B.A. / B.Sc. (Semester – II)

Theory – Philosophies and Methodologies in Geography Marks: 60

Credit – I

1. The nature of Geography

2. Objectives and Relevance of Geography

3. Major Themes of Geography (Areal Differentiation, Man-Environment Interaction & Spatial Organization)

4. Dualism in Geography

i. Regional/Systematic

ii. Physical/Human

iii. Historical/Contemporary

Credit– II

1. Contribution of Phoenicians and Greeks in the field of geography

2. Contribution of Romans in the field of geography, Dark Age and its impact

3. Contribution of Arabs in the field of geography

4. Schools of Thought: German School

Credit– III

1. Definition, Scope and Significance of Ecology

2. Concept and broad types of Ecosystem

3. Biodiversity: Concept, Importance and conservation

4. Ecological Imbalances: causes and consequences

Credit– IV

1. Quantitative Techniques and their relevance in Geography

2. Quantitative Revolution in Geography

3. Geomorphic field survey: Meaning, significance and procedure

4. Socio-economic field survey: Meaning, significance and procedure

Practical - Surveying 0 Marks

Credit– I

1. Introduction to Surveying: Classification and Types of Surveying

2. Plain Table Survey: Definition, accessories, procedure and precautions

3. Radial, Intersection and Resection Methods of Plain Table Survey

Credit – II

1. Study of survey of India topographic maps

2. Interpretation of SOI Top sheets with respect to Relief, Drainage, Settlements and Communication patterns

3. One day geomorphic field trip and report writing

CREDIT - I

Introduction

Geography as a branch of learning is focused on understanding the relationship between man and nature. The edifice of geography as a discipline is thus built on the experiences of successive generations of mankind (since the dawn of history) in trying to comprehend the world of which their homeland forms but a small part. Viewed thus, history of geography is fundamentally concerned with the development of human consciousness about the possibilities and limitations that the external world of nature presents for man's growth and progress. The thirst for geographical knowledge is as old as human curiosity, since some of the earliest questions agitating the minds of primitive man must have related to the character of his natural surroundings. There is natural urge in man to gain knowledge about the lands and people living beyond his own territory.

Geography has a long history of development of its thought. The ancient *Greek Scholars* laid the foundations of geography and on these foundations was created the edifice of modern geography by scholars of the subsequent ages. The *Romans,* the *Arabs*, the *Indians,* the *Germans*, the *French*, the *British* and the *American* geographers, all have contributed to the development and enrichment of its content. During different phases of its evolution, geography has undergone changes in its approach, philosophy and methodology. The earliest geographers were descriptive and geographers concerned with answering questions like *'What is where'* and the questions like *'Why it is there'* came to be added later. During the time of great formulators like *Kant, Ritter, Humboldt* and later on *Ratzel,* geography came to be developed as an analytical science, and today the discipline is not only concerned with descriptions but also with analysis as well as prediction.

Geography is one of the oldest earth sciences and its roots date back in the works of the early Greek Scholars like *Thales* and *Anaximander* during 6^{th} and 7^{th} century B.C. There is evidence that the Greek legends and poetry had begun to incorporate descriptions of the land around the *Aegean Sea* around 2000 B.C. The real beginning of the discipline however was made through the works of *Thales, Anaximander, Democritus, Pythagoras, Hecataeus, Herodotus* and their contemporaries. Since the period of these Greek scholars who are given credit of being the earliest geographers, till date, the philosophy of geography has undergone extensive changes. While the Greeks developed geography mainly as a descriptive science dealing with the physical

world, the modern geography has a much wider scope. Today the subject is not merely descriptive, but even analytical. From the descriptive facts, it proceeds to generalizations, hypothesis formulation and testing, formulation of laws and theories. The discipline does not stop at mere explanation of the empirical conditions and circumstances, it ventures in speculation also. Predicting the future on the basis of the analysis of the past and present is one of the basic objectives of the discipline of geography today.

1.1: Defining Geography

Geography has been defined differently through different periods of its history. Geographical work in ancient Greece had followed two distinct traditions. One was the mathematical tradition which was focused on fixing the location of places on the earth's surface, and the other was gathering information through travels and field work. According to them, the purpose of geography was to provide a description of the physical features and conditions in different parts of the world. This gave rise to the point of view that geography is a physical science. The emergence of regional approach in geography also emphasized the descriptive character of geography.

Kant, the famous German scholar defined geography as a study of the earth. According to him, the aim of geography was to explain the variations found in various parts of the earth and he emphasized that incidents and active relations are especially important in geography. According to ***Humboldt***, geography is the science related to nature and it studies and describes all things found on earth. ***Carl Ritter***, a contemporary of Humboldt put forward the relation of all phenomena and forms of nature to human race as the central principle in geography. Thus, he emphasized that geography should study the nature in relation to human beings. Most of the German geographers considered geography as the study of the earth surface according to its differences or the study of the different areas of earth surface in terms of total characteristics. Another important school of thought defined geography as the study of man-environment relationships. One of the most popular definitions of geography has been given by ***Hartshorne***. According to him, "Geography is concerned to provide accurate, orderly and rational description and interpretation of the variable character of the earth's surface." He further emphasized "Geography is that discipline that seeks to describe and interpret the variable character from place to place of the earth as the world of man." This definition of geography is today taken as the working definition of geography with minor modifications. According to ***Hettner***, 'Geography studies the differences of phenomena usually related in different parts of the earth's surface'.

Geography started attaining its present character from the latter half of the 18^{th} century. However it doesn't mean that geography as a discipline came into existence during the 18^{th} century. The roots of the subject could be traced to the period of early Greek and Roman scholars. Geography

has been as old as any other science, but the character and subject matter of the subject has been changing over the long period of its evolution to the present state.

1.2: Nature of Geography as a Discipline

Geography is one of the oldest earth science and its roots date back in the works of the early Greek scholars. The word *'geography'* was first used by the Greek scholar *Eratosthenes* in the 3rd century B.C. Geo *''Earth''* and Graphy *''to describe''* literal meaning of geography is to describe about the earth's surface. In other words ''Geography is largely the study of the interaction of all physical and human phenomena and landscapes created by such interaction''. It is about how, why and where human and natural activities occur and how these activities are interconnected.

There exist variations over the surface of the earth in its physical as well as in cultural environment. A number of phenomena are similar and many are dissimilar. It was therefore, logical to perceive geography as the study of *areal differentiation*. Thus geography was perceived to study all those phenomena which vary over space. Geographers do not study only the variations in the phenomena over the earth's surface (space) but also study the associations with the other factors which cause these variations. For example, cropping patterns differs from region to region but this variation in cropping pattern, as a phenomenon, is related to variations in soils, climates, demands in the market, capacity of the farmer to invest and technology inputs available to him/her. Thus, the concern of geography is to find out the causal relationship between any two phenomena or between more than one phenomena. A geographer explains the phenomena in the frame of cause and effect relationship, as it does not only help in interpretation but also foresees the phenomena in future.

The geographical phenomena, both the physical and human, are not static but highly dynamic. They change over time as a result of the interactive processes between ever-changing earth and untiring and ever-active human beings. Geography, thus, is concerned with the study of *Nature* and *Human* interactions as an integrated whole. 'Human' is an integral part of 'nature' and 'nature' has the imprints of 'human'. Nature has influenced different aspects of human life. Its imprints can be noticed on food, clothing, shelter and occupation. Human beings have come to terms with nature through adaptation and modification. Human beings have claimed their contribution using natural resources. With the help of technology, human being moved from the stage of necessity to a stage of freedom. They have put their imprints everywhere and create new possibilities in collaboration with nature. Thus we find *humanized nature* and *naturalized human beings* and geography studies this interactive relationship. The space got organized with the help of means of transportation and communication network. The links (routes) and nodes (settlements of all types and hierarchies) integrated the space and gradually, it got organized. As a social science discipline, geography studies the *'spatial organization'* and *'spatial integration'*.

Geography as a discipline is concerned with three sets of questions:

(i) Some questions are related to the identification of the patterns of natural and cultural features as found over the earth's surface. These are the questions about *what?*

(ii) Some questions are related to the distribution of natural and human/cultural features over the earth's surface. These are the questions about *where?*

Taken together, both these questions take care of distributional and locational aspects of natural and cultural features. These questions provide inventorised information of what features and where located. It was a very popular approach during the colonial period. These two questions did into make geography a scientific discipline till the third question was added. The third question is related to the explanation or the causal relationships between features and the processes and phenomena. This aspect of geography is related to the question, *why?*

Geography as a discipline is related to space and takes note of spatial characteristics and attributes. It studies the pattern of distribution, location and concentration of phenomena over space and interprets those providing explanations for these patterns. It also takes note of the associations and inter-relationships between the phenomena resulting from the dynamic interaction between human beings and their physical environment.

1.3: Evolution of Geography

Although geography is one of the oldest areas of human inquiry, it is also one of the most recent intellectual disciplines in modern academia. Since the earliest times human beings have explored and attempted to map and understand the workings of the world around them. However it was not until the 17^{th} century that geography began to emerge as an independent intellectual discipline and not until the late 19^{th} century that it was accepted as an academic discipline, with the founding of the first university geography departments.

Geography was first systematically studied by the ancient *Greeks*, who also developed a philosophy of geography. *Thales* of Miletus, *Herodotus, Eratosthenes, Aristotle, Strabo* and *Ptolemy* made major contributions to geography. Their contributions did much to advance geographical theory and gave the Western World its first important knowledge relating to the form, size and general nature of the Earth. The *Roman* contribution to geography was in the exploration and mapping of previously unknown lands. Greek geographic learning was maintained and enhanced by the *Arabs* during the Middle-Ages. Arab geographers, among whom *Al-Idrisi, Ibn-Khaldun* and *Ibn-Batutta* are prominent, travelled extensively for the purpose of increasing their knowledge of the world. The journeys of *Marco Polo* in the later part of the Middle-Ages began the revival of geographic interest outside the Muslim World.

With the *Renaissance* in Europe came the desire to explore the unknown parts of the world that led to the voyages of exploration and to great discoveries. However, it was mercantile interest rather than a genuine research for knowledge that spurred these endeavors. The sixteenth and seventeenth century reintroduced sound theoretical geography in the form of textbooks *(the Geographia Generalis of Bernhardus Varenius)* and maps *(Geradus Mercator's world map).* In the eighteenth century, geography began to achieve recognition as a discipline and was taught for the first time at the University level.

The modern period of previously geography began towards the end of the 18th century with the works of *Alexander Von Humboldt* and *Carl Ritter.* Thenceforth, two principal methods of approach to geography can be distinguished; the *systematic*, following *Humboldt* and the *regional*, following *Ritter*. Of the national schools of geography that developed, the German and the French were the most influential. The German school dealt mainly with the physical geography, developed a scientific and analytical style of writing. The French school became known for its description regional monographs present in a lucid and flowing manner; human and historical geography were its forte. Although emphasis has shifted several times between the approaches and view-points, their interdependence is recognized by all geographers.

Since the end of World War II, geography like other disciplines, has experienced the explosion of knowledge brought on by the new tools of modern technology for the acquisition and manipulation of data; these include *aerial photography*, *remote sensors* (include infrared and satellite photography), and the computers (for quantitative analysis and mapping). The quantitative method of geographical research has gained much ground since the 1950's; *Edward Ullman* and *William Garrison* of the United States and *Peter Hagget* of Great Britain being leading exponents.

Important contributions to the advancement of geography and to the development of geographic concepts have been made by the *Ferdinand Von Richtofen, Albert Penck, Friedrich Ratzel, Alford Hettner, Karl Haushofer* and *Walter Christaller* in Germany*; Paul Vidal de La Blache, Jean Brunches, Elsie Reclus de Mortonne* in France*;* and *W.M. Davis, Isaiah Bowman, Ellen Semple, Carl O' Sauer* and *Richard Hartshorne* in the United States. Today geography is studied by the government agencies and in many of the World's Universities. Research is stimulated by such noted geographic institutions as the *Royal Geographical Society* (1830, Great Britain), the *American Geographical Society* (1852, United States), and the *Societie de Geographia* (1821, France).

1.4: Objectives and Relevance of Geography

Geography is a spatial science. The science of space and place, that brings together earth's physical and human dimensions. It is a combined study of people, places and environments which shows the patterns and relationships between things.

Geography is a fascinating subject. It reveals all the wonderful changes and the activities that have been going on in the world since the beginning of time. Whether it is a quiz show or just a simple news program, importance of geography quite often passes undetected. By reading geography, we learn not only about our own country, but also about countries beyond the seas. We also learn about the mountains, oceans, lakes, island, volcanoes, the winds and a number of interesting things about the world and the Universe. Among the important things that we learn in geography are the infinite varieties of creatures, plants, birds and land features that exist in the world. We know that there are millions of creatures, small and large, of various kinds in all parts of the earth. We also know that many of the early creatures have now become extinct while many of them have changed from their original forms. Reading about all these is indeed very interesting. We also learn about the various types of plants and birds that exist throughout the world. The plants and birds in the cold lands are not the same as those in the warmer lands. In the same way, the landforms in the cold regions are different from those in other regions. For example, in the equatorial region plant and animal life is luxuriant, while in the poles, the land is covered with snow, plant and animal life is less abundant. As the climate and vegetation of one place are not the same as that of another, the habits and activities of the people are different regions are also different. Thus geography is a very important subject, and because of its width and variety, it is one of the most interesting subject to read.

Geography has now acquired the status of science that explains the arrangements of various natural and cultural features on the earth's surface. Geography is a holistic and interdisciplinary field of study engaged in understanding the changing spatial structure from past to the future. Thus, the scope of geography is in various disciplines, like armed services, environment management, water resources, disaster management, meteorology and planning and various social sciences. Apart from that, a geographer can help in day to day life like tourism, commuting, housing and health related activities.

Objectives of Geography

Geography has many practical and utilitarian values.

- It helps us to understand and appreciate the natural landscape of earth, which gives us knowledge about the stock of natural resources, which can be used for the benefit of mankind. Also we came to know about the impact of human activities on the physical environment, so necessary to avoid past mistakes and ensure eco-friendly utilization of resources.

- The usefulness of geography lies in its ability to study human problems. It explains many of the world's critical issues. For example, which parts of the world are facing over population crisis? A geographer may study this problem in relation to natural resources and social organizations. Geographers describe the spatial distribution of activities and explain the relationships in the location of different activities.

- Geography helps a lot in understanding the places and peoples in different parts of the world. Due to rapid increase in transport and communication and information explosion, the world has shrinked into a global village. Therefore, it is important that we must know as much as possible about the people of whole globe so that we may keep pace with the changing world.

- Geography helps in shaping our economics. Geographical knowledge helps us to learn about lifestyle of people, their wants, markets they offer, raw material available with them etc. This can guide us what we must produce in our factories and farmlands which can have a ready market in the business world.

- There are variations in the natural resource base, technological development, adaptation with and modification of physical environment, social organizations and cultural developments. As a student of geography you should be curious to know about all the phenomena which vary over space and interested in understanding the changes which have taken place over time. Geography equips you to appreciate diversity and investigate into the causes responsible for creating such variations over time and space.

