positive particles), electrons (negative particles), and neutrons (neutral particles). The chemical reactions of materials facilitate to rearrange the atoms in forming different kinds of matter. You must remember that an atom, for example, a carbon will always remain a carbon atom even after several chemical reactions. In chemical reactions, atoms are neither created nor destroyed. When the same kind or different kinds of atoms are bonded in a systematic way, a **molecule** is formed for example oxygen (O_2). On the other hand, two or more different kinds of atoms are bonded to form a **compound** for example water (H_2O). O_2 is a molecule but not compound and H_2O is both a molecule and a compound. Organisms use the molecules and compounds of atoms form their environment to grow and later decay, and repeat the process form in a cyclic manner.

You now understood that the energy and matter is constantly being exchanged within and between the four spheres of atmosphere, lithosphere, hydrosphere and biosphere. Organisms are grown by taking energy from the

environment and subsequently decay and then return to the environment again to complete the cycle.

All living organisms at one point of time decompose with the help of ***fungi*** and ***bacteria*** on the Earth. During this process, various forms of energy is created. In the ecosystem, the created energy in all forms eventually leaves the Earth and reradiate into the space. But the energy is again resupplied by the Sun in the Universe. As we know that the energy is neither created nor destroyed. Hence, the flow of energy is continually reused from the available resources of the Earth in the cyclic process to maintain a dynamic system.

Ecosystem mainly works on two basic kinds of processes including energy flow and recycling of chemical elements. Life on the earth's biosphere depends mainly on these two processes. Living things require proteins, carbohydrates, lipids, and nucleic acids. These compounds contain several elements such as carbon, hydrogen, oxygen, nitrogen, phosphorus, sulfur, calcium, magnesium, iron, manganese, boron, zinc, etc. Organisms need some of these compound compulsorily or sometimes in smaller amounts. Cycling process takes place in the biosphere mainly by four key elements of carbon, phosphorus, nitrogen, and sulfur that are involved in biological, geological, and chemical processes. These processes are believed to be operating in circular paths from the environment to living organisms and back to the environment called as **biogeochemical cycles**. Some processes in biogeochemical cycles, such as photosynthesis and respiration, occur rapidly. Others, such as the formation of coal from the remains of plants, takes hundreds of millions of years which we known as fossil fuel.

2.3.4 Ecological Communities

A set of interacting species are functioning together in their place of living for creating the environment to continue the life. Interaction of individuals in a community takes place through feeding on one another. During feeding between the individuals, the energy and nutrients pass on from one individual to another individual along the **food chains**. The linkage of feed between individuals is known as food chain. For example, eagle eats snakes to rat to insects to get the energy. The more complex linkages between the organisms are called **food webs**. The organisms can be grouped in a food web into different trophic levels. A trophic level consists of all organisms in a food web that are the same number of feeding levels away from the Sun's energy. Autotrophs are grouped into the first trophic level. The herbivores and carnivores are members of the second and third trophic levels, respectively. Carnivores that feed on third-level carnivores are in the fourth trophic level, and so on. Wastes and dead organisms of all trophic levels are fed by decomposers which is the highest trophic level in an ecosystem. Refer to Fig. 2.2, which explains a simple food chain reflecting various trophic levels in an ecosystem.

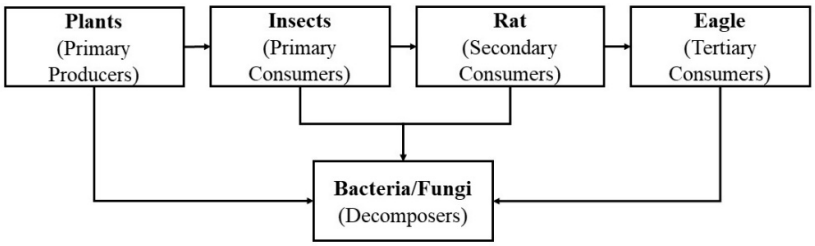

Fig. 2.2: A simple food chain in the environment.

Plants require some amount of water and chemical elements for their growth and development. You may be aware of that the plants get all necessary nutrients from the soil. However, the depth of their root's penetration to absorb the same or slightly different nutrients in a particular region is significantly diverse for each other type of plants. For example, some plants grow in high acidic soils and others are resistant to saline soils. In the same manner, some birds or animals are hunt during night times for their requirement of food. The activity for obtaining food, they perform hunting or catching under various conditions. Therefore, it can be understood that the species might be having the same requirements on one or more axes but not the same for all. So every organism has developed its own mechanism for remaining alive. The demands of an organism in its environment in terms of physical and chemical conditions, space, and food supply is defined as ***niche***. It simply explains how an individual, species, or population interacts with and exploits its environment. This is otherwise called adaptation to environmental conditions. A home of an organism is called as its ***habitat*** in which it lives.

You will understand more about humans and their ecology in the coming section.

SAQ 2

Match the following.

1. Biotic component	a) Consumer
2. Abiotic component	b) Human
3. Rabbit	c) Producer
4. Algae	d) Air

2.4 HUMAN ECOLOGY

We, humans, are very peculiar among all other organisms in the biosphere of Earth. As per ecologist's definition, the study of the interactions of humans with their environment is called ***human ecology***. It basically illustrates that the distribution and abundance of humans as like other organisms. However, the presence of humans seems to be everywhere and, they do construction and/or destruction and also affect their own distribution and abundance. Thus,

understanding of human behavior is important to study under the theme of human ecology.

Behavior of humans is diverse from place to place and time to time. Every species on the planet Earth has its habitat and are mostly restricted to their environment. In contrast to other living organisms, humans cannot stay in some splendid isolation from the rest of nature. Humans have adopted several traditional skills from others since million of years. On the other hand, the animals and birds hunt for their survival using the teeth or claws and beaks. We have developed several technological tools for getting food and are also utilized for extraction of natural resources from the environment for a better living.

There are several phenomena including genes, culture and environment that interact in different ways and affects human behavior. The study of human behavior under the discipline of human ecology is involved in understanding of several cross disciplines. Figure 2.3 represents the view of human ecology as a multi-disciplinary approach.

Since human behavior is so complex and diverse hence it is essential to understand several other disciplines.

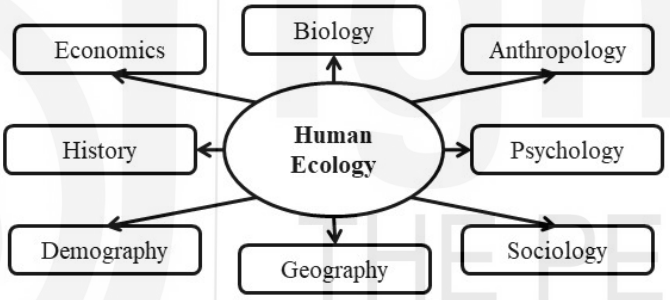

Fig. 2.3: Human ecology deals with multi-disciplines.

