1

NATURE OF GEOGRAPHY AS A DISCIPLINE

The proposed course aims at explaining the nature of the subject. It throws light on the importance of geography and describes the nature of geography as a subject. It attempts to enrich knowledge and illustrate basic concepts as well as technical terms which are building blocks of geographic knowledge. Effort, however, has been made to develop the concepts in a graded and sequencial manner and deepen the interest in the subject.

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 third century B.C.

Geo " Earth" and Graphy " to describe" literal meaning of geography is to describe about the earth's surfaces. In other words "Geography is largely the study of the interaction of all physical and human phenomena and landscapes created by such interactions." It is about how,why,and where human and natural activities occur and how these activities are interconnected.

Geography has undergone changes in its approach. The earlier geographers were descriptive geographers. Later, geography came to be developed as an analytical science. Today the discipline is not only concerned with descriptions but also with analysis as well as prediction.

In this lesson you will learn how important geography is in everyday life. This study will encourage you to understsnd your own place and spaces with greater interest.

OBJECTIVES

After studying this lesson, you will be able to:

- appreciate the use of Geography in daily life;
- trace development of Geography as a discipline;

- understand man-environment relationships and their impacts on each other;
- illustrate the systematic and regional approaches of Geography;
- understand various analytical techniques in Geography;
- identify the different branches of Geography and its scope.

1.1. GEOGRAPHY IN DAILY LIFE

You must have noticed that the earth's surface is ever changing; In general, the natural phenomena like mountains, rivers, lakes etc. change slowly while the cultural elements like buildings, roads, crops, change fast. Travelling from one place to another you notice that the trees number and types of trees change from area to area. All this is because of the continuous interaction between the enviroment in which we live in and the way we use it. The study of Geography is about observing such patterns. Another aspect of geography is to understand the factors or reason behind areal differentiation, how do social, cultural, economic and demographic factors change our physical landscape and create new or altered landscapes by human interventions. For example, human settlements are transformation of forest or barren lands for living purpose by human being.

Geography is often thought of as the art of making and studying maps. Maps give us a much more correct and graphic view of the way the Earth's surface looks compared to a picture of drawing. As earlier, even today geographical information about an area is available through reports, travel diaries and gazeteers. At present maps can be drawn by using satellite images using Geographic Information Systems (GIS) tools. Computers easily convert the information from satelite images into maps to show what changes development can bring about. Such information is of benefit to the society. Such mapmakers are in great demand today. Nowadays geographers, engineers, environmental scientists, city planners, social scientists, and many others learn to use GIS to understand the Earth better.

Geography, not only investigtes what is where on the Earth, but also why it is there. Geographers study the location of the activities, carefully identify patterns using maps and find out the reasons for these patterns. The areas are then described based on the distribution of land forms, population, house type and agriculture. They discover the linkages and movements between places and are able to infer the spatial processes that are working in an area.

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.

In brief:

1. Geography is a science of space.
2. Maps are an essential tool of geographers.
3. Digital Geographical Information system is a new tool for making maps.
4. Spatial Planning can be done using both maps and the study of geography

Basic Concepts

Geography has been defined differently through different periods of its history Geographical work in ancient Greece had followed two distinct traditions. One was the mathmatical tradition which was focused on fixing the location of places on the earth's surface, and the other was gathering geographic 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. The emergence of regional approach in geography also emphasied the descriptive character of geography. According to Humboldt, geography is the science related to nature and it studies and describes all material things found on earth. Another important school of thought defined geography as the study of man-environment relationships.

- Geography as a study of the earth's surface.
- Geography as the study of man-environment relationships.

INTEXT QUESTION 1.1

1. What is geography

   ____

2. Why is earth's surface changing

   ____

3. Which are the two distinct traditions followed by Greeks

   (i)____________________(ii)____________________

1.2 DEVELOPMENT OF GEOGRAPHY

(A) Ancient Period

The earliest records illustrate the interests of scholars in understanding the physical domain of the earth by making maps and astronomical measurements. The Greeks are given the credit of being the earliest geographers, prominent among them being Hower, Herodotus, Thales Aristotle and Eratosthenes.

(B) Pre-Modern Period

This period starting from the middle of 15th century and continuous with 18th early provides us enormous information about the physical and cultural nature of the world by the travels and explorations of early gergrophers. The early seventeenth century witnessed the beginings of a new scientific geography. Christopher Columbus and Vasco de gama, Fesdinend Meghellan and Thomas cook were important explorers and travelles among those. Varenius, Kant, Humboldt and Ritter led the geographers of this period. They contributed in the development of cartography and discovering new lands, and developing geography into a scientific disciplines.

(C) Modern Period

Ritter and Humboldt are frequently referred to us the founders of modern geography. Generally, latter half of nineteenth century is considered as a period of modern geography. The first modern geographer in true sense was Ratzel who built the structure of modren geography on the foundations laid down by classical geographers.

(D) Recent Period

The development of geography during the post Second World War period has been very rapid. The American and European geographers such as Hartshorne have contributed the maximum during this phase. Harthshorne described geography as a science dealing with areal differentiation. The present day geographers look upon regional approach and systematic aproach as complimentary rather than contradictory.

1.3 SCOPE OF GEOGRAPHY

Geography has now acquired the status of science that explains the arrangements of various natural and cultural features on the earth 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, meteriology and planining and various social sciences. Apart from that, a geographer can help in day to day life like tourism, commuting, housing and health related activities.