- The understanding and the skills obtained in modern scientific techniques such as GIS and computer cartography equip you to meaningfully contribute to the national endeavor for development. You will also develop skills to understand the globe converted into maps and have a visual scene of the earth's surface.

- It is essential for the student of geography to know the geographic facts, concepts, laws and principles because this knowledge will enable the students to give more intelligent consideration to current problems of the community, country and the world. This will enable the students to make use of geographic knowledge to explain the activities and characteristics of the people residing in different parts of the world.

- Today all over the world there are problems related to providing food security, health, effective energy use and environmental conservation. Equally important are equality issues and sustainable development. All these can be achieved by using our resources in sustainable ways. Study of geography is, therefore, necessary to learn more about environmental processes and to understand how land use planning can help us to overcome problems.

1.5: Approaches to the Study of Geography

Today geography is the only discipline that brings all natural and human sciences on a common platform to understand the dynamics of the spatial configuration of the earth's surface. There are two main approaches in geography: 1. Systematic 2. Regional

1. Systematic Approach

A study of specific natural or human phenomena that give rise to certain spatial patterns and structures on the earth surface is called systematic study. Ordinarily, systematic geography is divided into four main branches.

(i) Physical Geography

It deals with earth systems like atmosphere (air), the hydrosphere (water), the lithosphere (earth solid rock) and biosphere which encompasses all of earth's living organisms.

(ii) Biogeography, including environmental geography

It focuses on various kinds of forests, grasslands, distribution of flora and fauna, human nature relationships and the quality of the living environment and its implications for human welfare.

(iii) Human Geography

It describes culture, populations, and dynamics of social, economic and political aspects of space.

(iv) Geographical Methods and Techniques

It deals with methods and techniques for field studies, quantitative and cartographic analysis and Geographic Information System (GIS) and Global Positioning System (GPS) and remote sensing.

2. Regional Approach

Unlike systematic geography, regional geography starts with the spatial imprints of one or all the systematic geographic processes discernible as regions of different sizes. Regions could be based on a single factor like relief, rainfall, vegetation, per capita income. They could be multifactor regions formed by the association of two or more factors. Administrative units like states, districts, and tehsils also can be treated as regions. The main sub branches of regional geography are:

(i) Regional studies
(ii) Regional analysis
(iii) Regional development
(iv) Regional planning including areas and community planning.

1.6: Branches of Geography

Various phenomena on the earth's surface can be treated separately or in association. They are classified and categorized into physical phenomena and human phenomena. Thus geography has three main branches: *Physical Geography, Human Geography and Regional Geography*.

A. Physical Geography

Physical geography is the study of physical environment of the world, which is specifically composed of land, air, water, plants and animals. This gives rise to a number of subfields of physical geography.

(i) Geomorphology: It is concerned with the study of the landforms on the earth's surface. It includes origin and development of landforms through erosional, transportation and depositional processes of water, wind and glaciers.

(ii) Climatology: Climatology is the study of atmospheric conditions and related climatic and weather phenomena. It includes the study of atmospheric composition, climatic regions, seasons, etc.

(iii) Oceanography: It is concerned with the study of various types of Oceanic format component and processes related to ocean floor depths, currents, coral reefs and continental drifts, etc.

(iv) Soil Geography: It studies various soil forming processes, their physico, chemical and biological constituents, their colour and types, texture, and distribution and carrying capacity, etc.

(v) Bio-geography: It is concerned with the biological phenomena in space, especially in terms of the distribution of various kinds of floral and faunal species. Biogeography may be subdivided into plant or floral geography, animal or faunal geography and human ecology.

(vi) Astronomical Geography: It studies the celestial phenomena which concerns the Earth's surface particularly Sun, Moon and Planets of the solar System.

B. Human Geography

Human geography is the synthetic study of the relationship between human societies and the earth's surface. It is made up of three closely linked components: the spatial analysis of the human population; the ecological analysis of the relation between human population and its environment and the regional synthesis which combines the first two themes in an areal differentiation of the earth's surface. Human geography has a number of sub-branches.

(i) Anthropogeography: It largely deals with racial phenomena in their spatial context.

(ii) Cultural geography: It focuses on the origin, components and impact of human cultures, both material and non-material.

(iii) Economic Geography: It refers to the study of the location and distribution of economic activities at the local, regional, national and world scale. Economic geography can be studied under the following heads: Resource geography, Agricultural geography, Industrial geography and transport geography.

(iv) Political Geography: It is the study of political phenomena in their spatial context. Main focus remains for creation and transformation of political and administrative regions.

(v) Historical Geography: Spatial and temporal trends of geographical phenomena are studied in Historical geography.

(vi) Social Geography: It is the analysis of social phenomena in space. Poverty, health, education, livelihood are some important fields of study in social geography.

(vii) Population Geography: It is the study of various dimensions of population like its population distribution, density, composition, fertility, mortality, migration, etc.

(viii) Settlement Geography: It is the study of Rural/Urban settlements, their size, distribution, functions, and hierarch and of various other parameters of settlement system.

C. Regional Geography

Aspects such as delineation of regions, their geographical characteristics and processes of change constitute regional geography.

1.7: Dualism in Geography

Geography is a vast subject, as such specialization becomes inevitable. The vastness of the subject has given rise to diversity of approaches in its study. Right from the pre-historical period of geography, dualistic approaches are found in geographical description. This dualism depended on the aspect emphasized in the study. Earlier scholars laid emphasis on physical geography but human beings being a part and parcel of nature, also have contributed through their cultural development. Thus, develop human geography with emphasis on human activities. Dualistic thinking in geography became more prominent during the post-renaissance period in Europe. In fact no geographer remains rigorously adhered to a particular approach in his study; rather each geographer tries to combines a variety of methods and approaches. However, this tradition

stimulates innovative thinking among geographers. At present following approaches are more prominent in geographical studies:

1. *Regional vs. Systematic geography*
2. *Physical vs. Human geography*
3. *Historical vs. Contemporary geography*
4. *Deterministic vs. Possibilistic geography*
5. *Study of Formal regions Vs. Functional regions*

1. Regional vs. Systematic Geography

In regional approach, a geographer delineates a certain portion of the earth's surface as an area of his study. He studies the people and their activities within that area or region. In regional approach, the physical setting of the region is discussed first and then the adjustment of man in that physical setting is examined. The foundation of regional approach in geographical studies was first laid down by *Carl-Ritter*, a German Geographer. Later *Vidal de La Blache* was also convinced that small regions are the ideal units to train geographers in geographical studies. According to him, man and nature are inseparable parts of a geographical phenomenon. It is their intimate relationship that gives rise to a geographical region. Regional approach is highly suited to understand the problems of a particular area and ensure better utilization of its resources.

In systematic approach, a phenomenon is studied world over as a whole and then the identification of typologies or spatial patterns is done. For example, if one is interested in studying natural vegetation, the study will be done at the world level as the first step. The typologies such as *equatorial rain forests* or *softwood* or *conical* forests, etc., will be identified, discussed and delimited. Thus systematic approach is based on basic theories, techniques and universal laws. This approach was introduced by *Alexander Von Humboldt*, a German geographer.

2. Physical vs. Human Geography

This trend of dichotomy was initiated by the Greeks. *Hecataeus* studied physical geography while *Herodotus* and *Strabo* were more interested in human geography. Varenius in *Geographia Generalis* (1650) stressed on the differences of physical and human geography. *Albert Penck* coined the term '*geomorphology*'. By the second half of the 19th century, geomorphology became an important aspect of physical geography. Apart from *Humboldt* and *Ritter*, *Koeppen, Davis, Jefferson, Mortonne, Ratzel, Semple, Huntington, Herbertson,* etc. were also interested in this branch of geography. Physical geography is concerned with explaining the spatial features of the natural environment like relief, climate, soils, vegetation, animal life, water bodies, drainage, etc. Its methodology is similar to those of other natural sciences like geology and biology.

Human geography, on the other hand deals with the distribution of human population and their activities. Thus its approach is more like those of sociology and economics. *Ritter* and *Ratzel* were among the early geographers to consider man as an important agent to change the existing landscape. *Febrve* termed dichotomy as a process of *'humanization'* of the environment. Human geography basically deals with the symbiotic man-nature relationship.

Thus the spatial variation of physical and social phenomena is the hallmark of the study of geography. But it is to be borne in mind that if a geographer is concerned with the location of human activities, he has to make the use of natural environment concepts to explain the spatial patterns of those human activities. This point leads us to the conclusion that there can't be absolute separation between physical and human geography, instead there may be differences in emphasis.

3. Historical Vs. Contemporary Geography

Historical geography studies the geography of a region as it was in the past decades. The basic premises of the historical geography do not exactly coincide with the frame-work of geography; rather, it exists side by side with the geography of modern times. *Historical geography* encompasses both regional and general geography apart from all other branches. So, social geography in reality has become a part of historical geography. Historical geography can, therefore, be considered as a separate branch of study complete in itself. *Contemporary geography* revolves around the existing areal differentiation of phenomena which will ultimately pass into the realm of historical geography in the near future.

C.T. Smith (1967) has mentioned the following concerns as those of historical geography;

(a) The role of geographical factor in history.
(b) The evolution of cultural aspect of societies.
(c) The reconstructed study of past geographies.
(d) The study of changes in geographical features through chronological periods.

The modern trend of the study of historical geography dates back to the 1920s and 1930s when, after *Darby*, historical geography was established as a 'self-conscious discipline'. Several geographers like *East* have studied the human geography of Europe in several historical periods. *Ralph Brown* analyzed the geography of the USA at the time when it was settled by the Europeans. *S. M. Ali* in his The *Geography of the Puranas* has endeavored to construct the geography of ancient India. *Whittlesey* and *East* were convinced that the flow of historical events is better understood if we study the historical reconstruction of geography; others, however, view the domain of historical geography to be in the symbiotic relationship during the past ages. Past reconstruction of geography is of paramount importance for establishing a bridge between the geographical studies of the past and the present. Some geographers, *Mackinder* for instance,

consider the distinction between historical and temporary geography as baseless, because according to Mackinder historical geography has been concerned with the historical present. So historical and contemporary geography are one and the same because whatever we study in geography at present will be a part of historical geography in due course of time.

1.8: Major Themes of Geography

Geography is the study of the physical features of the earth, including how humans affect the earth and are affected by it. Geography deals with physical aspects of the earth: the composition, the layers of the earth, the atmosphere, the plants and animals, mountains, rivers and other landforms. But it also analyses how humans have affected those physical features and how the arrangement of those features have affected humans. Why do humans settle where they do? How do humans impact the environment? How do physical landscapes create human conflict? All of these things are covered by geography. Since geography is such a subject, with so many topics it makes sense to split it into key themes.

The Five Themes

There are five main themes of geography. Collectively these five themes encompass the whole of the subject of geography.

1. Location *(Position on Earth's Surface),*
2. Place *(Physical and Human Characteristics),*
3. Human-environment interaction *(Shaping the Landscape),*
4. Movement *(Humans interacting on the Earth)* and
5. Region *(How they Form and Change).*

Location is a kind of like the first step in understanding an aspect of the earth and involves providing a reference to describe where a particular place is on the earth. This could be an ***absolute location***, where a location is based on a definitive reference that rarely changes such as latitude or longitude, or an address. Or it could be a ***relative location***, where a place is described relative to its environment or its connection to other places.

Place is a description of the physical and human characteristics of the location being studied. This could involve describing the mountains, valleys, rivers, beaches and the living organisms that inhabit it. It also includes human features like land-use, infrastructure, and communities.

Human-environment interaction is the study of how humans affect the environment and how the environment affects humans. Humans can have positive impact on the environment or negative ones. Human geography is a complex and varied topic in itself.

Movement involves describing and discussing the affects of anything that moves across the earth. Very often that is related to humans: movement of humans themselves, goods, services, immigration and so forth. The migration of animals can play a part, especially when looking at changes in a landscape over long periods of time.

Region is about classifying the parts of the world. We humans love to draw borders and put names, labels and categories on things, even those borders and labels are mostly made up. Regions consider how the land is split up into continents, regions, countries, states and cities.

1. The Areal Differentiation Theme

Areal differentiation represents one of the classical philosophical approaches to geographic inquiry. Some of the earliest geographical scholars, including *Strabo* and *Ibn Khaldun*, sought to describe and catalog variations in the places and cultures they encountered, or were informed about by others. A central concept of areal differentiation is that the surface of the earth may be divided into regions, which may be distinguished and categorized using various special criteria. Thus, areal differentiation provides the theoretical foundation for regional geography, by conceptualizing space as consisting of identifiable units that may be distinguished from one another on the basis of a set of phenomena or criteria. For much of the historical development of geography as a science, this was the approach followed. Geographers partitioned the world as they encountered it into sections based on the differences they codified; formulating these distinctions in a descriptive designed to provide a sense of place.

During the quantitative revolution, this view was derided by its fiercest critics as simplistic, static and sterile, but in recent decades an emphasis on areal differentiation has reappeared in some sub-disciplines of geography. For example, areal differentiation has offered a basis for new directions in human geography, especially postmodern analyses that focuses on the social and cultural processes that construct a sense of place for a given location; and studies in the geography of economic development, which seek to conceptualize the forces and factors that result in an uneven geography of economic and political activity, as well as the spatial variation between places in terms of the opportunities and conditions that results from such variation.

The most detailed modern explanation and vigorous defense of the perspective of areal differentiation was provided by *Richard Hartshorne* in his influential monograph, *The Nature of Geography*, published in 1939. In his work, Hartshorne argued that geography is based on a ‘‘*chorographic point of view,*’’ which distinguishes it from ‘‘*systematic sciences*’’ and that geography ‘seeks to acquire a complete knowledge of the areal differentiation of the world…’’ Hartshorne closely correlates the study of geography with that of history, arguing that both must derive their basis from the integration of other scholarly sciences and philosophical approaches, and both are so called ‘‘naïve sciences,’’ meaning that they rely on describing phenomena as they

actually exist in the world. Many of Hartshorne's critics suggest that he is too dependent on the view of 'German School,'' especially Carl Ritter, Friedrich Ratzel, and Alexander Von Humboldt in his description of the evolution of geography, but his work remains a classic and is standard reading for students of the discipline.

2. Man-Environment Interaction

''Human/environment Interaction is how people adapt to, depend on, and modify their environment. For example in tropical areas people adapt to the weather by wearing shorts and t-shirts instead of winter coats, depend on wildlife and plants for food, and modify the land to grow crops and create farmland''. Human-environment interaction refers to the ways people change their environment and how the environment changes them. Human environment interaction is one of the five themes of geography created by the *National Council for Geographic Education* and the *Association of American Geographers* in 1984.

Human-environment interaction is an overarching theme in the study of geography that concerns the many relationships, both positive and negative, between people and their surroundings. This examination includes how people depend on and modify the environment and how people adapt behaviorally and physically in response to the environment. The study of human environment interaction focuses more on groups of people or cultures rather than on individuals. Therefore, human environment interaction looks at the interplay between human social systems and larger ecosystems.

An illustration of human environment interaction is found the discussions about climate change. The majority of scientists believe there is evidence that human activities contributed to the on-going changes in the global temperatures and climates. In response, people are now attempting to change these actions. Many speculate on how humans will be forced to adapt to the effects of climate change in the future, as well as how humans might modify the environment in attempts at countering the changes.