Biologists, anthropologists, psychologists, sociologists, geographers, demographers, historians and economists, etc. have adopted the ecological/evolutionary approach to humans. No single subject can explain about the human ecology in detail. Having said that '*a little knowledge is dangerous but it is perhaps less dangerous than no knowledge*!' .Biologists study our biological capabilities; anthropology deals with human experience and what makes us human; psychologists try to understand how people behave, think and feel; sociologists study about society and human behaviour and relationships; geographers are concerned with the places and the relationships between people and their environments; human population's size, structure, and their movements over space and time are examined by demographers; historians write about the past events with related to human race; and economists study how the societies use scarce resources; etc. Hence, it is a more complex subject. From the beginning of progress of humans, we could find simple societies to more complex societies now that complexity and diversity offer challenges in understanding humans.

We now study the development of technology and culture that occurred in the history of human development during the past 2-3 million years. There are several inventions which helped in human transformations of the environment including fire, language, agriculture, large habitations, sea route trade and commerce, industrial revolution and technological advancements, etc.for several years, humans depended on environment mainly for production of food. Let us understand how the human groups were developed in the natural environment of the Earth at various phases.

2.4.1 Hunting and Gathering Groups

Hunting and Gathering is the oldest form of human activity and most widely distributed technological method in time and space. It was found that various pebble tools with the remains of primitive human precursors or ***hominids*** borne in Africa particularly in Ethiopia (around 3 Million years ago). The ancient hominids were restricted mainly to Africa about 3 million years to 2 million years ago during Pleistocene. After that ***Homo erectus*** type hominids (1 million years ago) were extended to warm and temperate Eurasia. They used a kit of stone tools called the Achuelean. About 100,000 years ago, Neanderthal hominids were able to live in cold environments and hunt large animals with hand-held weapons instead of hurled spears or arrows. Fully modern humans, ***Homosapiens***, evolved between about 100,000 and 50,000 years ago. Late Pleistocene people (50,000-10,000 BP-Before Present) had involved in fishing which was common in the Holocene (the past 10,000 years). It was recorded that the modern humans perhaps put their imprints in Australia and America, the last major habitable land areas of the planet Earth in the history of human evolution.

Palaeolithic hand axes to more sophisticated tools, in the advancement of Stone Age, including light killing weapons, spears, bows and arrows, choppers and knives were extensively used by hunters and gatherers. Their preparation for food was very simple commonly through open fire and collect the food with simple wooden bowl. Shelters are often very simple windbreaks or huts. They had sophisticated tools particularly in extreme environment for example the Eskimo's winter clothing, kayaks, igloos, etc. They have understood greatly animal behavior, plant growth, flowering and fruiting. The tracking ability of hunters became legendary. Hunters wait for an injured big animal after hurting it for days to complete the kill.

Humans were able to explore a variety of diet not only meat including herbivores from their environment. They had developed communicative skills such as speech, which the other living organisms cannot express and describe. At an early stage humans also discovered the use of fire. They had very simple social systems. Women generally gather food and men play a major role in hunting because women mostly involved in caring of small children and young as well. All known hunter-gather subsistence systems essentially need the contribution of both men and women to succeed.

The hunting-gathering human groups lived before the agricultural 'revolution' some 10,000 years ago, in different parts of the globe. Probably with 5 million

total populations in the world spreading in very low densities, they mostly occupied small size of settlements. North America had a great variety of hunters and gatherers until the mid-19th century. Many of them lived in quite productive environments.

2.4.2 Horticultural Societies

Human groups in these societies began to use domesticated plants as the major basis for subsistence. In this system, people work hard to plant, weed, harvest, and process without assistance from animal traction and mechanized tools. In the beginning of the Holocene, about 10,000 years ago, the horticulture was probably developed in the Middle East and slowly spreading to the other parts.

They made simple tools like stone axe for cutting the trees in the forest, wooden sticks for digging, and spades for planting and cutting of sugar cane, maize seeds, etc. Textiles and pottery were common in use. African horticultural societies began to use iron tools. Though, these tools are hard to manufacture but iron ores are abundant.

Wet tropics with poor leached soils led to the horticulture societies with low human densities. In Amazon and lowland of New Guinea, density of population might be well within the range of hunters and gatherers. Tribal Chief is mainly the headmen in horticultural societies. Women play an important role as like in hunting and gathering groups in the subsistence activities because they were responsible for most of the gardening work.

Humans began to domesticate plants and animals rather than hunting and gathering for food that helped actually to create a base for cultural advancement of civilization. Human intervention to their environment had started from foraging to farming through domestication of animals.

2.4.3 Humans as Herders

Human groups in pastoral societies depend mainly on herding domesticated livestock.

The community life basically circles around the needs of the herds. **Nomadic** is one of the typical herding societies where the people live in portable tents or temporary structures and prefer to move considerable distances from pasture to pasture according to the dictates of ecological circumstances. They played significant roles in the ecological processes.These societies were considered to be environmentally specialized societies. Human adaptation to extensive tracts of grasslands and deserts, and animal husbandry made a successful activity of pastoralism.

Pastoralists quite freely use carts and caravans for the commercial trade and raiding because these supposed to be essential in their life. They have good knowledge in animal husbandry, pasture, and land transportation technology since their subsistence mainly depending on the herding animals like sheep, goats, cattle, horses, llamas, yaks, etc. The diet of pastoral people mainly

derives from plant products and small amounts of meat and animal fats. Leather, horn, wool, and animals for traction became prominent and valuable. They often trade the animal production for grains, crafts and manufactures, etc. They may completely depend on herd grazing in an area for a few days to weeks and move to another area. In some areas like Arabia and Africa, herds tend to move based on the availability of water. Seasonal migrations are prominent in much of Europe and Asian regions.

Men of pastoral society are often dedicated to herding larger stock such as cattle, whereas women engaged in handicrafts, food production and processing, small-stock herding and the milking of livestock. In human ecology, the development of pastoral societies has a key role in the environment, even after the advent of civilization.

2.4.4 Humans as Cultivators

Humans might have foresight in domestication of cattle as these are having great power when compare to human labour. Our ancestors got recognized their utility for labour in cultivation or milk. It is said that agriculture is one of the divine gifts to humankind. Humans became active in mixing of the horticulture and pastoralism to make an innovative cultivation or agriculture. With the continued development of agricultural technology in plant domestication has led to the substantial improvement in production in a unit of land.

This type of technological subsistence is more reliable hence it is influenced for developing greater population densities and sedentary settlements. It also increases the wealth in terms of storing food and luxury items. Farmers in agrarian societies had developed and utilized the sophisticated technology to get substantial gains with limited alteration in the environment. The technology including the usage of plough and draft animals may have helped the agrarian societies spreading to larger areas. In fact, some advanced horticultural groups, for example, Inca Empire had developed innovative form of plough. Plough were first used in the Middle East around 5,000 years ago. These were simple enough to scratch the light dry soils. Another revolutionary step was the innovation of wheel, animal-drawn cartage that helped to move the cultivated products to greater distances. The ox or bull-drawn plough, notably used in the Indus Basin, are still used in arable lands of several countries. There were several items included in agrarian tool kit mainly metallurgy, weaving, marine vessels, pottery, and military equipment, and so on.