3. The Spatial Distribution Theme

A view has frequently been put forward that the overriding aim of geography is to describe and explain the distribution of phenomena over the earth's surface. Hartshorne regarded such a study as being an essential preliminary to the study of areal differentiation, but to others this aim became in itself a sufficient focus for geographic research. To a degree, opinions on this issue split, according to the regional and systematic dichotomy, and we, therefore, find many of the systematic aspects of the geographic research (as in climatology and economic geography) developing around this fundamental theme as their focal point of interest. Locational analysis, at present an active area in geographic research may conveniently be regarded as a manifestation of interest in the theme of spatial distribution.

CREDIT - II

2.1: Contribution of Phoenicians in the Field of Geography

More than 2500 years ago, the Phoenicians mariners sailed to the Mediterranean and southwest European ports. The Phoenicians were the great merchants of ancient times. They sold rich treasures from many lands. These Phoenicians were Semitic people. Their country was a narrow strip of the Syrian coast, about 160 miles (260 km) and 20 miles (32 km) wide. The area now comprises Lebanon, parts of Israel and Jordan. Their territory was so small that the Phoenicians were forced to turn to the sea for living. They became the most skillful shipbuilders and navigators of their time. They worked the silver mines of Spain, passed through the Strait of Gibraltar, and founded the city of Cadiz on the southern coast of Spain. They sailed to the British Isles for tin and may have ventured around South Africa. They founded many colonies, the greatest being Carthage.

The Phoenicians began to develop as a seafaring, manufacturing and trading nation when the Cretans – the first masters of the Mediterranean – were overthrown by the Greeks. Not only did they take the fine wares of the Eastern nations to the Western barbians, but they also become skilled in making such wares themselves – especially network, glass and cloth. From a snail, the murex, they obtained a crimson dye called Tyrian purple. This was so costly that only kings and wealthy nobles could afford garments dyed with it. Perhaps the most significant contribution of the Phoenician was a syllabi writing, developed in about 1000 B. C. at Babylon. From the city's name come the Greek word biblia (books) and the English word Bible. This form of writing was spread by the Phoenicians in their travels and influenced the Aramaic and Greek Alphabets.

After the Jews and Egyptians, it was the Phoenicians who contributed to the advancement of geographical knowledge. Phoenicians occupied Asia Minor *(Coastal Turkey, Lebanon, Syria, and Israel)* while Tyre *(Tyr)* and Sidon *(Sada)* were their major ports. Gadeira *(Gadis)* was established by the Phoenicians as early as 1100 B. C. while Carthage (near the present Tunis) and Utica cities were established in about 813 B. C. along the northern coast of Libya (Africa) as the colonies of Phoenicians.

Thus Phoenicians were the first repositories of geographical knowledge. But their narrow, selfish and secretive policies prevented them from communicating to others the information they had obtained about the distant nations and trading centers.

2.2: Contribution of Greeks in the Field of Geography

The foundation of modern scientific geography appears to have been laid by the ancient Greek scholars. Although the roots of the ancient Greek scholarship in the development of geographical ideas reach back to the *observations, measurements* and *generalizations* of the ancient *Egyptians,* the *Phoenicians* and the *Mesopotamians,* its organization in the form of concepts or paradigm was essentially the achievements of *Herodotus, Plato, Aristotle, Eratosthenes* and *Strabo.* Both literary and mathematical traditions can be traced in the works of Greek scholars. They produced topographical description of places in the known world, discussing both natural conditions and the culture of the inhabitants.

The primary fields of their interest in the early phase were *astronomy* and *mathematical geography*. Mathematical geography was founded by *Thales, Anaximander* and *Aristotle* and it reached its zenith with the works of *Eratosthenes*. Studies in mathematical geography and astronomy led to the development of techniques to locate places with some accuracy. The sphericity of the earth was proved and its size computed with surprising accuracy. The latitude and longitude of many places were calculated and the practice of plotting world maps on grid began during this period. This was the period when describing the location of various places in the world and locating them on maps was one of the most important tasks of the geographers. They were supposed to provide information about the location of various places and various types of landforms such as mountains and seas, etc. This laid the foundation of *cartography*.

Physical geography, however, progressed less rapidly among Greeks. Various writers speculated about tides, weather phenomena and volcanism. A correct explanation of the Nile floods was advanced, formation of deltas was studied and *Polybius* pointed out how streams slowly eroded their valleys. *Possidonius,* the most outstanding physical geographer of his times, investigated tides, measured the depth of *Sea of Sardinia* and sought to explain many other phenomena.

The roots of *biogeography* or *plant geography* can be traced in the works of *Theophrastus* who wrote a history of plants examining the relationship of plants and climates and compared the vegetation of different areas. They also started the study of *human geography* although in a small way. *Agarthecides* classified the ethnic Ethiopian tribes according to their diet, and *Possidonius* gave an accurate description of the mountain folk of Galicia and Asturias. However, most of the writings of these people were a mixture of history and geography, and *Herodotus* and *Polybius* stand out among those who used geographical facts in historical writings in scientific manner.

Herodotus also included a lot of geographical material in his history though not scientifically. His work can be considered as an example of *historical geography,* though not in the manner as we see it today. *Polybius* is given credit for his scientific use of geographical facts in historical writings. His work contains many excellent descriptions of town sites. Finally, in the work of

Hecataeus of Miletus, who wrote a general survey of the inhabited world on a regional basis, we see the beginnings of *regional geography.*

The Greek Scholars

1. Homer

- Greek geographers called him 'father of geography.'
- Book – *Odyssey, Iliad*.
- Earth a plain of circular form surrounded on all sides by Ocean River.
- He described the four winds – *Borus* from north, *Eurus* from east, *Notus* from south and *Zephyrus* from west.

2. Thales (640 - 540 B.C.)

- First Greek scholar to measure and locate things on the face of the earth.
- Water in various forms constitutes the prime substance form which all observable features of the earth were made.
- He considered earth as a disc floating in water.

3. Anaximander (6th century B.C.)

- He invented Babylonian instrument called the *'gnomon'* by which he made a variety of observations regarding relative position of celestial bodies. This made it possible to establish the time of solstice and equinox.
- Prepared a world map to scale with Greece at the centre and ocean all around.
- He is generally regarded as 'founder of mathematical geography'.

4. Hecataeus

- *'Ges-peridos'* is his main work which means the description of the earth and is the first systematic description of the world.
- He had an intimate knowledge about the lands bordering the Mediterranean Sea as far west as Sardinia.
- He has also travelled through Egypt and he was perhaps the first to call his country as *"Gift of the Nile'*.
- He is known as *'Father of Geography*.'

5. Herodotus (485 – 425 B.C.)

- Considered as *'Father of History'*, for him, all history must be treated geographically and all geography must be treated historically.
- Pointed out the physical process of delta building and the regularity of summer flood of the Nile.

- First scholar to have drawn a meridian on the world map.
- He is also known as *'father of ethnography'*.

6. Plato (4th century B.C.)

- First philosopher to have given the concept of round earth located in the centre of the universe with celestial bodies in circular motion around it.

7. Aristotle (384 – 322 B.C.)

- *'Father of Teleological Concept'* which sees the universe planned by the Creator.
- He founded the fundamental principle of scientific explanation.
- He gave the theory of natural places and distinguished between the celestial space and the earth space.
- He originated the concept of varying habitability of earth with latitudinal differences.
- Book – *'Politics', 'Meterologica'*.

8. Hippocrates (460 – 376 B.C.)

- Book – *'Our Airs, Water, Places'*.
- Climate provides explanations for the physical and intellectual differences among people.
- He produced the world's first medical geography.
- First Greek to inform the ocean tides and their relation to moon.

9. Eratosthenes (276 – 194 B.C.)

- Known as *'Father of geography'* as he coined the term *'geography'*.
- He succeeded in calculating the circumference of the earth and found out that the whole world was about 25,000 miles in circumference.
- He provided mathematical boundaries to the five major climatic zones – a torrid zone, two temperate and two frigid zones.
- His world map was based on the frame of north-south and east-west lines, but these were not spaced regularly.
- He also attempted to determine the distance of the sun and the moon from the earth.

10. Hipparchus (150 B.C.)

- First Greek scholar to establish the exact position of every point on the earth's surface and divided the circle into 360 degree.
- He defined the grid of latitude and longitude lines, for the determination of latitude and longitude he invented an instrument *'Astrolabe'*.
- To him the equator was a great circle that divided the globe into two equal parts.
- He devised the orthographic and stereographic projection.

11. Possidonius (135 – 50 B.C.)

- He calculated the circumference of the earth and arrived at a much smaller figure than Eratosthenes.
- Book – '*The Ocean'* and in oceanography he was considered as an authority.

2.3: Contribution of Romans in the Field of Geography

The decline of Greek empire led to a decline in the academic and philosophical pursuits also. After the decline of Greek science, the Romans stole a march in this field. The Romans, however, were more practical than philosophical in their outlook. They were mainly concerned with the commercial and administrative problems, and plans for military conquest. Most of the writers were concerned with the itineraries of various places and areas of topographical dictionaries. Historical and regional geography were their major fields of interest. A brief account of the contribution of Roman scholars is provided below.

Strabo (64 B.C. – A.D.26)

The geographical treatise, *Geographica,* is his most important work. He, for the first time, tried to bring together all geographical knowledge of his time in his work. Strabo recognized the regional value of geography as it ''acquaints us with the occupants of land and ocean and vegetation, fruits and peculiarities of various quarters of the earth and marks him who cultivates it as a man earnest in the great problem of life and happiness.'' He was thus primarily a regional geographer. He started the tradition of chronological writings in geography. In all he wrote a total of 43 volumes, 17 of which were concerned with geography. He was the first to conceive the idea of a complete geographical treatise, comprising all the four branches of the discipline – mathematical, physical, political and historical geography. His treatise was designed not only for geographers but also for politicians and statesmen.

In mathematical geography he accepted the spherical shape of the earth as pointed out by his predecessors and the division of the earth into five zones. He also accepted the view that the earth was situated at the centre of the universe. He considered the earth as an *oblong* and regarded Ireland as the northernmost point of the known world. His interest in physical geography was limited but he compiled a large amount of material to highlight the changes that have taken place due to changes in the sea level and due to volcanic eruptions and earthquakes. Strabo's major contribution has been in the field of historical geography. Throughout his work, he has attempted to highlight the intimate relation between history and geography. He also tried to study the influence of physical features of an area on the character and history of its inhabitants.

The chief objective of his treatise was to present a general survey of the then known habitable world. The first two volumes of *Geographica* were devoted to the introduction of the subject and they list the objectives of his treatise and the principles on which he conceives the general

features that characterize the entire world and the then known continents. The remaining books give an account of individual continents or regions. Six of his books are devoted to Asia.

Ptolemy (A.D.90 – 168)

A native of Egypt who lived in Alexandria, Ptolemy is considered the most outstanding mathematical geographer. His most outstanding works include *Syntaxes* (popularly known as *The Amalgast*) and the *Outline of Geography*. The first of these works deal with problems of mathematical geography and astronomy. He believed in the sphericity of the earth and situated at the centre of the heaven. His *Outline of Geography* was devoted to determination of position of places using the system of latitude and longitude.

He opined that the purpose of geography is to provide a view of the whole. He thus segregated geography from *chorography*, which is concerned with describing the parts. He also suggested that geography is a science that deals with the art of map making. The basic aim of Ptolemy was to reform the map of the world on the basis of astronomical principles. Accordingly, he laid great emphasis on calculating the latitude and longitude of various places accurately. Six out of eight books that he wrote were devoted almost exclusively to astronomical tables and latitudes and longitudes of various places. A major contribution of Ptolemy to cartography has been the use of graticule of latitude and longitude and the mathematical construction of the projection for his map. He not only marked the latitudes and longitudes properly on his map but also marked the climatic zones on it.

Ptolemy also provided detailed accounts of various parts of the then known world. He plotted the Gangetic Gulf *(Bay of Bengal)* for the first time on his map and also showed the main source of Ganga in the Himalayas. However, his description of this region is rather vague.

Pompanos Mela

An important contributor to geography during the early years of Christian era, Pompanos Mela was a Spanish geographer and wrote *De Chorographia* and *Cosmography* in Latin. In his book he divided the world into five macro regions and provided a detailed account of north temperate regions. His *De Chorographia*, however, is not considered a work of great scientific value.

Pliny (23 – 79 A.D.)

A naturalist, who wrote extensively on various themes in his famous work *Historia Naturalis*. Pliny was a well read person, and collected information from a large number of sources.

Brief Introduction of Roman Geographers

1. Strabo (64 B.C – 26 A.D.)

- He gives a correct explanation of the flood of the Nile.

- Book – *'Geographica', 'Historical Memoir', 'Geographical Treatise'*.
- The first scholar who conserved the idea of complete geographical treatise comprising all the four branches – mathematical, physical, political and historical.

2. Claudius Ptolemy (90 A.D – 168)

- Book – *'Amalgast'* (deals with complicated problems of mathematical geography and astronomy), *'The Outline of Geography'* (deals with the exact determination of the position of places by means of latitude and longitude).
- He improved the art of map making by adopting modified conical projections of the world.
- After Ptolemy the period of 200 A.D. to 700 A.D. is known as the *'Dark Age'*.

3. Pliny (27 – 79 A.D.0

- Book – 'Historia Naturalis'.

4. Pompanos Mela (335 – 391 A.D.)

- Book – 'De Geographia".

5. L. Firmanus (260 – 340 A.D.)

- Book – 'Christian Topography".

2.4: Impact of Dark Ages on Geography

During the 5th century A.D. the Roman Empire suffered demise. The downfall of Roman Empire led to the decline in art, science, literature and explorations. From the time of *Ptolemy* up to 14th century, there was a period of confusion and chaos in science and literature. All earlier works were lost and there was negligible addition in geography and other sciences. There was continuous deterioration, both in the theory of geography and practice of exploration as in other fields of knowledge. The Christian supernaturalism rendered it a thing of fancy and imagination.

During this period ideas were shaped by church and people were not allowed to raise any scientific question which could go against the thinking of the Church. The so called scholars of this period even modified the earlier works by rejecting all those principles which do not confirm to the dogmas of the church. The earth was declared a float body with Jerusalem at its centre. No new countries were discovered and there was no longer any question of research. The only works produced were nothing but compilations from the earlier works in which many earlier errors reappeared. This period of intellectual darkness which lasted from 5th century to 12th century is known as the *Dark Age* in European history. This however does not mean that the geographical knowledge did not flourish in other parts of the world during this period. Geography flourished in China, India and Southeast during this period.

The period of about five hundred years, i.e. 200 A.D. to 700 A.D., which followed the publication of Ptolemy's *The Guide to Geography* was an age of complication, turmoil and abridgement. During this period, not a single work of originality in any field of the sciences and humanities was written. There was continuous deterioration, both in the theory of geography and the practice of exploration from the glories of the Greek and Roman periods.

For this retrogression, which was most rapid during the period A.D. 300 TO 500, the following conditions were responsible:

(i) Parts of the Roman Empire, e.g., Dacia, Gaul and Spain, passed into barbarian hands. North Africa was seized by Vandals; consequently travel even within the empire was hazardous.