The agrarian technology supported the higher population densities and larger settlements through urbanization of population. The sexual division of labor remains fundamental to the economics of agrarian societies, men's labor becomes relatively much more important. Ecological and environmental variables like climate, soils and topography are main concerns in agriculture. For example, topography which influences the transport costs, and rainfall and the availability of water affects the productivity, etc. The important development in agriculture is irrigation which is supposed to be the earliest

human effects on environment. Because of limited and seasonal rainfall, irrigation is practiced everywhere from sea level to the limits of cultivation at nearly 2,000 m altitude.

Pastoralists certainly had made effects on environment through animal grazing which leads to soil erosion. However, they might have had utilized the earth's land cover with other living things. But, the agriculturalists drastically transformed the terrestrial ecosystem through ploughing and seeding the grasslands by the elimination of a large number of species of native herbs and grasses. For example, the Prairies of North America introduced new crops of wheat, corn or alfalfa. In the olden ages, we used to have several species of plants and animals with domestication. Now it is evident that the human societies mostly rely on four major crops such as wheat, rice, maize and potatoes.

With the advancement of agricultural technology, humans tend to control their environments leading to the formation of large societies and people movement. Degradation of environment mainly due to global warming and haphazard growth of population and unsustainable use of natural resources are nowadays a major threat to the ecology and environment of humans. Humans might have begun the agriculture 10,000 years ago, they could not have expected that it would be a great fundamental change of nature.

2.4.5 Humans in Modern Industrial and Urban Societies

A large chunk of humans started to live in larger settlements in the basin of the Tigris and Euphrates, the coastal Mediterranean, the Nile valley, the Indus plain and coastal Peru nearly 6000 to 5000 years ago. In the modern era especially from the late 17th century humans made considerable influence on the environment through the advancement of culture, science and technology. This accelerated development and its consequences are never and ever happened before as today's human transformation of the environment.

Population in commercial and industrial societies have mostly involved in urban activities like manufacturing, selling, etc., but not directly engaged in food acquisition. They are hassle free from land-owning lineages, chieftains, or aristocrats, etc. these we can see in the case of horticultural, pastoral, and agrarian societies. Industrial and commercial revolution probably started around 1800 by the human's innovation of the application of mechanical sources of energy that led to solve several problems related to the production. It resulted, into a substantial growth of non-farm occupations happened to occur in the Western Europe and USA by the middle of 19th century. Humans are still trying industrial advances with an accelerated pace but one can understand that based on the history of human evolution, there is no guarantee that the industrial revolution will be completed across the globe.

Europeans used seaborne transportation which is the key development of commercial/industrial technology to connect global countries for trade and commerce. By sea-going ships in the sixteenth and seventeenth centuries, they had transported spices, precious metals, grains, sugar, cloth, dried fish,

and timber, etc. The industrial and commercial technology was largely extended to powerful stream vessels, railroads, automobiles, and aircraft, etc.

Human access to energy became possible by the late 19th century. They started decreasing dependency on animals, wind and water. Modern science, technology and industry have also been applied to agriculture, and progress made through utilization of fertilizers and pesticides, genetic breeds of plants and animals. Majority of population began to live in urban areas because of better transportation and medical and other facilities, the living standards of people tremendously been improved. Modern science and modern medicine have led to the population increase even in non-industrial societies.

In the twentieth century, human population increased from 1.5 to 6 billion, which was a time of extraordinary change. The large numbers of urban agglomerations has mushroomed in recent decades and are now having their own environmental problems. Now, everyone can clearly discern the changes in the planet earth over the past three centuries by humankind. We were used to alter the forest cover for sustenance of life but now we are altering fundamental flows of chemical compounds and energy. This will certainly harm the living organisms of the Earth which is the only habitable planet at large scale.

We human beings affected the plant life seriously than any other biological organism of the environment. We are still affecting the animal life, soils, waters, and climate knowingly or unknowingly in time and space. You will study about the relationship between the humans and environment in the coming Block 2 of this course in detail.

SAQ 3

a) Define human ecology.

b) What is the role of nomadic groups in the environment?

2.5 SUMMARY

In this unit, you have studied so far:

- Ecology explains that the interactions between the organisms with one another and with the non-living components of their environment.
- Ecosystem consists of biotic components such as producers, consumers, and decomposers and abiotic components including energy, climate, minerals, water, air, soil, sunlight, etc.
- In the ecosystem, the flow of energy and the cycling of chemical elements are very important to sustain the life.

- Human ecology deals with the interactions of humans with their environment. It mainly involves in the distribution and abundance of humans as like other organisms.
- To understand human ecology better, one need to have knowledge in several other disciplines like biology, anthropology, geography, sociology, etc.
- The development of technology and culture from the beginning of human progress have transformed the environment at large scale.
- Humans had used hunting and gathering technology primarily for wild game and plant resources.
- Humans by pastoralism involved in domestication of herd animals that was the main basis for subsistence.
- Horticultural societies can be separated from agricultural societies by their lack of skills in ploughing and animal traction.
- Agrarian people depended mainly on plant cultivation, and used widely draft animals and plough
- Population in modern industrial and urban cities mainly engaged in trade and manufacturing activities.

2.6 TERMINAL QUESTIONS

1. Explain the importance of ecological structure and process.
2. Human ecology is a multi-disciplinary field of study. Explain.
3. Differentiate between hunting and gathering, and agriculture subsistence technologies.
4. Write a note on human's role in the development of industrial and urban societies.

2.7 ANSWERS

Self Assessment Questions

1. To understand interactions of organisms in the environment of biosphere.
2. 1-b; 2-d; 3-a; 4-c.
3. a) Human ecology is the study of the interactions of humans with their environment.

b) Nomadic societies are herders. They are active in herding domesticated livestock and are considered to be environmentally specialized societies.

Terminal Questions

1. Refer to Section 2.3.
2. Human ecology deals with different themes of biology, anthropology, geography, sociology, etc. You may refer to Section 2.4 for more details.
3. Hunting and Gathering is the oldest human activity. Humans probably started practicing agriculture about 10,000 years ago. Refer to the sub-sections 2.4.1 and 2.4.4.
4. Refer to Section 2.4.5.

2.8 REFERENCES/SUGGESTED FURTHER READING

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UNIT 3

BIOGEOGRAPHY

Structure

3.1 INTRODUCTION

Science and technologies are so advanced today, that human is able to plan for establishing human settlements on the Moon and the Mars, as early as possible. Even today, we all know that Earth is the only planet that supports life in the entire universe. It is because of its relative location in the solar system. It is astonishing to note that Earth's surface receives small fraction of the energy emanated by the Sun which is referred to as insolation or the incoming solar radiation. This process is primarily responsible for the origin, evolution and sustenance of life, in its several forms, on our habitable planet.