(ii) The Middle and Far East, almost entirely passed into the hands of Persian, Arab or Abyssinians. Moreover, the northern overland route through the Dariel Pass by way of the Caspian to Central Asia was too insecure for even the most adventurous.

(iii) Apart from political instability, the decline of theoretical study of geography was largely due to the wrong thinking of the church. The attitude of most Christian writers at that time was not calculated to promote any form of scientific inquiry. Any scientific investigation about the shape and size of the earth was discouraged.

At best, scholars of this period made accurate but sterile copies of the works of the ancients, rejecting anything which did not conform to the dogmas of the Church. Such an intellectual environment stifled any development of critical scientific analysis. Concepts of the world which had been developed in Greek and Roman times were reshaped to conform to the teaching of the Church. The earth became a flat disc with *Jerusalem* at its centre.

Solinus (250 A.D.), who appears to have flourished in the 3rd century A.D., gave a general geographical account of the world. The work of *Solinus* entitled *Collective Rerum Memorabilum* (the collection of wonderful matters) cannot be taken as a worthwhile geographical description of the world. In fact, the basic motive of *Solinus* was to collect 'all the wonderful things' and the geographical framework in which they were set. He, however, has been described as a plagiarist of *Pliny* and *Pomponius.*

The period from the 3rd century A.D. till the rise of Islam was influenced by Christianity. The Christian era was marked by the loss of scientific concepts about the world as well as their replacement by unscientific, uncritical cosmogonies based largely on the scriptures. As stated above, during this period, travelling and explorations, owing to political instability, were hazardous. The missionary travels are the only source of knowledge for the regional account of

the different nations of the world. Most of the correct classical concepts were forgotten and old errors reappeared about the map of the world and the habitable parts of the globe.

About the Dark Age, the German scholar *Schmidt* summarizes: ‘‘New countries were not discovered; the empire became smaller not greater; trade relations, thanks to the war in the east, the south and the north, became more and more restricted; besides, there was no longer any question of research in industry and of the spirit of discovery. Thus, the only books that were put together were compilations from older works. ‘’

2.5: Contribution of Arabs in the Field of Geography

The collapse of the Roman Empire and decline of scientific studies in the European region saw the emergence of an interest in geography in the Arab world during the medieval period. In 17th century A.D. Islam made its dawn in the Arabian Peninsula. In a short span of time, Muslims of Arabia conquered many parts of the world outside of Arabia. They conquered *Persia (Iran), Egypt, Sahara Desert, Andulus (Spain), Portugal, Malta, Cyprus, Romania, Albania* and *Bulgaria.* Later on Muslim rule was extended to *Central Asia, India, Malaysia, Northern China* and some parts of *South East Asia*. Thus, Arabs emerged as a great force in the world after the *Dark Ages*. Because of their intellectual curiosity and integrity, they contributed a lot in the fields of Geography, Mathematics, Astronomy, Chemistry, Anthropology and Sociology. They revived Greek and Roman literature and translated them into Arabic along with Latin, Persian and Sanskrit works. Arabs proved a bridge between the Pre-Dark Age period and modern period and thus provided a path for the modernization of the world.

A host of factors were responsible for the growth and development of knowledge, particularly geographical knowledge in Arabia which can be summarized as under:

01. Arabs tried to learn Sanskrit, Persian and other languages in order to translate the literature written in these languages into Arabic. Greek and Roman literature was collected and translated into Arabic. Indian scholars like *Aryabhatta* were invited to learn mathematics and numerals from them. On the basis of studies of earlier civilizations, Arabs developed their own concepts and theories and produced a lot of literature on various aspect of geography and allied fields.

02. They sent many adventurous people to far off places to study their literature, political system, social system and way of living. The worth mentioning are *Ibn-Khaldun, Ibn-Hawqal, Al-Biruni, Al-Khatiti*. Because of vastness of the Muslim Empire, they were welcomed everywhere with great honour and respect which gave them moral boosting for studying those parts of the world.

03. Arabs were age-old and active merchants. They had trade relations with India, Spain, Morocco and Indonesia. The merchants, with their merchandise brought enormous reliable

geographical knowledge of these distant places like the physical and weather conditions, agricultural products, etc. They brought knowledge about the Indian monsoons, Indian peninsula, Western coast and Malabar Coast.

04. Further, with the improvement of ships and navigation, they carried voyages in the Red Sea, the Persian Gulf, the Arabian Sea, the Indian Ocean, the Bay of Bengal, and the Sea of China. Thus, they brought not only geographical knowledge of these places, but also about the salinity of the oceans, the climate and the winds.

05. Muslims make the pilgrimage to Mecca and Medina (Hajj) once in a year. People from every part of the Muslim World – *Egypt, Malaysia, China, Sudan, Morocco, Spain, Portugal* and *France* would thus gather at Mecca. This gathering of people from different countries would provide ideal opportunity for Arab Scholars to gather information regarding various facts of far off places.

06. The Arabs launched *Jihad* (Holy War) against many non-Muslim countries like Marrakesh, Spain (Andulus), Algeria, Albania, Malta, Cyprus, and Romania and conquered them. Here they compiled various information which was lost in the Dark Age.

Contribution of Arab Geographers

Arabs were the first to show their interest in geography because of their special surroundings. They made outstanding contributions in the field of mathematical, physical and regional geography. Their achievements in climatology, oceanography, geomorphology, linear measurements, determination of cardinal points, limits of habitable world, sprawl of continents and oceans are highly appreciable.

Contribution to Mathematical Geography

01. Arabs were highly influenced by the Greek ideas about the shape and size of the earth.

02. Earth was considered as the centre of the Universe, round which revolve the seven planets. *(Moon, Mercury, Venus, Sun, Mars, Jupiter and Saturn).*

03. The Prime Meridian plotted by *Ptolemy* was used by the Arabs for the calculation of time and longitudes. This meridian used to pass through *Fortunate Islands, Abu Masher*.

04. For determination of latitudes, the Arabs made use of the sun's shadow where it happened to be on the meridian.

05. *Al-Battam* measured the circumference of the earth as 27,000 miles.

06. Amongst the Arab geographers, *Al-Biruni* was the outstanding mathematical geographer.

Contribution to Climatology

01. In 1921, A.D. *Al-Balakhi* gathered climatic data and information from Arab travelers and prepared the first climatic atlas of the world *'Kitab -ul-Ashkal'*.

02. *Al-Masudi* described Indian Monsoons.

03. *Al-Maqdisi* divided the world into 14 climate regions. He presented the idea that the southern hemisphere was the most open ocean and most of the world's land area was in the northern hemisphere.

04. *Ibn-Khaldun*, *Al-Biruni*, *Al-Masudi* described the influence of climate on vegetation and life style of the people. According to *Ibn-Khaldun*, people of the warm climate are passionate. He also said that Negroes are black because they live in warm climate.

Contribution to Geomorphology

01. *Al-Biruni* in his book *"Kitab-ul-Hind"* opined that the stones become round because they had fallen along torrential mountain streams. He also discovered that alluvial soils became finer in texture farther away from mountains.

02. *Ibn-Sina* (Avicenna) keenly observed the works of agents of denudation and ascertained that:
(i) Mountain streams erode the slope;
(ii) The highest peaks occur where are rocks are specially resistant to erosion;
(iii) The mountains are immediately exposed to the process of wearing down as soon as they rise up.

Contribution to Oceanography

01. The Arabs proved that tides are caused due to the gravitational pull of the sun and the moon.

02. *Al-Masudi* observed variation in the colour of the ocean water and attributed it to the variation in the salinity of water and presence of vegetation.

Contribution to Regional Geography

1. The Arabs scholars contributed appreciably to the field of regional geography.
2. *Al-Masudi* presented a fairly reliable regional description of the countries he travelled.

3. *Al-Masudi* divided the habitable world into 7 linguistic divisions: (i) Arabs, (ii) Persians, (iii) Greeks, (iv) Egyptians and Libyans, (v) Turks, (vi) Hindus and (vii) Chinese.

4. *Ibn-Khaldun* presented a broader view of regional geography. He maintained that the Northern Hemisphere is more populated than the Southern Hemisphere.

5. *Ibn-Hawqal's* treatise entitled "*A Book of Routes and Realms*" gives a philosophical regional description. He has given a detailed regional account of the Arab world, the European countries and other bordering the Islamic world.

Contribution to Human geography

01. The Arab scholars also developed progressive thinking pertaining to human geography. They tried to study man environment relationship.

02. *Ibn-Khaldun's* monumental book "*Muqaddimah*" is a masterpiece on human geography, in which he presented a detailed discussion on human society in its various aspects

Contribution to Cartography

01. *Al -Biruni* wrote four books on cartography and meteorology.

02. *Al-Idrisi* contributed more in cartography than in any other field of geography. He prepared the world map in which he plotted various geographical features.

03. *Al -Balakhi* presented the first climatic atlas of the world.

Brief Introduction of Arab Geographers

1. Al - Balakhi

- *"Kitab-al-Ashkal"* – World's first climatic Atlas presented by him.

2. *Al - Masudi*

- Believed that the surface of the earth must be curved.
- Book - *"Kitab-al-Dhahab"*, in which he presented a good account of the monsoon.
- He was of the opinion that climate varied not only as regards latitude but also according to east and west position.

3. *Al-Biruni*

- Book -'*Kitab-al-Hind', "Tarikh-ul-Hind"*.
- He has been in India during the time of Mahmud Ghazanvi and presented his great geography of India.

4. Avicenna / Ibn-Sina.

- Credited with the idea of landscape erosion.

5. Al-Idrisi

- Book -*"Amusement for Him who desires to Travel around the World", "Geographia Neubienses"*.

6. Ibn-Batutta

- One of the great travelers of the medieval Arab world.
- In India, he served at the Court of 'Mohammad Bin Tughluq' who further appointed him as an Ambassador to China.

7. Ibn-Khaldun

- He established the foundation of political geography.
- He might be considered the first environmental determinist who tried to correlate man and environment in a scientific way.

Book -*"Muqaddimah"* dealing with the description and discussion of human society in its various aspects.

2.6: Role of Germans in the Development of Modern Geography

Germans contributed enormously in the development of modern geographical thought. In the 18th and 19th centuries, the Germans made rapid strides and put the subject on sound footing, giving it a philosophical and scientific base. Alexander Von Humboldt, Carl Ritter, Oscar Paschal, Ferdinand Von Richtofen, Friedrich Ratzel, Alfred Hettner, Albert Penck, Walter Christaller, Von-Thunen were the leading German geographers who revolutionized the geographical thought. Alexander Von Humboldt (1790-1859) and Carl Ritter (1779-1859) are regarded as the founders of modern geography who sharply identified the field and scope of geography on sound scientific footing.

According to *Humboldt*, Geography is the description of the earth which deals with the interrelationship of phenomena that exist together in an area. He treated geography as a discipline concerned with both inorganic as well as organic phenomena on the earth's surface as an interrelated entity. He put forth the concept that man everywhere becomes most essentially associated with terrestrial life. Humboldt believed in empirical method of research and made comparative study of different geographical regions. He also emphasized the importance of representation of statistical data on maps and the utility of maps for geographical studies. He laid the foundation for an approach of theory-building and model making.

Carl Ritter, a contemporary of Humboldt, emphasized that geography is not merely a gazetteer of names of places, rivers, mountains, state capitals and trade routes, but a subject that deals with man-nature interrelationship. He developed the concept of '*Unity in diversity*.' Ritter was mainly concerned with human geography. He believed that the earth and its inhabitants stand in the closest reciprocal relations, and one cannot be truly presented in all its relationship without the other. The land affects the inhabitants and the inhabitants the land. Ritter declared geography to be '*Erdkunde*' or an earth science, which deals with the local conditions and embraces the attributes of place with respect to topical, formal and material characteristics. In brief, according to Ritter, geography is that branch of science which deals with the globe in all its features, phenomena and relations as an independent unit and shows the connection of this unified "whole" with man and with man's Creator. According to him, the main theme of geography is "the relation of all phenomena and forms of nature to human race." *Oscar Paschal* (1826-75), a leading German geography developed comparative geography. He compared different parts of the world from geographical point of view. Moreover, he laid the foundation of modern physical geography. *Ferdinand Von Richtofen* (1833-1905), on the other hand says that the main objective of geography is the exploration of the relationship of man to the physical earth and to the biotic features. In order to study this relationship one must first study the physical setting (relief, climate, soils, vegetation, flora, fauna) of a region and then adjustment of man in that setting be examined. Richtofen was the first German geographer to differentiate between the 'general' and 'regional' geography. For systematic regional study, he emphasized the need of field work.

The geographical thinking in Germany, in the later part of the 19th century was however dominated by *Friedrich Ratzel* (1844-1904). He applied Darwin's theory of '*Evolution of Species'* to geographical studies, especially to human geography. In his monumental work "*Anthropogeographie*", he described the effects of different physical features and locations on the life styles of people. His environmental deterministic approach became very popular world over. He applied Darwin's philosophy to political geography. He stressed that like an organism; a state must grow or die but can never standstill. Thus, according to Ratzel, superior people or nations have right to expand their territories or 'living space' at the expanse of inferior neighbors. It was this philosophy of Ratzel that became the cause of 2nd world war. *Alfred Hettner* (1859-1941), pupil of Ratzel, described geography to be a chorological science or the study of regions. He claimed geography to be an idiographic (regional) rather than nomothetic (general) subject. In the beginning of the 20th century, *Albert Penck*, a leading German geographer, formulated the concept of 'geomorphology' and put forth the concept of evolution of landforms.

In the field of Oceanography, Germans made a substantial contribution. *Gerhard Schott* studied the motion, temperature, salinity, colour, ocean deposits, ocean climates, geological structure of ocean basis, etc. *Walter Christaller* put forth the Central Place theory with the set objective of functional organization of space. *Von-Thunen* advocated the Crop Intensity theory. *Haushofer* in

1924 convinced that state is a living organism which needs space to grow (*Geo-Politics*). In 1947, a new geographical periodical entitled *'Erdkunde'* appeared, the Germans started studying landscape with the help of new tools and techniques. Now there is more stress on variation from place to place as the function of latitude, altitude, and distance from the sea and direction from the nearer coast. In the post-war period the new trend is that of "*Cultural determinism*", in place of environmentalism or physical determinism. The new emphasis on culture is called "*Social Geography*." German geographers and Cartographers made notable contribution in the art of map-making during the 19th and 20th centuries.

Brief Introduction of German Geographers

01. Varenius *(1622-1650 AD).*

- Book – 'Geographia Generalis' comprising two parts – Universal geography and Special geography.
- He propounded the dichotomy of Systematic vs. Regional geography.

02. Immanuel Kant *(1724-1804 AD)*

- He defined geography as a 'Chorological Science.'
- He gave the philosophical foundation to 'Scientific geography.'
- For him, physical geography is a general outline of nature and constitutes not only the basis of history, but also of all other branches of geography such as mathematical, political, commercial and theological geography.
- Kant along with Varenius belonged to classical period of modern geographical thought.