We have introduced the concept, definition, scope and classification of biography in Section 3.2. Different types of flora and fauna distributed in various geographical regions of the world which improve adaptation capabilities to sustain life in their environment. Section 3.3 will explain you about these biogeographical regions biomes of the world.

Expected Learning Outcomes

After studying this unit, you should be able to:

- describe the concept and definition of biogeography;
- explain the scope and classification of biogeography; and
- elucidate the biogeographical regions-biomes of the world.

3.2 BIOGEOGRAPHY

3.2.1 Concept and Definition

Centuries back, it was believed that the animals and plants were created by the great God and they remain same till date. Slowly, during 20th century such myths had come to an end, when the scientists started proving the biological process of evolution and geological process of plate tectonics. Carl von Linné (Carolus Linnaeus), studied medicine and botany in Sweden, who laid the foundation stones for the modern biogeography during 18th century. He was developed a comprehensive system of taxonomy and its nomenclature in his book '**Systema Naturae'** in 1735. He tried to explain how the particular type of species gets colonized in a particular environment. This subject what we call now is ecological biogeography. Georges Buffon also gave insights about biogeography that the similar environments found in different regions of the world, contained different groupings of organisms. His book '**Histoire Naturelle'** published in 1761 highlights the number of features of world biogeography with their possible explanations. He identified that the same species of mammals of North America were also found in Eurasia, but the South America mammals are quite different from those of Africa, even though they live in similar tropical environments. The possible reason could be the separation of continents through various historically important geological processes. The climatic influences were also pointed out for the presence of different flora and fauna in different geographical regions as a reason of the world.

The origin of biogeography is mainly linked with the observations of organism's association with their natural environment that made us to understand the complexities of natural phenomena. The discoveries of the biological diversities by the various explorers and naturalists like Alexander von Humboldt, Louis Agassiz and Charles Darwin had largely created the interest which ultimately led to formation of the theory of evolution and the origin of species. The natural selection of each organism in its habitat suitably explains the concept of adaptation.

To understand further about the concept of biogeography, let us study our earth's environment. As all of us know till today that the life is possible only on the planet Earth because of the Earth's natural environment that supports various forms of life. It has four distinctive and vital spheres namely,

A) The Atmosphere
B) The Lithosphere
C) The Hydrosphere and
D) The Biosphere

A) The Atmosphere

The gaseous layer that encompasses the earth's surface, is called the atmosphere. It consists of several layers and the lower most layer, about 15 kilometers thick, is known as the **troposphere**, contains the planet's air. It is primarily a mixture of nitrogen (N), oxygen (O_2), argon (Ar), carbon dioxide (CO_2), neon (Ne), helium (He), krypton (Kr), hydrogen (H_2), and water vapour.

The lower part of the next layer is known as the **stratosphere**, consists of ozone (O_3) that filters the deadly ultra violet (UV) radiation coming from the Sun. The direct UV radiation from the Sun is capable of destroying all forms of life on the planet.

B) The Lithosphere

The solid part of the earth's surface comprising of the earth's crust (both oceanic and continental crust) and the upper mantle lying above the partially melted less rigid as the no sphere, occupying about 21% of the surface area is called the lithosphere. It is divided into seven major continents and several islands. The thickness of lithosphere varies from nearly 50 kms under the oceans and about 100 kms below the continents.

C) The Hydrosphere

Earth is often called as blue planet as it holds water. The hydrosphere corresponds to all the areas on the earth's surface and underground covered by water in all the three of its physical forms, namely, the water, water vapour and ice. While water vapour is mostly found everywhere, water and ice occupies about 79% of the earth's surface. It includes all the water bodies of the world such as the oceans, seas, lakes, ponds, rivers, groundwater aquifers, glaciers, ice-sheets and the ice capped polar regions.

D) The Biosphere

There is a thin layer constituting the zone of contact between the atmosphere, hydrosphere, and lithosphere, formed on and near the earth's surface. This thin layer where life exists in abundance in innumerable numbers and variety of organisms and hence, is known as the biosphere. It covers the lower layer of atmosphere and the land surface of lithosphere, and almost the whole of hydrosphere. Therefore, the biosphere comprises of both land and oceanic areas.

For detail description of earth's four spheres, you may refer to Physical Geography course (BGGCT 131).

The life-forms or the **'biota'** includes micro organisms, plants and animals including human life in the biosphere. They depend on the abiotic conditions such as the light, air, water and soils, etc., prevailing in their surroundings for the sustenance. The abiotic conditions vary from place to place and also from time to time and so is the distribution of the biota, accordingly.

Ernst Haeckel (1876) wrote that "*the actual value and invincible strength of [Darwin's] Theory of Descent…[is] that it explains all biological phenomena, that it makes all botanical and zoological series of phenomena intelligible in their relations to one another*". The science of biogeography is involved in documentation and explanation of spatial patterns of biological diversity in an understandable manner. Hence, **biogeography** can be defined as "the study of the temporal as well as the spatial distribution of the living beings (the biota) and their living conditions (the abiotic conditions) in the biosphere". Naturally, this study also includes the interaction between different types of life forms and interaction between them and their abiotic conditions.

3.2.2 Scope

The scope of biogeography is wide. The subject matter of biogeography is mainly concerned with biology and geography which studies about the biosphere in particular. We all know that environment is very dynamicin nature. It is subjected to several changes by several factors such as the changes in climates, unscientific exploitation of natural resources, human warfare, etc., which leaves a great impact on the earth's surface, especially, on the biosphere and all the living beings. The study of biogeography thus helps humans to know their environment fairly well. It will also help in perpetuating their race as well as improving their standard of living from time to time, forever. The biogeography overlaps the boundaries of multi-disciplinary subject themes of botany, zoology, hydro-geomorphology, climatology, geology, pedology, and anthropology. Biogeography was initially developed based on taxonomy investigations like identifying and classifying plants and animals and later supplemented on ecological and analytical lines. The present and past distribution of organisms are traditionally studied under the subject matter of biogeography.

Since 1960's, researchers have been using computer related technologies for identifying problems in the fields of ecology and biogeography. Now, multivariate statistics coupled with satellite remote sensing and global positioning system studies are extensively being used with the help of computers and software packages as well. These scientific techniques greater helps us to locate and map the distribution and pattern of living organisms more precisely even in inaccessible remote areas. Based on above advancements and avenues of enquiry and increased modern methods of experimentation and analysis, the subject of biogeography has a lot of scope for understanding our nature scrupulously. Modern biogeography deals with the nature by studying all patterns of geographic variations, from genes to entire communities and ecosystems, and elements of biological diversity that vary based on their area, isolation, latitude, depth and elevation. You could understand now the biogeographer who must have the knowledge in phytogeography, which explains about plants, and zoogeography which studies the animals. Therefore, a biogeographer needs to acquire and synthesize a huge amount of information across a broad range of temporal and spatial scales.

3.2.3 Classification

In the modern era, late 19th century, the British P.L. Sclater, ornithologist, and A.R. Wallace, biogeographer and naturalist, categorized the geographical distribution of fauna into two creations as the Old World (Creatio Paleogeana) consisting Europe and Asia (Northern Part), Africa (South of the Sahara), India and Asia (Southern Part), Australia and New Guinea; and the New World (Creatio Neogeana) which comprises of North America and South America. They identified six regions and its sub-regions including Nearctic, Neotropical, Palaearctic, Ethiopian, Oriental, and Australian. Most of the biogeographers are still following this classification scheme.

The subject of biogeography is broadly classified into two main fields of study. They are a) Historical (Paleo) Biogeography and b) Ecological Biogeography. Each field, however, looks at phytogeography (the past and present distribution of plants) and zoo-geography (the past and present distribution of animals).

a) Historical or Paleo-Biogeography

Historical biogeography which is also called as paleo-biogeography. It studies the past distribution of species. There are a number of biotic and abiotic factors that are used to explain the past and present patterns of distribution. It considers several biological factors such as adaptation, predation and competition on the one hand and physical factors like geology, climatic and evolutionary events, soil and light on the other hand to determine the development of certain species in a particular area. The historical approach would help us to reveal that there are more species in the tropics than at high latitudes because the tropics experienced lesserow changes in climates during the glacial periods. This led to fewer extinctions and more stable populations thrived over the time. This study often includes paleo-geographic ideas by considering plate tectonics. This type of research uses fossils to show the movements of species across space, via moving continental plates.

b) Ecological Biogeography

This study looks at the factors responsible for the current distribution of plants and animals. The most common fields of research within ecological biogeography are a) climatic equability, b) primary productivity, and c) habitat heterogeneity.

Climatic equability: This study deals with the variations between daily and annual temperature values. It is very difficult to survive in areas with high variation between the diurnal and seasonal temperatures. Due to this reason, we could find fewer species at high latitudes, when compared to the tropics which have a steadier climate with fewer variations in temperature. Daily temperature patterns are also modified by topography even in the absence of vegetation.

Primary productivity: This study considers the 'evapo-transpiration' rates of plants. Evapotranspiration refers to the release of water into the atmosphere as water vapor, both by the physical process of evaporation and by the biological processes of transpiration and respiration. Wherever, evapotranspiration is high at higher temperatures, so is the plant growth. The tropics generally are warm and moist that allows more plants to grow. On the other hand, in higher latitudes, it is simply too cold for the atmosphere to hold enough water vapour, thereby, limiting the number of plants that are present there.

Habitat heterogeneity: It leads to the presence of greater biodiversity. Habitat heterogeneity explains that the increase in number of habitats leads to an increase in the number of different species in a natural landscape.

SAQ 1

a) What are the four spheres of Earth?
b) List out the important fields of biogeography.

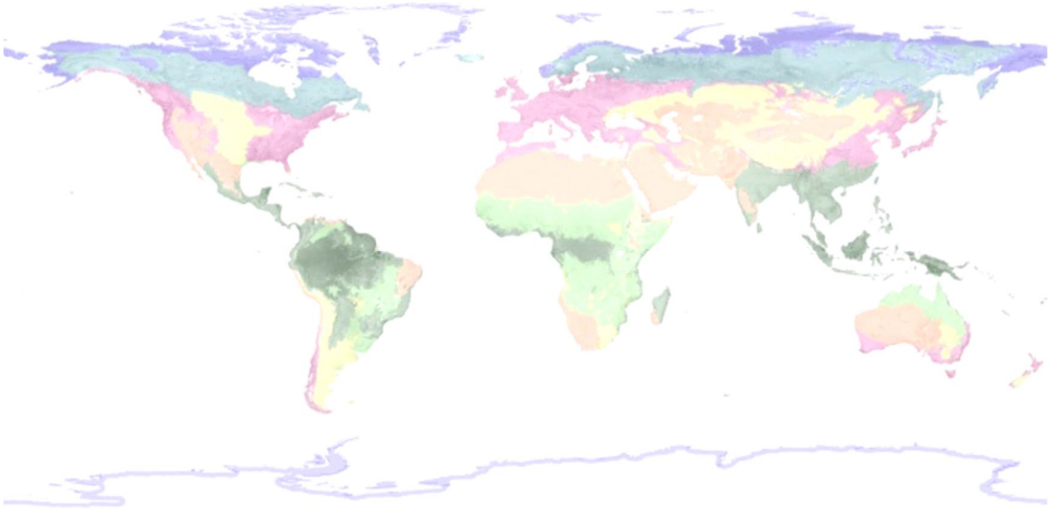
3.3 BIOGEOGRAPHICAL REGIONS-BIOMES OF THE WORLD

We already know that Earth is the only planet that supports life in the entire universe. The organisms such as plants, animals, humans, and millions of micro-organisms live in this planet. Interestingly, the distribution of these organisms is not uniform and it is primarily influenced by the climatic conditions, mainly, temperature and rainfall.

You may understand that the living organisms including plants and animals are found in areas where they suitably adopted in that climatic condition. Therefore "a distinct-ecological community of plants and animals, living together in a particular climate" may be the suitable definition of a '**Biome'.** The following are recognized as the major biomes of the world:

1. Tropical Rainforest Biome
2. Temperate Deciduous Forest Biome
3. Taiga Biome
4. Tropical Grassland Biome
5. Temperate Grassland Biome
6. Desert Biome
7. Arctic Tundra Biome

Refer to Fig 3.1, which gives you an idea about the major biomes that are distributed across the world. In this context, let us now study the characteristics and importance of these biogeographical regions or biomes of the world.



(Source: NASA, 2020; https://earthobservatory.nasa.gov/biome-draft).

3.3.1 Tropical Rainforest Biome

The tropical rainforest biome is characteristically hot and moist in condition distributed around the earth's equator. The tropical rainforests are largely found in South America, Africa and Southeast Asia. These biogeographical regions receive rainfall evenly between 1500 mm and 4000 mm throughout the year. The average temperature is approximately 25° C all year round and humidity also ranges from 77 to 88%. The combination of constant warmth and abundant moisture makes the tropical rainforests the most favourable environment for many plants and animals. As a result, this biome contains the greatest biodiversity by housing a large number of species of plants and animals in the world.

The micro-organisms including bacteria and fungi play an important role as the hot and humid conditions make an ideal environment for their development. They are able to decompose the organic matter very quickly and the nutrients are quickly consumed by the vegetation. The nutrients absorbed by the soil are leached out by the abundant rainfall, thereby leaving the soil infertile and acidic.

Flora: You will be astonished to know that the tropical rainforest areas receive approximately 12 hrs of sunlight in a day. Of which, only 2% of total sunlight, reaches to the ground. This biome has the densest vegetation on the earth's surface, often forming three layers - the canopy of vegetation, the under storey and the ground layer. The canopy of vegetation is created by the apex portion of tall trees. The under storey prevents sunlight to reach the ground and hence, very little vegetation is able to survive at the ground level.