03. Alexander Von Humboldt *(1769-1859 AD)*

- Book-'Cosmos', 'Asia Centrele'.
- Earth – an inseparable organic whole and their all parts are interdependent.
- He proposed the concept of 'Unity of Human Race' – all races have a common origin.
- He prepared the first isothermal map of the world based on data from different weather stations set up by the Tsar.
- Introduced the term 'Climatology', 'Permafrost'.
- He followed the inductive method, outlined the empirical method of research.
- He considered man as a part of nature.
- He laid the foundation of 'Systematic Geography.'
- He was an agnostic (not believe in God).

04. Carl Ritter *(1779-1859 AD)*

- Book – 'Erdkunde', 'Berdkunde.'
- Strong belief in God.

- Method – (i) Empirical method based on inductive approach, and (ii) Regional.
- He is regarded as 'Father of Regional Geography', for regional study he preferred natural regions rather than political regions and for natural region he used the term 'Landerkunde.'
- He considered a close relationship between man and environment.
- He developed the concept of 'Unity in Diversity'.
- As a teleologist, he regarded 'earth as an educational model for man.

05. Federich Ratzel *(1844-1904) AD.*

- Book – 'Anthropogeographie' 'Politische Geography'.
- He was contemporary of Darwin and was influenced by his 'Theory of Evolution of Species'.
- First to give the concept of 'Environmental Determinism' and for him the man and nature relationship must be viewed through ecology and environmental determinism.
- Followed the biological approach and coined the term 'Anthropogeography.'
- First to give the concept of 'Social Darwinism',
- He considered State as a living organism and superior nations have the right to expand their territory at the expanse of inferior neighbours.
- His philosophy governed German policy of 1930 and resulted in 2nd World War.

06. Richtofen *(1833-1905 AD)*

- Book – 'Physische Erdkunde.'
- Distinguished between General Geography and Regional Geography.
- First to use the term 'Chorology and Chorography' for regional study.
- 'Dynamic Anthropography' – to understand the influence of nature of lands on man and the influence of man on nature of land.

CREDIT - III

Introduction

Geography, right from its beginning, deals with the man-environment relationship in spatial context and today it has become an inter-disciplinary science concerned with the surface of the earth and its natural environment as well as the human intervention which has changed the physical and cultural landscape over years. Environmental geography is, therefore, a close analytical scrutiny of the various facets of environment, its degradation as well as its management.

Environment is the source of life on earth and it not only directs but also determines the existence, growth and development of mankind and all its activities. Primitive man ate wild fruits - hunted and fished - and relied heavily on nature for his very existence. Even these basic activities damaged nature to some extent. As society developed, man's impact on environment grew in scope and strength. Until very recently, we adhered to the following dictum; ''*we cannot expect favours from nature; we must take them*''. For quite a long time, no thought was given to the possible consequences of such 'taking' from nature. But the consequences were significant and pervasive. Mankind has long trusted in nature's potential and restorative powers, though there was no reason to believe that these powers were inexhaustible. Only recently man has come to realize the necessity for conservation. Undoubtedly, this is the result of revolution in science and technology which has dramatically increased man's ability to use natural environment and its resources.

The human environment is the earth we live on. It includes all the physical parts of the earth, such as air, soil, minerals, rocks and water, and all its living organisms, such as animals and plants. Environmental science provides an approach towards understanding the environment of our planet and the impact of human life upon that environment. It is also a search for solutions to the environmental problems that confront us. Among other branches of the knowledge, the status of geography is unique because of its inter-disciplinary nature. Basically, geography is the study of interrelationship between man and environment. This aspect is of prime importance in present times, because while other disciplines deal with specific aspects of environment, such as forest, soil, air, water or even aspects like social, economic, demographic, etc., geography deals the environment in its totality. It also analyzes the 'time' and 'space' relationship between man and environment.

Geography, right from its beginning, deals with various components of the environment, i.e., relief, climate, natural vegetation, soil, water bodies, etc., not only in isolation but in their relation to man and his activities. The concept of man-environment relationship has been developed during the

initial stages of the development of geography and still forms the basis of geographical knowledge and research. It was during 1950 to 1970, that there was a shift in geographical studies when more emphasis began to be given to quantitative and locational analysis. But soon the situation has been changed and it was felt throughout the world that geographers can contribute a great deal towards environmental studies. With the result the branches like *'Geography of Environment', 'Ecological Geography'* and *'Geography of Environment and Ecology'* have been developed.

3.1: Environment

The term 'environment' etymologically means surroundings. Literally, it is an English word formed by two words, i.e., *'environ'* and *'ment'* which means *'encircle'* or *"all around"*. Thus, environment is a complex of many variables which surrounds man as well as all living organisms. Any external force, substance or condition which surrounds and affects the life of an organism in any way becomes a factor of its environment. These factors have been variously called as *environmental factors*, *ecological factors* or simply, factors and may be living, *biotic*, as well as non-living, *abiotic*. The sum of all these living and non-living factors makes the environment of an organism. The place where an organism lives is called *'habitat'*. It is also known as '*milieu*' which means "total set of surroundings". In fact, habitat is a part of the earth's surface where life originates and develops according to the geographical conditions. *Moore* (1967), in his book *'A Dictionary of Geography'*, has defined habitat as the ''the natural environment of a plant or animal. It is often expressed as one of the main natural regions or one of their sub-divisions, which are recognized in geography as equatorial forests, the tundra''. The encyclopedic definitions of environment are:

The sum total of all the conditions, agencies and influences which affect the development, growth, life and death of an organism, species or a race. (*The Universal Encyclopedia)*

The entire range of external influences acting on an organism, both the physical and biological (in other organisms) forces of nature surrounding an individual. (*Encyclopedia Britannica*)

Environmental Factors

Environment is a complex phenomenon of several factors which are the product of the forces and processes of nature, and according to *White* and *Renner's*, are universal and inherent all over the earth. These factors are classified into two groups as under;

(i) *Direct Factors*: includes light, temperature, soil, air, water, soil nutrients, etc.

(ii) *Indirect Factors*: includes soil structure, soil organisms, altitude, wind, slope, etc.

According to *Ousting* (*1948*), the environment is a complex of variable factors or causes, which includes;

(a) Substances (soil, water)

(b) Conditions (temperature, light)

(c) Forces (wind, gravity)
(d) Organisms (plants, animals)
(e) Time.

Another ecologist *Daubenmire* (*1959),* classified these factors into seven coordinate headings as; (a) *soil,* (b) *water,* (c) *temperature,* (d) *light,* (e) *atmosphere,* (f) *fire,* and (g) *biotic factors.*

Others have grouped these elements as follows:
(i) Climatic or aerial factors,
(ii) Topographic or physiographic factors,
(iii) Edaphic factors,
(iv) Biotic factors.

While studying environment geographers have also considered the above mentioned factors. These factors are termed as *physical factors*. The natural environment of any part of the earth's surface can be classified into following fourteen elements.

***A – Abstract Elements*:**
(i) Location
(ii) Situation
(iii) Geometrical position
(iv) Size or areal space
(v) Form

B - Physical Elements:
(i) Physiographic/landforms
(ii) Climate
(iii) Rocks and minerals
(iv) Soils
(v) Surface waters of the land
(vi) Underground water
(vii) The ocean and its coast

C – Biotic Elements:
(i) Natural vegetation
(ii) Animal life

All these factors of the environment are not independent but are linked with each other in such a way that none can be separated from the other. Therefore, the environment should be taken into

consideration in its entirety. The total impact of environment is reflected in all man's developmental activities – economic, social, political or cultural.

3.2: Concept of Ecology

Ecology is the science of the relations of all organisms to their environment. The two components of nature, organisms and their environment are not only complex and dynamic but also interdependent. Ecology is a relatively new science, dealing with the various principles which govern such relationship between organisms and their environment. *Professor Eugene P. Odum* (1913-2002), is widely recognized as the *''Father of Ecosystem Ecology''*. His monumental book entitled *Fundamentals of Ecology* (first published in 1953) revolutionized teaching of ecology world over as it presented a new framework of the subject. The term 'ecology' was coined by combining two Greek words, *viz*. '*Oikos*' meaning 'house' or 'dwelling place' and *'logos'* meaning 'the study of; to denote the relationships between the organisms and their environment. A German Zoologist *Ernst Haeckel,* who used the term '*Oekologie*' in 1869, became the first person to use the term 'ecology'. The study of interactions between life forms (biotic) and the physical environment (abiotic) is the science of ecology. Hence, ecology can be defined as a scientific study of interactions of organisms with their physical environment and with each other.

Some of the definitions of ecology are as under:

1. Ecology is defined as the study of the relations of organisms, or groups of organisms to their environment.

2. Ecology is the science which treats the organisms in relation to their environment. - (*Moore*)

3. Ecology is the study of plants and animals in relation to their environment. - (*Hagget*)

4. Ecology is the science of the mutual relationship of organisms to their environment. - (*Monkhouse and Small*)

5. Ecology is the science dealing with the relationship of organisms to one another and to other factors that comprise their environment - (*Encyclopedia Britannica*).

Ecology has been variously defined by other investigators as, ''scientific natural history'', ''the study of biotic communities'', or ''the science of community population''; probably the most often given: a study of animals and plants in their relationship to each other and to their environment. It becomes clear from the definitions that ecology is the study of the interrelationship between all living organisms and environment. All its components, i.e., energy, air; water, soil, vegetation, animals as well as man have mutual relations responsible for the development of a particular ecological system.

The interactions of a particular group of organisms with abiotic factors within a particular habitat resulting in clearly defined energy flows and material cycles on land, water and air, are called *ecological systems.* A *habitat* in the ecological sense is the totality of the physical and chemical factors that constitute the general environment. A system consisting of biotic and abiotic components is known as *ecosystem*. All these components in ecosystem are interrelated and interact with each other. Different types of ecosystems exist with varying ranges of environmental conditions where various plants and animal species have got adapted through evolution. This phenomenon is known as *ecological adaptation*.

Basic Concepts of Ecology

The basic concepts of ecology are as follows:

(i) All living organisms and their environment are mutually reactive, affecting each other in various ways.

(ii) The environment which is a complex phenomenon of several interrelated factors is highly dynamic (i.e. varying with time and space).

(iii) The species put forth every effort to maintain its uniformity in structures, function, reproduction, growth and development by preservation of its genetic pool.

(iv) Not only does the environment influence the life of organisms, but organisms too modify their environment as result of their growth, disposal, reproduction, death, decay, etc.

(v) Each population occupies a specific niche, a unique function with respect to other organisms with which it interacts.

(vi) There exists varying degree of neutral interactions among organisms, at both inter-specific and intra-specific levels.

(vii) The chemical components of the ecosystem move in defined cycles known as *biochemical cycles.*

Objectives of Ecology

Ecology is a distinct science because it is a body of knowledge not similarly organized in any other division of biology; because it uses a special set of techniques and procedures; and because it has a unique point of view. The essence of this sentence is a comprehensive understanding of the import of these phenomena:

1. The logical and geographic distribution and abundance of organisms *(habitat, niche, community, biogeography).*

2. Temporal changes in the occurrence, abundance, and activities of organisms *(seasonal, annual, successional, geological).*

3. The interrelationship between organisms in population and communities *(population ecology).*

4. The structural adaptations and functional adjustments of organisms to their physical environment *(physiological ecology).*

5. The behaviour of organisms under natural conditions *(ethology).*

6. The evolutionary development of all these interrelations *(evolutionary ecology).*

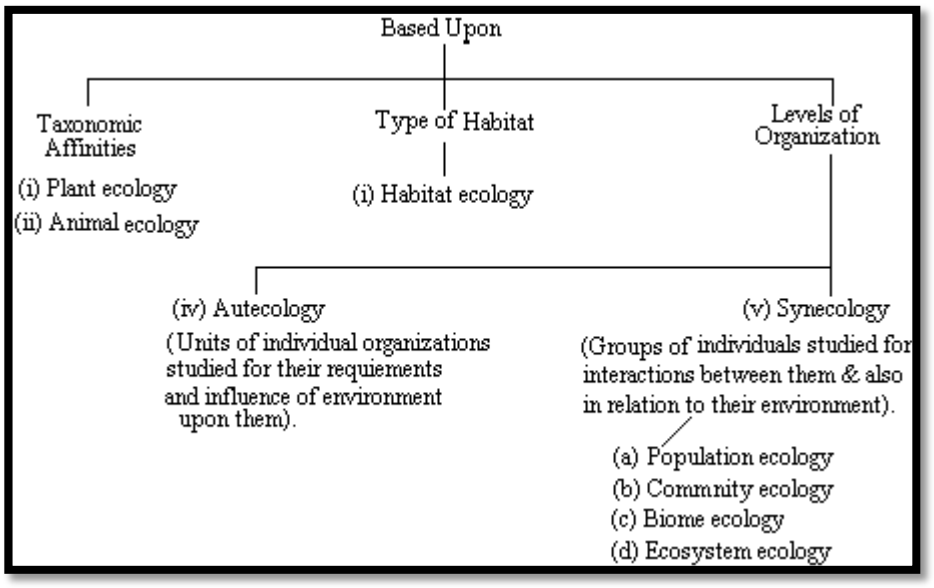
7. The biological productivity of nature and how this may best serve mankind *(ecosystem ecology).*

8. The development of mathematical models to relate interaction of parameters and predict effects *(system analysis).*

Main Sub-Divisions and Specialized Fields of Ecology

On the basis of the approach of study, the main sub-divisions of ecology can be summarized as below:

Main Sub-divisions and Specialized Field of Ecology



Ecology has been sub-divided into different fields so as to understand the subject in a more profitable way. Ecology can be commonly divided into animal ecology and plant ecology. However, two major sub-divisions were preferred by ecologists. The whole subject was divided into *autecology* and *synecology*. Autecology deals with the study of individual species whereas synecology deals with the study of a group of organisms or population.

Autecology

A study of the individual species in relation to their environment is known as *autecology*. It includes the study of its geographical distribution, taxonomic position, morphological characters, reproduction, life cycle and behaviour with reference to ecological factors that might influence these activities

Synecology

A study of group of organisms in relation to their environment is called *synecology*. Here the units of study are the groups of species. It comprises population ecology, community ecology and the study of the ecosystems.

Useful sub-divisions may also be made according to the habitat, taxonomic divisions and level of organization. Thus, the subject can be studied through following branches of ecology:

1. *Population ecology*: It deals with the growth, trophic structure, metabolism and regulation of a population.

2. *Community ecology:* It deals with the ecology of different populations in the same habitat and same environmental conditions.

3. *Habitat ecology*: It includes the study of animals and plants in different habitats. According to habitat, it can be sub-divided into freshwater ecology, marine ecology, terrestrial ecology, forest ecology and desert ecology.

4. *Human ecology*: It deals with the effects of human activities on environment and vice-versa.

5. *Applied ecology*: It deals with the application of ecological concepts to human needs including wildlife management, biological control, forestry and conservation of natural resources.

6. *Physiology ecology (ecophysiology):* Physiological adaptations according to ecological conditions are dealt in ecophysiology.

7. *Paleo-ecology:* It deals with the environmental conditions and life of the past ages. Paleontology and radioactive dating have aided significantly in the study of palaeo-ecology.

8. *Ethology:* It is the study of animal behaviour in different environments under their natural conditions.

9. *System ecology:* When the structure and function of an ecosystem is analyzed using applied mathematics, statistics or computer, it is called system ecology.