The flora is highly diverse. The trees are generally tall, nearly 20-35 m high with strengthened trunks and shallow roots, mostly evergreen, and with large dark green leaves. Plants such as orchids, bromeliads, vines, ferns, mosses and palms are present in these regions. Survival of a plant in the tropical rainforest depends on its ability to tolerate constant shade or to adapt strategies to reach sunlight.

Fauna: Tropical rainforests provide sufficient water and food constantly than any other biome of the world. Hence, the large number and variety of animal species are accustomed to live in these regions. Small animals including insects, birds, rodents, frogs, lizards, possums, snakes and monkeys live in the tropical rainforests and many of them never set their foot on the ground. Larger animals include tigers, leopards, gorillas, rhinoceros, and so on. Some animals use the tall trees and under storey for shelter and as a source of food. For example, the toucan, sloth, camouflage and blue-green algae also survive in the rainforest.

Toucan

3.3.2 Temperate Deciduous Forest Biome

Temperate deciduous forest biomes are geographically located between the polar regions and the tropics. These are also known as the Mid-Latitude deciduous forest biome. These forests are spread over the eastern parts of the United States and Canada, central European regions, and parts of China and Japan. Air masses from both the cold polar regions and the warm tropical regions largely affect these biogeographical areas which lead to the significant changes in climatic conditions.

Temperature ranges between -30^{o}C and 30^{o}C while precipitation varies from 750 to 1500 mm annually. You will find a major chunk of the human population in this geographical region. The significant vegetation is deciduous forest covered with an abundance of deciduous trees. "**Deciduous**" means 'to fall off', or 'shed', seasonally. Just as the name implies, these trees shed their leaves during autumn season every year. As they fell off, they decay, and the nutrients contained in the leaves are absorbed by the soil. Due to decomposition of trees and leaves, the soils of this biome tends to be very fertile.

Flora: Trees of this biome include maple, oak, hickory, birch, magnolia, hemlock, spruce, fir, etc. A deciduous forest typically creates several layers of plant growth. Top layer is created by the tall deciduous trees with moderate canopy as it allows sunlight to reach the ground. The shorter species of trees make up the second layer of plant growth. Shrubs and forest herbs include wild flowers and berries are able to grow quickly taking an advantage of intervening period of shedding leaves by deciduous trees. The last layer includes mosses and lichens that largely grow on tree trunks.

Initially the, deciduous trees begin to produce thin, broad, light-weight leaves and are turned to green due to warm temperature and plenty of sunlight.

However, when temperatures are cold, the broad leaves expose too much surface area to water loss and leads to tissue damage. When the temperature dips coupled with limited sunlight, the trees start to shed their leaves. Deciduous trees stay dormant in the winter season and bloom again in the spring season.

Fauna: In this geographical region, we largely find a wide varieties of mammals, birds, insects and reptiles. It includes bears, raccoons, squirrels, skunks, woodmice, salamanders, frogs, turtles white-tailed deer, elk, bison, bobcats, mountain lions, timber wolves, and coyotes, etc. As the climate pattern changes, the animals in this biome try to adopt hibernation and others are able to migrate to suitable lower areas that enable them to live in the habitat. We can find a wide variety of birds that migrates and many of the mammals hibernating during cool temperatures when food is in short supply. During the summer, squirrels, chipmunks, and jays use to gather the nuts and seeds, and store them in the hollows of trees for use during the winter months. Cold temperatures help to prevent decomposition of the nuts and seeds.

Squirrel

SAQ 2

a) What is the important character of tropical rainforests?
b) What is the meaning of deciduous?
c) Which season is favourable for shedding leaves by the deciduous trees?

3.3.3 Taiga Biome

If you see the Fig. 3.1, you will notice green colour portions near the polar regions. This is the place where you will find the largest biome in the world, the 'taiga' which is distributed between 50^0 N and 60^0 N latitudes in the northern hemisphere. The taiga biome is also called as the **Boreal forest** or **Coniferous forest** biome. Since, it is very near to polar region, it is strongly affected by cold temperatures. This cold biome stretches across the northern portions of North America, Europe and Asia. The maximum area is occupied by Siberia which is famously known as Siberian desert. Moscow in Russia and Toronto in Canada are the largest human population cities found in the southern regions of taiga. However, the northern areas are relatively unpopulated, hence, it is called cold desert.

The temperatures significantly vary during the winter and summer seasons as winters are long and cold and the summers are short and cool. The average temperature in summer ranges from -40°C to 20°C and precipitation varies between 300 to 900 mm annually with the occurrence of with snow fall during winters. In the lower latitudes, precipitation is more evenly distributed throughout the year.

Do you know, this taiga region was covered with glaciers several millions of years ago. You will find gouges and depressions like topography which proves that the position of glaciers were slowly receded. These gouges and depressions are frequently filled with precipitation often snow and ice, creating bogs and lakes geomorphic structures. The soil found in the taiga is low in nutrients and highly acidic in nature. It is rocky and covered with un-decayed leaf litters. Patches of permafrost can also be found in some geographical areas of the taiga.

Flora: We all are aware of the climate which strongly influences the living capabilities of organisms. The severe cold climates of taiga do not support a large number and variety of plant life. The most common type of trees found in the taiga are the conifers. Four kinds of conifers, ever greens, spruce, fir and pine, and the larch (a deciduous tree) are found in the taiga. Birch and aspen are also seen in this biographical region of the world.

The leaves of evergreens are always green as they don't drop their leaves when temperatures cool. They conserve the limited energy available to them and may use it for structural growth rather than producing leaves. Due to harsh climates, the ground freezes during the winter months and plant roots are unable to get water. The typical structure of leaves, the conical shape, which allows the snow to slide off the branches, thus protecting them from severe damage in this taiga biome.

Fauna: Many of the animals and birds are not able to survive round the year because of cold climates. Examples of the animals living in the taiga are moose, deer, bear, bobcats, squirrels, chipmunks, ermine and moles.

The taiga is home to many insects and birds such as the bald eagle, wood peckers and warblers. Taiga is considered to be a wonderful breeding place for a wide variety of insects. Many migratory birds come to nest and feed on

the huge insect population. The bogs and lakes/ponds are the main source of water which often remains filled during summer season. The major phenomenon we can observe in this region is that most animals migrate to warmer climates once the cold weather begins. Some animals live in the taiga by hibernating when temperatures drop. They with stand the extreme cold temperatures by producing a layer of insulating feathers or fur to protect them from the cold.

Bald Eagle

Polar Bear

3.3.4 Tropical Grassland Biome

The tropical grasslands or shrub lands are also popularly called as **Savannah.** It is characterized by tall grasses and occasional trees. Such regions also includes chaparral and woodland areas.

The countries like Botswana, Namibia, Kenya, Brazil, India, Australia and USA are covered with large portions of Savannahs. These biogeographic regions are having 6 to 8 months as summer season and rest a dry winter

season. There is wide range of rainfall variations as low as 250 mm/year and upto 1250 mm/year high in some areas. The rain is unpredictable, varying from month to month. Due to different climate and soil conditions or agricultural practices, these regions are characterised by limited growth of trees. These regions are now severely altered by humans in order to plant the crops by burning the huge traits of grasslands and felling off the trees.

Flora: A wide variety of grasses is predominant plant life which grows in the Savannahs. The grasses in some areas grow about 2 to 3 meters tall that is named as 'Elephant Grass'. Scattered isolated trees or small group of trees can also be found in particular locations. The acacias and baobab trees are common examples seen in African Savannahs. A **'Prairie'** is named for savannah biome where trees are almost absent. Due to fires, the grasses are burnt. However, they grow with the help of water and other water reserves below the ground.

Fire is a phenomena which stimulates a fresh growth and replenishes the soil with nutrients. Baobab trees produce a small size of leaves during the wet season that helps limit water loss. They store water in its large trunk to survive during drought conditions. The acacia tree also develops long taproots that can reach deep underground water source.

Baobab Tree

Acacia Tree

Fauna: You might be knowing that the variety of animals are housing by the African Savannahs. Elephants, lions, leopards, cheetahs, rhinos, zebras, hyenas, ostrich, and starlings are some examples. The rainwater is the important source of water supply where birds, insects and several animals thrive in the Savannahs. Most of the birds and animals migrate in search of water to places within the biome or outside and is a common phenomenon. As and when rainy season starts they come back to their habitats. Fires are common in this dry grass region and some animals run fast and fly, and some are stayed in burrows for escaping from the fires.

African Elephant

Rhino

3.3.5 Temperate Grasslands Biome

As we discussed earlier, the name itself suggests that these are characterized by a dominance of grass. Temperate grasslands are distinguished from tropical grasslands based on lack absence of trees and shrub plant life. These are found in the north and south of the tropics. The major temperate grasslands in the world are:

1. Veldts of South Africa
2. Puszta of Hungary,
3. Pampas of Argentina and Uruguay
4. Steppes of Russia and China
5. Plains and Prairies of North America
6. Downs of Australia and New Zealand

Temperatures vary more from summers to wards winters, and the amount of rainfall is lesser in temperate grasslands than in Savannas. The annual range of temperature varies between – 40^{o}C and 38^{o}C. The average annual rainfall ranges from 500 mm to 800 mm which is considered to be low. There is a positive relationship with the growth of grass to the amount of rainfall. The high rainfall results in to the tall growth of grass in this biome. Drought and fire plays a large role in keeping the trees from taking over the grasslands as like that of tropical grasslands.

Flora: Plants growing in the steppes, usually in dry habitats, are more or less 30 cm in height. The various species of grasses include purple needle grass, blue grama, buffalo grass, sagebrush, spear grass cacti, and galleta. The famous plant called **'sweet'** (Adonis Vernalis) grows in steppes that is widely

used as a tranquiliser and a powerful medicine for treating heart and kidney diseases.

Fauna: The fauna like bison, saiga antelope, coyotes, bobcats, wolf, prairie chicken, badgers, eagles, hawks, owls, snakes, etc., can be found in this biogeographical region. The saiga antelope has a large, inflatable, humped and movable nose, living in the extremely cold and dusty environment. Today, people use steppes to graze livestock and to grow wheat and other food crops. Overgrazing, ploughing, and irrigation have started are greatly affecting the steppes on large scale.

Saiga Antelope

SAQ 3

Match the following:

1) Taiga forest	a) Tropical grasslands
2) Steppe	b) Boreal forest
3) Savannah	c) Temperature grasslands
4) Pampas	d) Argentina

3.3.6 Desert Biome

We all are aware of a 'desert' which means dry area. In this biogeographical regions, the annual precipitation varies from about 100 mm to as much as 370 mm. You will find the localized seasonal rainfall in this biome and it is difficult to predict when or where it will occur. Interestingly, in Atacama desert located in Chile, we could not measure rainfall for several years at several places. Deserts can be either hot or cold or semi-arid. The type of desert is assessed by its geographic location, atmospheric pressure, and proximity of mountain

ranges, etc. The world's known desert are: Antarctic Desert (Antarctica), Arctic Desert (Arctic), Sahara Desert (Africa), Arabian Desert (Middle East), Gobi Desert (Asia), Patagonian Desert (South America), Great Victoria Desert (Australia), Kalahari Desert (Africa), Great Basin Desert (North America), Syrian Desert (Middle East) and so on.

You can find deserts along the coast called coastal deserts located on the west coasts of continents between 20^{o} to 30^{o} latitude, for example, Atacama and Namib deserts. Prevailing winds blow in an easterly pattern and prevent the moisture from moving onto the land. Semi arid deserts are not only located far from the moisture, but are frequently associated with high mountain ranges that produce a rainshadow effect. Examples are Gobi desert of Mongolia and Great Basin desert, etc.

Deserts have large daily temperature variations. Temperatures are high during the day because there is very little moisture in the air to block the Sun's rays from reaching the earth. Once the Sun goes down, the heat is absorbed. During the day, the temperatures are very high and the night's record low temperatures which makes survival in the desert a difficult task.

Flora: The abundance and variety of plant life in these regions are short grasses, sage brush, creosote bushes, and cacti, etc. Short grasses are grown in almost all desert areas. The typical examples are the saguaro cactus (Sonoran desert) and spinifex (Australian desert).

Because of the dry climate, plants have developed taproots as long as 6 to 9 meters for capturing the water. Other characteristic root systems are horizontal way in which roots penetrate just below the surface and extend far beyond the plant canopy. The root system of the mulga tree is another unique system of collecting water. The tiny leaves of the tree capture the water from rain and funnel it down along the branches to its centre. The water then falls to the ground near the trunk of the tree where the roots are concentrated and survived. Some desert plants store water in their roots, stems, leaves or fruit which are referred to as succulents, for example, cactus. Desert plants can retain moisture by limiting water loss through their leaf surface, their size, sheen or texture of their leaves.

Fauna: You might have come to the conclusion that the desert regions does not support the animal life. But, it is not one hundred percent true. Many reptiles, insects, birds, and small animals do also survive in the desert biome. The kangaroo mice of North America and the bilby and red kangaroo of Australia are just a few examples of small animals that live in the desert. You will not find large animals in the desert regions except camel. Camel possess characteristic not used used ability to store water in large quantities in several sacs in its abdomens and can survive without water for many days. Animals in this region seek shelter by burrowing into the ground. The animals remain inactive during the hot daytime. They hunt at night when temperatures are cool.

Camel

3.3.7 Arctic Tundra Biome

Arctic tundra is a typical biogeographical regional biome and is distributed across northern Alaska, Canada, and Siberia. **Tundra** is a Finnish word which means **'treeless'**. These regions experience long and cold winters as well as short and cool summers. An average annual precipitation of about 250 mm and dry winds make desert like conditions in Arctic Tundra. The permafrost (the sub-soil) consisting mostly of gravel and finer material remains below the freezing point throughout the year. It is characterized by the lack of cracks and pores, which creates and get obstacles for plant roots as well as for water penetration.