10. *Ecosystem ecology:* Biological productivity of an ecosystem or nature and how it can best serve the mankind encompasses ecosystem ecology.

11. *Eco-geography:* It studies the geographical distribution of plants and animals in different environments - collectively called as *biomes.*

12. *Evolutionary ecology:* It deals with evolutionary problems like speciation and segregation.

Scope of Ecology

Ecology is the science that needs minimum time and labour for its introduction to a layman. Present day problems of varied nature in human life are directly or indirectly very much related to ecology, as their solution needs an ecological knowledge. These days ecology has been contributing very much to socio-economic, political and other similar policies of the world. It is so common to find references of ecology in socio-economic writings, magazines, weeklies and daily newspapers. There are interdependencies not only between ecology and other areas of plant sciences, but also between ecology and physical as well as social sciences.

Ecology indeed plays an important role in human welfare. This is primarily a field subject and modern ecology is concerned with the functional interdependencies between living things and their environment. *Taylor* (1936) has very rightly pointed out the scope of ecology by stating that "ecology is the science of all the relations of all organisms to all their environments". Ecology plays an important role in agriculture (crop rotation, weed control, etc.), management of grasslands, forestry, biological surveys, pest control, and in the conservation of soil, wildlife, forest, water, etc. The international problem of environmental pollution also needs ecological assistance.

3.3: Ecological Succession

The replacement of one vegetation community in a given region by the other vegetation community is called *biotic succession*. Succession simply means the entire process of directional and sequential change of either plant community (groups of plants adapted to a particular habitat) or the whole ecosystem through time. In simple terms, an *ecological succession* may be defined as the process of sequential development of ecological community or ecosystem. The sequence of the development of vegetation community (biotic succession) is called *sere*. In other words, the transitional stages of sequential changes from one vegetation community to another vegetation community are called

Sere which is complete when the succession of vegetation community after passing through different phases of changes culminates into equilibrium or mature condition.

This phase of development of vegetation community is characterized by maximum growth and development of plants. Thus, the vegetation community developed at the end of succession is called *climax vegetation, climax community*, or *climatic climax* (due to dominant control of climate on the evolution and development of vegetation). It is obvious that the last succession in the chains of biotic sequential changes of vegetation community becomes *climax succession*. According to *P. E. Clements*, (1916) biotic succession of vegetation community is primarily of two types e.g., primary biotic succession and secondary biotic succession.

1. Primary Biotic Succession

Primary succession refers to developmental sequence of vegetation in those bare areas where there were no vegetation and animals earlier. Such areas or sites may be newly emerged sea floor, cooled and solidified basaltic surfaces due to recent lava flows, exposed lake bed due to drying of water, newly formed sand dunes, flood plains formed by recent alluvia, heaps of debris accumulated by man, the areas of exposed rocks due to melting of ice from the glacial areas, etc.

2. Secondary Biotic Succession

Secondary succession refers to the developmental sequences of vegetation in those areas which had vegetation cover earlier but now have been rendered nude or bare due to destruction of vegetation (partly or completely) either by natural processes (like lava flow, prolonged drought, glaciations, forest fires, floods, etc.) or by human interferences (like intentional burning of vegetation, massive land use changes, mass felling of trees, overgrazing, etc.). It may be pointed out that such disturbed ecosystems or habitats still contain mature soils and some original vegetation and therefore the initial stage or 'sere' of secondary succession of plant community is quite different from the initial stage or 'sere' of primary succession which starts on bare rocky surface, having no earlier plants and animals.

3.5: The Ecosystem

The various communities of living organisms (plants and animals) interact among themselves as well as with their physical environment like soil, air and water. The living organisms interact with one another through their food chains in which one organism consumes another organism. The living organisms like plants interact with soil to get essential nutrients like nitrogen, phosphorous, etc., with air to get carbon dioxide and with water bodies for carrying out the process of photosynthesis. Thus, the various communities of living organisms like plants and animals along with soil, air and water of that region form a self-subsisting or functional ambit of the living world. This functional unit or system made up of living and non-living components which is capable of independent existence is called an *ecosystem*.

Ecosystem is a structural and functional unit of biosphere consisting of community of living beings and the physical environment, both interacting and exchanging materials between them. The term 'ecosystem' was coined by *A.G. Tensely* in 1935, who defined it as "the system resulting from the integration of all the living and non-living factors of the environment". He further stated that "the whole system includes not only the organism complex but also the whole complex of physical factors forming what we call the environment of the biome - the habitat factors in the widest sense. It is the system so formed which - are basic units of nature on the face of the earth", where *'eco'* implies the environment, and *'system'* means interdependent, interacting complex.

According to *Monkhouse and Small*, ecosystem is "an organic community of plants and animals viewed within its physical environment or habitat". The habitat or physical environment controls the whole world of organic community, viz., plants and animals. With the change in physical environment, the type of plants and animals too has changed. Similar views have been expressed by *Hagget*, "Ecosystems are ecological systems in which plants and animals are linked to their environment through a series of feedback loops". Ecosystem has also been defined as – ''a unit that includes all the organisms (biological factor) in a given area interacting with the environment (physical factors) so that a flow of energy leads to a clearly defined trophic (nutrient requiring) structure, biotic diversity, and material cycles (i.e. exchange of material between living and non-living sectors)''.

An ecosystem is an overall integration of whole mosaics of interacting organisms and their environment. It is normally an open system with a continuous, but variable, influx and loss of material and energy. It is a basic, functional unit with no limits of boundaries, consisting of both biotic and abiotic components interacting with each other, both necessary for maintenance of life upon the earth. Thus, an ecosystem represents the highest level of ecological integration which is energy-based and this functional unit is capable of energy transformation, accumulation and circulation. Its main function in ecological sense is to emphasize obligatory relationships, interdependence and casual relations.

Importance of Ecosystem Study

1. Ecosystem study indicates the available solar energy and the efficiency of an ecosystem to trap the same.

2. It gives information about the available essential minerals and their recycling periods.

3. Gross and net productivity of an ecosystem are known.

4. It provides knowledge about the web of interactions and interrelations amongst the various populations as well as between populations and the abiotic environment.

5. It helps human beings to know about conservation of resources, protection from pollution and inputs required for maximizing productivity.

Types of Ecosystem

Ecosystem may be categorized as follows:

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

a. *Terrestrial* as forest, grassland, desert, mountains etc.

b. *Aquatic,* which may be further distinguished as:

(i) Fresh water, which may be *lotic* (running water as stream, spring or rivers) or *lentic* (standing water like pond, lake, swamp, pools, etc.).

(ii) Marine, such deep bodies as an ocean or shallow ones as a sea or an estuary, etc.

2. Artificial (man-engineered) ecosystems: These are maintained artificially by man where, by addition of energy and planned manipulations, natural balance is disturbed regularly. For example, croplands like maize, wheat, rice fields, etc. where man tries to control the biotic community as well as the physico-chemical environment, are artificial ecosystems.

Structure and Function of an Ecosystem

The two major aspects of an ecosystem are its structure and its function.

By structure, we mean:

1. The composition of biological community including species, numbers, biomass, life history and distribution in space etc.
2. The quantity and distribution of the non-living materials such as nutrients, water, etc. and
3. The range or gradient of conditions of existence, such as temperature, light, etc.

By function, we mean:

1. The rate of biological energy flow i.e. the production and respiration rates of the community.
2. Rate of materials or nutrient cycle, and
3. Biological or ecological regulation including both regulation of organisms by environment (photoperiodism etc.) and regulation of environment by the organism (nitrogen fixing organisms, etc.).

Structure of an Ecosystem

All the ecosystems are made up of two main components i.e. abiotic components and biotic components.

1. *Abiotic components of an ecosystem include:*

(i) The amount of inorganic substances like carbon dioxide, nitrogen, oxygen, water and elements (P, S, C, N, H, etc.) involved in material cycles. The amount of these inorganic substances present at any given time in ecosystem is designated as the *Standing State* or *Standing Quality*.

(ii) The amount and distribution of inorganic chemicals, such as chlorophyll, etc. and of organic chemicals, such as proteins, carbohydrates, lipids, etc., present either in the biomass or in the environment i.e. Biochemical structure that links the biotic and abiotic components of the ecosystem.

(iii) The physical factors or climatic factors like temperature, light, pressure, rainfall and humidity.

2. *Biotic components of an ecosystem*:

Biotic component of an ecosystem is indeed the trophic structure of any ecosystem, where living organisms are distinguished on the basis of their nutritional relationships. From this trophic standpoint, an ecosystem has two main components:

(I) *Autotrophic Component* in which fixation of light energy, use of simple inorganic substances and build up of complex substances predominate. The component is constituted mainly by green plants, including photosynthetic bacteria. To some lesser extent, chemosynthetic microbes also contribute to the buildup of organic matter. Members of autotrophic components are known as *Producers*.

(II) *Heterotrophic Component* in which utilization, rearrangement and decomposition of complex materials predominate. The organisms involved are known as *Consumers*, as they consume the matter built up by the autotrophs. The consumers are further categorized as;

(i) *Macro consumers:* These are the consumers, which in an order as they occur in a food chain are *Herbivores, Carnivores* (or *Omnivores*). Herbivores are also known as *Primary Consumers.* Secondary and Tertiary Consumers, if present, are Carnivores or Omnivores. They all are *Phagotrophs* which include chiefly animals that ingest other organic and particulate organic matter.

(ii) *Micro consumers:* These are popularly known as *Decomposers.* They are *Saprotrophs* (Osmotrophs) and include chiefly bacteria, actinomycetes and fungi. They break down complex compounds of dead or living protoplasm, absorb some of the decomposed products and release inorganic nutrients in environment, making them available again to autotrophs.

Function of an Ecosystem

From the operational viewpoint the living and non-living components of an ecosystem are so interwoven in the fabric of nature that their separation from each other becomes practically very

much difficult. Ecosystems possess a natural tendency to persist. This is made possible by a variety of functions performed by the structural components. For instance, green leaves function as sites of food production, and roots absorb nutrients from the soil. Herbivores perform the function of utilizing parts of the plant production and in turn, serve as food for carnivores. Decomposers carry out the function of breaking down complex organic materials into simpler inorganic products, which can be used by the producers. These functions are carried out in the ecosystem through deliberately balanced and controlled processes. For example, the process of photosynthesis is involved in food production, and that of decomposition, leads to release of nutrients contained in the organic matter.

Knowledge of the rates at which different processes occur in an ecosystem is necessary to understand the interrelations of the ecosystem's structure and function. The key functional aspects of the ecosystem are:

1. Productivity and energy flow;
2. Nutrient cycling; and
3. Development and stabilization.

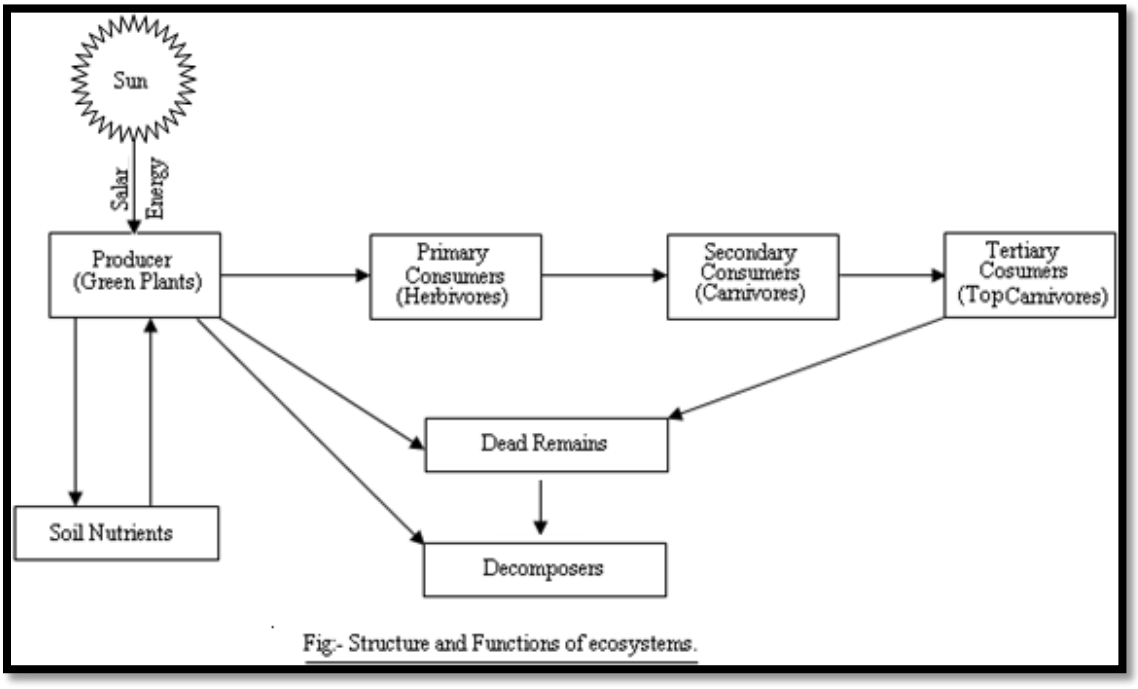


Fig:- Structure and Functions of ecosystems.

3.6: Ecological Imbalance

Ecological balance is a state of dynamic equilibrium within a community of organisms in a habitat or ecosystem. It can happen when the diversity of living organisms remains relatively stable. Gradual changes do take place but that happens only through natural succession. It can also be

explained as a stable balance in the numbers of each species in an ecosystem. This occurs through competition and cooperation between different organisms where population remains stable. This balance is brought about by the fact that certain species compete with one another determined by the environment in which they grow. This balance is also attained by the fact that some species depend on others for their food and sustenance. Such accounts are encountered in vast grasslands where the herbivorous animals *(deer, zebras, buffaloes, etc.)* are found in plenty. On the other hand, the carnivorous animals *(tigers, lions, etc.)* that are not usually in large numbers, hunt and feed on the herbivores, thereby controlling their population. In the plants, any disturbance in the native forests such as clearing the forest for shifting cultivation usually brings about a change in the species distribution. This change is due to competition where the secondary forest species such as grasses, bamboos or pines overtakes the native species changing the original forest structure. This is called *succession*.

Ecological balance may be disturbed due to the introduction of new species, natural hazards or human causes. Human interference has affected the balance of plant communities leading to disturbances in the ecosystems. Such disturbances bring about numerous secondary successions. Human pressure on the earth's resources has put a heavy toll on the ecosystem. This has destroyed its originality and has caused adverse effects to the general environment. Ecological imbalances have brought about many natural calamities like floods, landslides, diseases, erratic climatic occurrences, etc.

There is a very close relationship between the plant and animal communities within particular habitats. Diversity of life in a particular area can be employed as an indicator of the habitat factor. Proper knowledge and understanding of such factors provide a strong base for protecting and conserving the ecosystems.

In agriculture, monoculture cropping practices are narrowing the base of biodiversity. As a result, new diseases and deficiencies have erupted in. Nutrient cycle of soil gets disturbed and the soil becomes impoverished. Excessive use of chemical fertilizers causes soil degradation and eutrophication.

Reckless deforestation, especially on slopes, exposes the soil to erosive forces which further lead to siltation of streams. Besides, the soil is deprived of leaf litter, leading to impoverishment of its structure. Thus, the abiotic components of the ecosystem are disturbed and an imbalance sets in. Overgrazing exposes the soil to wind erosion. These areas face the threat of desertification. Introduction of alien varieties of plants and animals causes a chain of disturbances in the ecosystem. For instance, the introduction of rabbit into Australia led to the destruction of grasslands, as the rabbit had no predator in the new environment. Changes in the physical environment also play a crucial role in altering the ecological balance. Global warming is expected to lead to melting of ice caps and a rise in sea level.

3.7: Biodiversity: Concept, Importance and Conservation

Concept

The world "biodiversity" is an abbreviated version of "biological diversity". The *Convention on Biological Diversity* defines biodiversity as: "the variability among living organisms from all sources including inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species, and of ecosystems." Thus, Biodiversity refers to the variety of forms – the different plants, animals and micro-organisms. It also includes the genes they contain and the ecosystem they form. It deals essentially with dynamic processes and increases when genetic variation is produced and decreases on the loss of genetic variation or species extinction. Thus, it is a concept laying emphasis on inter-related nature of the living world with its processes. The conservation of biological diversity seeks to maintain the life-support system, provided by nature in all ways and the living resources, essentially for ecologically sustainable development.

Biodiversity is of fundamental importance to the functioning of all ecosystems and to the ecosystem services that nature provides to human society. Living organisms play central roles in the cycles of major elements (carbon, nitrogen and so on) and water in the environment, and diversity specifically is important in that these cycles require numerous interacting species. Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. For example,

- A large number of plant species means a greater variety of crops.
- Greater species diversity ensures natural sustainability for all life forms,
- Healthy ecosystems can better withstand and recover from a variety of disasters.

General interest in biodiversity has grown rapidly in recent years, largely as a consequence of accelerating rates of natural habitat loss, habitat fragmentation and degradation, and resulting extinctions of species. The *IUCN* Red list estimates that 12-52% of species are threatened with extinction. These estimates are the basis of the consensus that the Earth is in the midst of the sixth mass extinction event in its history; the present extinction event is termed the *Holocene Mass Extinction*. Biodiversity as we have today is the result of 2.5 - 3.5 billion years of evolution. Biodiversity is a system in constant evolution, from a view point of species, as well as from view point of an individual organism. Biodiversity is not found evenly on the earth. It is consistently richer in the tropics. As one approaches the Polar Regions, one finds larger and larger populations of fewer and fewer species.

Types of Biodiversity

Biodiversity can be discussed at three levels: (i) Genetic diversity; (ii) Species Diversity; (iii) Ecosystem Diversity.

1. Genetic Diversity

It refers to variation of genes within species. This variation can exist between different populations of the same species as well as between individuals within a population. It is estimated that about 109 different genes are distributed across the world's biota. Genetic diversity provides organisms and ecosystems with capacity to recuperate after change has occurred. Thus Genetic diversity is a number of genetic characteristics in the genetic makeup of a species.

2. Species Diversity

Refers to variety of living species. It relates to the number of species in a defined area. The diversity of species can be measured through its richness, abundance and types. Some areas are richer in species than others. Areas rich in species diversity are called *hotspots of diversity*. Equatorial region is species rich than the rest.

3. Ecosystem diversity

This includes broad difference between ecosystem types, including the diversity of habitats and ecological processes occurring within each ecosystem type. Each one is characterized with distinct patterns of energy flow and water cycles. This essential element is reflected in all biodiversity measurements.

Importance of Biodiversity

Biodiversity has contributed in many ways to the development of human culture and, in turn, human communities have played a major role in shaping the diversity of nature at the genetic, species and ecological levels. Biodiversity plays the following roles.

Ecological Role of Biodiversity

Species of many kinds perform some function or the other in an ecosystem. Nothing in an ecosystem evolves and sustain without any reason. That means, every organism, besides extracting its needs, also contributes something of useful to other organisms. Species capture and store energy, produce and decompose organic materials, help to cycle water and nutrients throughout the ecosystem, fix atmospheric gases and help regulate the climate. These functions are important for ecosystem function and human survival. The more diverse an ecosystem, better are the chances for the species to survive through adversities and attacks, and consequently, is more productive. Hence, the loss of species would decrease the ability of the system to maintain itself. Just like a species with a high genetic diversity, an ecosystem with high biodiversity may have a greater chance of adapting to environmental change. In other words, the more the variety of species is an ecosystem, the more stable the ecosystem is likely to be.

Economic Role of Biodiversity

For all humans, biodiversity is an important resource in their day-to-day life. One important part of biodiversity is *'crop diversity'*, which is also called '*agro-biodiversity.'* Biodiversity is seen as a

reservoir of resources to be drawn upon for the manufacture of food, pharmaceutical, and cosmetic products. This concept of biological resources is responsible for the deterioration of biodiversity. At the same time, it is also the origin of new conflicts dealing with rules of division and appropriation of natural resources. Some of the important commodities that biodiversity supplies to humankind are: food crops, livestock, forests, fish, medicinal resources, etc.

Scientific Role of Biodiversity

Biodiversity is important because each species can give us some clue as to how life evolved and will continue to evolve. Biodiversity also helps in understanding how life functions and the role of each species in sustaining ecosystems of which we are one of us so that we live and let other species also live their lives. It is our ethical responsibility to consider that each and every species along with us have an intrinsic right to exist. Hence, it is morally wrong to voluntarily cause the extinction of any species. The level of biodiversity is a good indicator of the state of our relationship with other living species. In fact, the concept of biodiversity is an integral part of many human cultures.

Social Benefits

Nature serves as the best laboratory for studies. It is hard to duplicate strictly a natural environment. So, research, education and such extinction works can progress only with the help of nature and its inherent biodiversity. Unaltered habitants help us to evolve indexes to formulate different management levels.

The aesthetic qualities of natural habitats are as a result of its biological diversity. No two spots in a forest can be alike in all aspects. Since time immemorial nature has satisfied recreational pursuits of the humans. There are ample evidences to prove that human culture has a co-evolved with the environment. For this reason itself, conservation of biodiversity is important for man's cultural identity. For, it has been found that nature has always provided inspirational, aesthetic and educational needs of the people. Nature also contributes to our emotional and spiritual well being.

Let us summarize briefly the important points about the importance of biodiversity.

1. Biodiversity provides us valuable natural resources to satisfy the subtle needs of mankind. Our homes, livestock, fruits vegetables, grains, grams, etc. all are derived from the products of diverse and healthy ecosystems. Our food, shelter, clothing's and a host of other useful products are derived from a variety of living organisms.

2. Diverse communities of plants, animals and micro-organisms also provide us valuable and indispensable ecological services. They recycle wastes, maintain the chemical composition of the atmosphere, and play a major role in determining the climate of the different parts of the world. The "ecosystem services" provided to us by nature in "gratis" also include supply of fresh water, generating soils, etc.

3. A diversity of abodes of biological communities such as parks, gardens, natural animal habitats, forests, mountain, seashores, etc. are useful for recreational facilities.

4. Biological diversity represents a valuable genetic resource for the mankind. The genetic organization of wild plants and animals, which has been continually evolving for millions of years survived the trials, tribulations and vagaries of nature.

5. Biological diversity helps in maintaining a stable and healthy ecosystem. In a simple ecosystem, loss of even one or a few species could be disastrous because of the lack of alternatives. However, in a complicated ecosystem having several trophic levels, loss of one or more species do not cause any serious problems because, the alternatives available can maintain the functionality of the system. Thus, biological diversity helps in maintaining a stable ecosystem.

6. The vast insect fauna contain large number of species that are potentially superior crop pollinators, weed control agents and are parasites of insect pests.

7. The vast pool of genetic diversity contained within wild populations of plants and animals is enormous value for the continuing research and development of agriculture, industry and medicine.

Threats to Biodiversity

Extinction is a natural event. We now know that most species that have ever lived gone extinct. The average rate over the past 200 million years is 1-2 species per year, and 3-4 families per million years. The average duration of a species is 2-10 million years. There have also been occasional episodes of much extinction.

In modern era, failure to consider the importance of nature has resulted in the threat to biodiversity as a whole. There exists an overall lack of any sustained effort to preserve the ecosystem. As genetic diversity erodes our capacity to maintain and enhance agricultural forest and livestock productivity decreases. Due to human actions, biodiversity is threatened with destruction to an extent rarely seen in earth history. We can attribute the loss of species to the accelerating transformation of the earth by a growing human population. We appropriate roughly half of the world's net primary production and most available fresh water, and we harvest virtually all of the available productivity of the oceans. No wonder that species are disappearing and ecosystems are being destroyed. Apart from population growth, we can examine six types of human actions that threaten biodiversity.

Over-hunting has been a significant cause of the extinction of hundreds of species and the endangerment of many more, such as whales and many African large mammals. The inability to site a single tusker in *Periyar Sanctuary* in *Kerala* is a case in point. Animals are hunted for many

precious commodities notably ivory, fur, skin, horn, etc. Most extinction over past several hundred years is mainly due to over-harvesting for food, fashion and profile.

Habitat loss/degradation/fragmentation are an important cause of extinctions. All species have specific food and habitat needs. The more specific these needs and localized the habitat, the greater the vulnerability of species to loss of habitat to agricultural land, livestock, roads and cities. The banning of buffaloes into *Keoladeo National Park* of the *Bharatpur Bird Sanctuary* since 1982 has led to an overgrowth of grass in wetlands, disrupting the aquatic habitat. In the future, the only species that survive are likely to be those whose habitats are highly protected.

Habitat damage, especially the conversion of forested land to agriculture, has a long human history. The tropical humid forests came under attack mainly in 20^{th} century, under the combined influence of population growth, inequitable land and income distribution, and development policies that targeted rain forests as the new frontier to colonize.

Habitat fragmentation is another aspect of habitat loss that. Forests meadows or other habitats, that remain, are generally in small, isolated bits rather in large intact units. Each can at best maintain a very small population. Environmental fluctuations, disease and other chance factors make such small isolates high vulnerable to extinction.

Invasion of non-native species is an important and often overlooked cause of extinctions. The African Great Lakes – *Victoria, Malawi* and *Tanganyika* – are famous for their great diversity of endemic species, termed "species flocks", of cichlid fishes. In Lake Victoria, a single exotic species, the Nile Perch, has become established and many cause the extinction of most of the native species, by eating them all. It was a purposeful introduction for subsistence and sports fishing but a great disaster.

Pollution from chemical contaminants poses a great threat to ecosystem and species. While not commonly a cause of extinction, it can likely be for species whose range is extremely small, and threatened by contamination.

Climate Change

A changing global climate threatens species and ecosystems. The distribution of species is largely determined by climate, as is the distribution of ecosystems and plant vegetation zones *(biomes).* Climate change may shift these distributions but, for a number of reasons, plants and animals may not be able to adjust. The pace of climate change almost certainly will be more rapid than most plants are able to migrate. The presence of roads, cities, and other barriers associated with human presence may provide no opportunity for distributional shifts. Parks and nature reserves are fixed locations. For these reasons, some species and ecosystems are likely to be eliminated by climate change. Agricultural production likely will show regional variation in gains and losses, depending

upon crop and climate. As a consequence of these multiple forces, many scientists fear by the end of next century, perhaps 25% of existing species will be lost.

Deforestation

Large forest areas have been cleared for constructional as well as extensive agricultural purposes leaving the native animals homeless. Construction of dams has destroyed many large sections of rivers and streams and their ecosystems. Coastal Zone development is responsible for wiping out the reefs near the shores. Jhum cultivation has led to considerable decline in the North Eastern forests of India. Earlier, the Jhum cycle was 25 to 50 years, now it is just 5-8 years, almost doubling the deforestation. Over 300 km^2 of forest cover has been lost in the North East, while the figure for India as a whole is 5482 km^2.

The *International Union for Conservation of Nature* (IUCN) estimated that many species are threatened with extinction. In addition,

- 75% of genetic diversity of agricultural crops has been lost.
- 75% of the world's fisheries are fully or over exploited.
- Up to 70% of the world's known species risk extinction if the global temperatures rise by more than 3.5^oC.
- 1/3 of reef-building corals around the world are threatened with extinction.
- Every second, a parcel of rainforest the size of a football field disappears.

Conservation of Biodiversity

The ever increasing loss of bio-wealth has posed serious threat to the very existence of mankind. If this trend of biodepletion continues, one quarter of the world's species may be gone by the year 2050. Desertification, collapse in fisheries production, tropical desertification, etc. are some of the ghastly acts threatening biodiversity. Biodiversity is important for human existence. All forms of life are so closely interlinked that disturbance in one gives rise to imbalance in the others. If species of plants and animals become endangered, they cause degradation in the environment, which may threaten human being's own existence.

There is an urgent need to educate people to adopt environment-friendly practices and reorient their activities in such a way that our development is harmonious with other life forms and is sustainable. There is an increasing consciousness of the fact that conservation with sustainable use is possible only with the involvement and cooperation of local communities and individuals. For this, the development of institutional structure is at neither merely the conservation of species nor the habitat but the continuation of the process of conservation.

The Govt. of India along with other 155 Nations have signed the Convention of Biodiversity at the *Earth Summit* held at *Rio de Janiero, Brazil* in June 1992. The *World Conservation strategy* has suggested the following steps for biodiversity conservation.

i. Efforts should be made to preserve the species that are endangered.
ii. Prevention of extinction requires proper planning and management.
iii. Varieties of food crops, forage plants, timber trees, livestock, animals and their wild relatives should be preserved.
iv. Each country should identify habitats of wild relatives and ensure their protection.
v. Habitats where species feed, breed, rest and nurse their young should be safe guarded and protected.
vi. International trade in wild plants and animals should be regulated.

There are some countries which are situated in the tropical region; they possess a large number of world's species diversity. They are called *mega diversity centers*. There are 12 such countries, namely *Mexico, Columbia, Ecuador, Peru, Brazil, Democratic Republic of Congo, Madagascar, China, India, Malaysia, Indonesia,* and *Australia* in which these centers are located. In order to concentrate resources on those areas that are most vulnerable, the *International Union for the Conservation of National Resources* (IUCN) has identified certain areas as *biodiversity hotspots*. Hotspots are defined according to their vegetation. Plants are important because these determine the primary productivity of an ecosystem. Most, but not all, of the hotspots rely on species-rich ecosystems for food, firewood, cropland, and income from timber. In *Madagascar,* for example, about 85 percent of the plants and animals found nowhere else in the world, other hotspots in wealthy countries are facing different types of pressures. The *islands of Hawaii* have many unique plants and animals that are threatened by introduced species and land development.

Conserving biological diversity involves restoring, protecting, conserving or enhancing the variety of life in an area so that the abundance and distribution of species and communities provide for continued existence and normal ecological functioning, including adaptation and extinction. This demands an urgent attention for the conservation of biosphere.

3.8: Hot Spots of Biodiversity

Biodiversity is not uniformly distributed across the geographical regions of the earth. Certain regions of the world are mega diversity zones where a very large number of species are found *Norman Myers* developed the hot spots concept in 1988 to designate priority areas in situ conservation. The hot spots are the richest and the most threatened resources of plant and animal life on earth. The key criteria for determining a hot spot are:

- Number of endemic species, i.e., the species which are found nowhere else,
- Degree of threat, which is measured in terms of habitat loss.
- Twenty-five terrestrial hot spots for conservation of biodiversity have been identified worldwide.