During the summer, Arctic tundra is typically covered with a lot of surface water. The water cannot percolate into deep grounds due to permafrost conditions, forming as pools of water on the surface. These regions receive low amount of sunlight. Though, the sun remains in the sky for 24 hours a day during the summer, it stays close to the horizon and provides only low intensity sunlight.

Flora: In the Arctic tundra, due to short supply of sunlight, even in the summer, plants are able to penetrate roots at very shallow depth. Permafrost prevents plants from sending their roots down the past pores. Hence, Arctic plants have a very short growing season. But interestingly, there are approximately 1700 types of plants which thrives well in this region by facing severe conditions and the short growing season spanning hardly about 50 to 90 days period. Some of the plants include mosses, lichens, shrubs, and grasses which grows in this biome. A small leaf structure is another instance

of physical adaptation that helps plants to survive. By producing small leaves, the plant is able to retain more moisture, which it has stored.

Fauna: Animals rarely live in the Arctic tundra throughout the year. Most of the birds and animals use it as a summer home. The musk-ox, Arctic wolf and brown bear are adopted to live year around in these extreme climatic conditions. Animals need to find ways to stay warm in order to survive in the long and cold winter months. Animals including lemmings, voles, caribou, arctic hares, squirrels, arctic foxes, wolves, polar bears, and migratory birds such as ravens, snow buntings, falcons, loons, sandpipers, terns, snow birds, and various species of gulls are some of the examples.

The peculiar character of animals in this regions is the hibernation which means sleeping during the winter. The food eaten by bears during the summer is to be stored as a layer of fat underneath its skin. This fat is slowly converted into energy for sustaining life during the hibernation. Another example is that of layer of long fur that protects the musk-ox from the cold wind and iey water. The hooves of the musk-ox are large and hard that allows breaking the ice and drinking the water underneath.

Muskox

Polar Bear

SAQ 4

a) Name any two cold deserts.
b) What is the meaning of Tundra?

3.4 SUMMARY

In this unit you have studied so far:

- The life of organisms exists on the earth which is known as biosphere. This is the zone of contact between the atmosphere, lithosphere and hydrosphere.
- The life forms on Earth depends for their sustenance on the abiotic conditions such as the light, air, water and soils, prevailing in their immediate surroundings.
- The abiotic conditions vary from place to place and also from time to time, so is the distribution of the biota, accordingly.
- Biogeography may be defined as “the study of the temporal as well as the spatial distribution of the living beings and their living conditions in the biosphere”.
- You have also studied the major biogeographical regions or biomes of the world such as: the tropical rain forest biome, the temperate deciduous forest biome, the taiga biome (the Boreal forest biome), the tropical grasslands biome (the Savannah), the temperate grasslands biome (the Steppe), the desert biome, and the Arctic tundra biome.

3.5 TERMINAL QUESTIONS

1. Define the biogeography and explain scope of biogeography in detail.
2. What are biographical regions or biomes of the world? Explain any two important biomes of the world.

3.6 ANSWERS

Self Assessment Questions

1. a) They are the atmosphere, the lithosphere, the hydrosphere, and the biosphere.

   b) Historical biogeography and ecological biogeography.

2. a) Hot and moist in condition.

   b) Deciduous means “to fall off”.

   c) During the autumn season, the deciduous trees shed their leaves.

3. 1 b; 2 c; 3 a; 4 d

4. a) Antarctic and Gobi deserts

   b) Treeless

Terminal Questions

1. Refer to the Section 3.2.
2. The major biogeographical regions or biomes of the world are the tropical rain forest biome, the temperate deciduous forest biome, the taiga biome (the Boreal forest biome), the tropical grasslands biome (the Savannah), the temperate grasslands biome (the Steppe), the desert biome, and the Arctic tundra biome. Refer to the Section 3.3.

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GLOSSARY

Abiotic components : are nonliving things that influence an organism. Abiotic factors include energy, nonliving matter, living space, climate, weather, minerals, water, air, etc.

Atmosphere : The gaseous layer that encompasses the earth's surface is called the atmosphere.

Atoms : They are made up of protons, electrons, and neutrons.

Autotrophs : Producers or phytoplankton are termed as autotrophs.

Biome : It is a distinct ecological community of plants and animals, living together in a particular climate

Biosphere : It represents the thin layer constituting the zone of contact between the atmosphere, hydrosphere and lithosphere. It supports all forms of life on the Earth.

Biotic Components : The living or organic components is called biotic components.

Carnivores : These are secondary consumers who capture and eat other animals.

Consumers : They depend on producers for their source of food in the growth and development. Examples of consumers are animals, fungi, and bacteria.

Cultivators : They are also called as farmers in agricultural societies and are utilizing the sophisticated technology by mixing horticulture and pastoralism to get substantial production in unit land.

Decomposers : They convert the nonliving organic matter into inorganic material which are called decomposers. These live on dead, excretes waste products or decaying organisms.

Ecological Biogeography : is concerned with short-term periods of time at a smaller scale and local or within the habitat of living animals or plants.

Ecology : It is the scientific study of how organisms interact with one another and with the non-living components of their environment.

Ecosystem : The system resulting from the integration of all the living and non-living factors of the environment.

Environmental Geography : Description of different components of environment and interactions of human with these components and their spatial variation over the Earth's surface.

Food Chain : The linkage of feed between individuals is known as food chain.

Food web : It is a more complex linkage between the organisms.

Herbivores : These eat producers as a source of food for example leaf-eating insects, some birds and animals.

Heterotrophs : Consumers are also known as heterotrophs.

Historical Biogeography : It deals with long-term periods of time at a large scale, and global areas of living and/or extinct species.

Human Ecology : The subject of human ecology studies the interactions of humans with their environment and illustrates human's distribution and abundance.

Humanmade Environment : It is also referred to social environment which deals with culture, language, social conditions, health, living conditions, and economic capability of the people in an area.

Hydrosphere : It corresponds to all the areas on the earth's surface cover by water in all the three of its physical forms such as water, water vapour and ice.

Insolation : It is also referred to as the incoming solar radiation. It explains the small fraction of energy emanated by the sun that reaches the earth's surface. It is responsible for the origin, evolution and sustenance of life in the world.

Lithosphere : It corresponds to the solid part of the earth's surface comprising the earth's crust and the upper mantle.

Matter : It is anything like solids, liquids, gases and all living and non-living organisms.

Omnivores : They eat both plants and animals for example most humans and rats.

Parasites : These are consumers living in or on another living organism for example tapeworm, bacteria, and viruses.

Pastoralists : These human groups depend mainly on herding domesticated livestock.

Physical Environment : It is also known as the natural environment which includes all living and non-living things that occur on the Earth.

Producers : Sun energy is used for photosynthesis for their needs in the environment. Examples are Plants, algae, and other tiny aquatic organisms.