These hotspots together cover about 1.4% of the earth's land area. Tropical forests appear in 15 hot spots, Mediterranean zones in 5, and 9 hot spots are mainly or completely made up of islands. As many as 16 hot spots are in the tropics. About 20% of the human population lives in the hot spot regions. Among the 25 hot spots of the world, two (Western Ghats and Eastern Himalayas) are found in India and these extend into the neighboring countries. These areas are rich in flowering plants, reptiles, amphibians, butterflies and some mammals and also show a high degree of endemism.

CREDIT - IV

4.1.: Quantitative Revolution in Geography

Quantitative approach is one of the most recent methodological and conceptual approaches in the field of geography. The quantitative revolution refers to the adoption of mathematical procedures and tools to study geographical phenomena. The supporters of this approach argue that study of just the occurrence of geographical phenomena is not enough for a meaningful explanation. Besides the fact of occurrence and non-occurrence, the geographers should look into the magnitude or the quantity of the phenomena. In other words, the information such as whether rainfall occurs at a place or not is not enough for meaningful conclusions; we should also know the amount of rainfall occurring at that place and its seasonal distribution and variability. This approach of quantifying geographical information and applying mathematical tools to analyze it entered geography during the mid-1950's and became popular very quickly. Due to this quick change in methodology it is called *quantitative revolution*.

Many of the modern scholars are of the view that geography does not differ from other sciences in terms of the need for statistical methods and thus quantification is a desirable development. Although the revolution originated from mathematics and physics, its direct invasion in geography came from much closer. The inter-disciplinary approach has been an important carrier of this methodology and geographers began to look for quantitative techniques by getting encouragement from the works in sister disciplines, and work of the non-geographers bringing and applying new techniques to old geographic questions.

The fields of geography responding early to the call of quantification have been *geomorphology* and *climatology*. Work of scholars like *Koeppen* and *Thornthwaite's* proved the utility of quantitative techniques in climatic classifications. An outstanding early plea in favour of quantification in geomorphology was made by *Strahler* and *Dury*. Although the idea was received skeptically in the beginning, most of the geomorphologists today accept the quantitative approach. The climatologists have also reacted in much the similar way after *Thornthwaite's* work silenced the critics. The greatest struggle for the acceptance of quantitative methods has been in human and economic geography. It is logical, again, from the point of view of Possibilistic thesis and it is here that the revolution runs against the nations of free will and unpredictability of human behavior. There were a lot of arguments for and against the idea of quantification in 1950s and the research journals published a number of debates. Ultimately, the revolution got better of the tradition in these fields also.

This wave of statistical methods in geography can broadly be studied under four major phases of Quantitative Revolution:

(I) 1950-58:

This phase was the period of use of primary methods of statistics. Geography began to use the methods of the Measures of Central Tendency *(Mean, Medium, and Mode)*, deviating trends - *Standard Deviation* and *Quantitative Deviation* and data generation method - Sampling, Central Tendency methods and Deviation method and use of geographical maps, particularly maps showing distribution. Before the use of this method value lines were drawn arbitrary. Hence, every geographer was free to draw lines on his own choice and sometimes conclusion was contradictory. But once Central Tendency and Deviation Methods were used geographers began to find unanimity in conclusion and the conclusion became reliable and acceptable to other.

Before World War II geographers were principally using data supplied by secondary and tertiary sources. Hence geographers have no command over reliability of data. But post world war geographers began to make use of various methods of sampling to make direct generation of data. Hence geographers have command and authenticity over the data. This is how conclusion began to be based on primary information. During this phase principal work has been by *B. J. Berry*. He was a great champion of statistical method. Some other main contributors were *Herten* of Canada, *Bun gag* of USA.

(II) 1958-68:

This phase was the period of Advanced Statistical Methods. Geographers began to use Co-relation and Co-efficient, Pearson Methods and Regression method to measure the amount of closeness between two variables. Co-relation and Co-efficient methods has proven very helpful to geography. This method began to measure co-relation between independent variables, mainly physical variables. Geography itself is a discipline of relation between physical and human variables. Hence scientific conclusion of this relationship was lightly appreciated. The use of regression was found to have improved credibility of diagram. Geographers were traditionally making scattered diagram. But when regression method was used the amount of closeness between the two axis of diagram became clear. American geographers did this type of work. Some of the pioneering works in this regard were of *Ackerman, Chorley and Hagget.*

(III) 1968-78:

This phase was the period of use of Nearest Neighbor Statistics, brought from science of ecology when it was developed by *Clark* and *Evance*. Beside that geographers used Multivariate analysis method which is based on weight technique. Nearest Neighbour Statistical used in Settlement geography to study the rural as well as urban geography while Multivariate Analysis used in complicated social organization. Hence a number of variables are considered to draw a general conclusion. It is based on assumption that problem is geared by number of factors. But all are not equally significant. Hence the quantification process would eliminate in significant factors and major factor would survive and thereafter planning efforts can be carried on this process made it possible to arrange magnified information. Prominent supporters are *Chorley* and *Hagget* and *PredPect.*

(IV) After 1978:

Geographers began to use more sophisticated method and remote sensing information method in analysis. Several department of geography all over the world have how established computers and are interpreting

satellite information. It is very helpful in identification of natural resources and planning for both rural and urban land use pattern. Satellite photographs provide adequate information like - relief features, structural layout and reserves of resources. In fact this type of geography makes geography almost distinguishable among the community members of social science.

The supporters of the quantitative approach emphasized that geography had come a long way from being a purely descriptive discipline. The nomothetic or analytical approach needs formulation of better tools for explanation of geographical phenomena. Also mere description of phenomena is not enough; the geographers should be capable of making predictions also. This necessitated formulation of laws, theories and models and strong and reliable analytical tools are required for this. Hence a quantitative approach in geography is a need of the present times. This type of study has therefore improved importance of geography and advantages are like –

1. It helps in the characterization of crude primary information.
2. It has helped in theorization and model making work in geography.
3. Helps in delimitation of various types of geographical regions.
4. Helps in management of multitude of information.
5. Geography is a discipline of relation and various methods of co-relation have improved relevance of geography.
6. Geographical inferences are now more precise, scientific and credible.
7. Geographical maps have become more acceptable. Maps and diagram teaching become popular simply due to its improved quality.

The opponents of the quantitative approach in geography have argued for their view in various ways. A few among them said that the geographical tools like the maps had taken a lot of time and energy to achieve the current levels of perfection, and thus should not be discarded in favour of a new and little tested tool. Some others argued that the statistical tools are suitable for application only to a few of the geographical problems. According to them, much of the human geographical information cannot be quantified. An objection was made on the plea that often the quantitative techniques can be used to prove pre-conceived notions and these techniques can be used to prove irrelevant hypothesis. One of the reasons for opposition was that the application of the new techniques required a fair amount of knowledge of mathematics and most of the geographers entering the field of geography through the social science stream found these techniques difficult.

Thus, in spite of the objections to the idea of quantification, the quantitative revolution has been successful and the techniques are accepted today almost universally. The quantitative methods are the most appropriate for theory formation, and wherever a theory is needed, quantification is also needed. In real practice, the descriptive geography supported by quantitative analysis can provide a state of balance. The quantification should be treated as a tool and not as an aim in itself, and in such cases it can certainly serve a useful purpose in geography.

4.2: Field Work in Geography

Geography is essentially an empirical science using a lot of information in the form of data. The most common source of data in geography is Field Survey. Field surveys constitute an integral part of geographical studies. The surveys unfold the varied interrelations between man and nature. There has been a long and cherished tradition of field work in geography. In fact the frontiers of geographical knowledge have been extended by the explorers and travelers.

Geography of the modern age has realized that geographical knowledge of places and processes must be based on more than the fleeting glimpses of a passing traveler. They have developed appropriate techniques for the systematic acquisition of data about the things in which they are interested. There is no denying the fact that there is no substitute for field surveys which provide first-hand information and direct observation of nature - the greatest geographical laboratory. Although there is much emphasis laid on geographical theories and models in this age, nevertheless the significance of field surveys has not dwindled. They continue to be imperative for validation and feedback. A student of geography himself observes, analysis evaluates various geographical phenomena during field surveys. He understood more clearly the objects of nature in the open at their actual locations. Since Geography concerns with the study of elements of both natural and cultural environment, so a geographer has to conduct two following type of field surveys to generate date regarding these components of environment.

i. *Geomorphic field survey* and
ii. *Socio- economic field survey*

1. Geomorphic Field Survey

These field surveys are concerned with the study of location, altitude and space relations of various places. Besides, it also studies *rock types*, their lithological and mineral characteristics; various *structural features* like folds, faults, dips and strikes, thrusts, etc.; various *landforms* such as mountains, plateaus, plains, valleys, gorges, rift valley, horsts, etc.; various *geomorphic processes* which are constantly engaged in changing the morphological characteristics of the earth's surface in the areas under investigation. There are various techniques of field work and surveying which help in collection of data regarding the geomorphology of the area under study. The information obtained thus is presented in the form of maps – topographical maps, geological maps and other types of maps. All these maps provide detailed information of the areas concerned. A number of instruments are used during such field surveys.

If one has to prepare a general map of an area, one should know the space relations of various points or spots in that area. The measurements can be made by various methods of surveying such as Chain and Tape Surveying, Plane-table Surveying, Prismatic Compass Surveying, etc. Linear measurements of distances between different points on the ground are taken and plotted on paper to a scale. Direction is determined with the help of trough compass. Information about altitude of various places can be obtained with the help of variety of instruments like *Abney level, Clinometers, Dumpy level* or *Theodolite.* These instruments are called *leveling instruments* because the altitudes with them are calculated on the basis of comparison of the heights of various points, the height of at least one of which is already known such a point used as a reference point in leveling is called a *bench-mark station.*

Significance of Geomorphic Field Survey

The significance of geomorphic field survey can be highlighted as follows:

1. Students can observe and interpret the process that operates in the formation of landscape.
2. It is a sort of field training to the students.
3. Students come to understand the role of a particular environment in the formation of particular landscape.
4. It increases the confidence of the students in explaining the basic concepts in geomorphology.
5. Students apply the examples from field tour to the theoretical descriptions.
6. Students come to know about the various resources and their utilization.

Procedure for Geomorphic Field Survey

Geomorphic field studies may be carried out under the following stages:

1. Preparatory Stage

The first stage in geomorphic field studies is the preparation for field survey and it involves the following steps.

a. Selection of study area.
b. Preparation of base map.
c. Acquiring basic knowledge of geomorphology of study area.
d. Collection of equipments and their knowhow.
e. Arrangement of transport.

2. Field Observation Stage

Field observation can be carried out under the following heads:

a. Qualitative Observation

By qualitative analysis a surveyor can collect the following types of observation.
(i) Evolution of landscape.
(ii) Dominant weathering process and factors responsible for them.
(iii) Soil erosion process and factors affecting soil erosion.

b. Quantitative Observation

A surveyor can undergo the following quantitative observation during geomorphic field survey.
(i) Measurement of heights, depths and dimensions.
(ii) Measurement of dip of sedimentary beds and other geological structure like fold, fault, joint, etc.
(iii) Contouring of hill locks, valleys, etc.
(iv) Collection of samples

Sampling is the most important aspect of geomorphic field studies because tour report can be written after analysis of data of samples collected during field tour. Sampling should be carried out under the following aspects.

a. Soil sampling
b. Water sampling
c. Rock specimen sampling

3. Laboratory Observation Stage

Under this stage samples are sending to the concerned laboratories for analysis.

4. Tabulation and Mapping

Data report from field observation and laboratories should be tabulated and maps should be prepared for the tables.

5. Report Writing

This is the last stage and involves writing of tour report under the following heads.

Title of the Topic

(i) Introduction of Geomorphic Field Survey.
(ii) Significance of Geomorphic Field Survey.
(iii) Data base and Methodology.
(iv) Literature Review.
(v) Study Area.
    (a) Physical framework
    (b) Socio-economic setup
(vi) Detailed description of the topic.
(vii) Conclusions and Suggestions.
(viii) References.

2. Socio-Economic Field Survey

A geographic enquiry of socio-economic set up of a region often needs to be supplemented through well planned field surveys. These surveys enhance our understanding about patterns of spatial distribution, their association and relationships at the local level. Such field surveys are carried out to have an in depth study of the problem under investigation & to comprehend it in totality at the place of its occurrence.

Procedure

A socio-economic field survey is carried out following a well-define procedure. It involves the following inter-related steps:

(i) Defining the problem

The problem to be studied (for which the socio-economic field is to be conducted) is defined precisely. The nature of the problem is indicated in the title of the topic of the survey.

(ii) Objectives

Various objectives to be realized through the socio-economic survey are listed. Theses objective determine the selection of tools for acquisition of data and methods of analysis of the problem.

(iii) Scope

Scope of the survey is delimited in terms of the geographical area to be covered and time framework of the enquiry. The multidimensional delimitation of the study is essential for realization of pre- defined objectives, pointing out limitations of analysis, drawing of inferences and stating their applicability

(iv) Tools and Techniques

Different types of tools and techniques are used to collect information through socio-economic field surveys such as maps and other data, field observation, data generated by interviewing people through questionnaires.

(v) Completion and computation

The information of various types collected during the field surveys needs to be organized systematically for its meaningful interpretation and analysis to achieve the desired objectives. The statistical data obtained during the survey is tabulated for further analysis.

(vi) Cartographic Application

For getting visual impressions of variations in the geographic phenomena, diagrams, graphs, maps, etc. are drawn. Their presentation effectively facilitates the description & analysis of the information.

(vii) Presentation

The field study report in concise form should contain all the details of the procedures followed, methods, tools and techniques employed. The major part of the report should be devoted to the interpretation and analysis of information gathered and computed along with supportive facts in the forms of tables, charts, statistical inferences, maps and references. A summary of the investigation should be provided at the end of the report.

(viii) Report Writing

After proper analysis of data and map work project report writing should be carried out with the following chapter scheme.

CHAPTER SCHEME FOR PROJECT REPORT

Chapter - I: Introduction

a. Significance and scope of socio-economic field survey.
b. Study Area
c. Sample village's brief description

d. Data base and methodology

Chapter – II: Physical Framework (brief description of each sub-heading)

a. Relief
b. Climate
c. Drainage
d. Vegetation
e. Soils

Chapter – III: Socio-economic setup of Sample Villages

a. Demographic profile
b. Agriculture set up
c. Settlement pattern
d. Industrial set up
e. Economy of the area
f. Culture
g. Health care pattern
h. Nutritional aspects
i. Tourism

Chapter – IV: Topic Concerned (in detail)

Chapter – V: Conclusion and Suggestions.

Significance of Socio-economic Field Survey

1. It helps us to identify the causes of spatial variation in social, cultural and economic characteristics within a region.
2. Students get first hand information about man and environment relationship within an area.
3. It is a sort of practical training and there is no need of proof or examples as in classroom.
4. Students learn some new techniques of man and environment adjustment and can apply the same in his day to day life.
5. Students get a chance of conversation with the people of different tribes of different areas.