1.4 APPROACHES TO 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 surface. There are two main approaches in geography :

1. Systematic   2. Regional

1. Systematic Approach

A study of specific natural or human phenomenon that gives 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,

(ii) Biogeography, including environmental geography,

(iii) Human geography,

(iv) Geographical methods and techniques

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

(ii) It focusses 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) It describes culture, populations, dynamics of social, economic, and political aspects of space.

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

- Geography has developed in four periods i.e. ancient period, pre-modern period, modern period and recent.
- Contribution of Harthshorne is pioneering in the field of geography in recent period.
- Geography is a holistic and interdisciplinary field of study engaged in understanding the chaning speatial structure at different territorial levels.

2. Regional Geography

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 also be multificator regions formed by the association of two or more factors. Administrative units like, states, districts, 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.

- Two main approaches in geography i,e (i) systematic and (ii) regional
- Systematic geography is divided into four branches.
- Regional geography has also four branches.

Notes

INTEXT QUESTION 1.2

1. Which are the four branches of systematic geography.

   (i)____________(ii)____________(iii)____________(iv)____________

2. Name the main branches of regional geography.

   ____

1.5 GEOGRAPHY AND SOCIETY

Geographical thinking and concepts affect our daily decisions in a number of ways–

For example when urban master plans are made or rural development strategies are considered, it is importannt to undersatand the physical structure, climatic conditions and availabilities of resources in an area. The decision to shift industries from city areas would require the extension of industrial land use into farming areas. This would displace farmers and their source of income. Similarly, the construction of a railway line or highway causes ribbon development. Many economic activities concentrate along such corridors. Now a days with the need to provide relief material to all affected persons after a flood or an earthquake requires a good understanding of the geography of the area. Distribution of relief is functional and related to the needs of people, according to climate or terrain.

1.6 METHODS AND TECHNIQUES OF GEOGRAPHY

Each branch of systematised knowledge has certain methods / tools and techniques on which it depends to further its basic objectives. Geography too has its tools, techniques and methods. Important among them are globes, maps, diagrams, relief models and spatial analytical methods. Cartography is concerned with preparation of maps and diagrams to show distribution of geographical phenomena. Important methods in geography are deductive and inductive in nature. Various statistical techniques and models are used for regional analysis and to understand spatial distribution and interaction.

(A) Cartography

Most of us are fascinated with maps. "Cartography" is the study and practice of making maps and diagrams. It represents the earth with maps and abstract symbols. Maps have traditionally been made using pen, ink and paper, but computers have revolutionised cartography and with GIS methods one can prepare maps and diagrams with greater choice and efficiency.

Spatial data is obtained from measurement and other published sources and can be stored in a database, from which it can be extracted for a variety of purposes. Current trends in this field are moving away from drawing with ink or paper type methods of map making towards the creation of increasingly dynamic, interactive maps that can be manipulated digitally. Most commercial quality maps are now made with map making software that falls into one of three main types; Computer aided data management (CAD), Geographic Information Systems (G.I.S) and Global Positioning systems (GPS).

Cartography has grown from a collection of drafting techniquies into an actual science. Cartographers must understand which symbols convey information about the Earth most effectively, and make such maps that will encourage everyone to use the maps to find places or use it for their daily work. A cartographer must learn geodesy and fairly adavnced mathematics to understand how the shape of the Earth affects the distortion of map symbols projected onto a flat surface for viewing.

"Geographic Information Systems" deals with the storage of information about the Earth for automatic retrieval by a computer in an accurate manner. In addition to other sub disciplines of geography, GIS specialists must understand computer science and database systems. Maps have traditionally been used to explore the Earth and to exploit its resources. GIS technology, as an expansion of Cartographic science, has enhanced the efficiency and analytic power of traditional mapping. Now, as the scientific community recognizes the enviornmental consequences of human activities, GIS techology is becoming an essential tool in the effort to understand the process of global change. Various map and satellite information sources can combine in ways that recreate the interactions of complex natural systems. Such visualisation can help to predict what will happen to an area if it is repeatedly flooded, or what changes are expected if a particular industry is located or developed in an area.

Next to Survey of India, inherited from the British Ordinance Survey, the NATMO is a premier organization for mapping in India. Its maps of one million series are well known. The organiszation of the Cartographic Unit in 1960s at the French Institue, Pondicherry, brought a significant impact on the development of Geography in India. Its publication of Vegetation and Soil maps at the scale of 1:100000 were very well received for their cartographic appreciation and resource mapping. This Unit was upgraded in 1995 as a Geomatics Laboratory with an emphasis of computer cartography and GIS.

(B) Quantitative methods in Geography

These aspects of geographical techniques deal with numerical methods most commonly found in geography. In addition to spatial analysis, you are likely to find methods like cluster analysis, discrimnant analysis in geographic studies. These statistical techniques are introduced to you in later chapters and you will find that when you undertake the local area study, you yourself will see how useful these methods are in finding patterns and identifying relationships between space and the activities that are performed in them.

(C) Regional science method

In the 1950s, the regional science movement arose led by Walter Isard. This provided a more quantitative and analytical base to geographical questions, in contrast to the more qualitative tendencies of traditional geography. Regional Science comprises the body of knowledge in which like regional economics, resource management, location theory, urban and regional planning, transportation and communication, human geography, population distribution, landscape ecology, and environmental quality are examined for regional development.

1.6 BRANCHES OF GEOGRAPHY

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

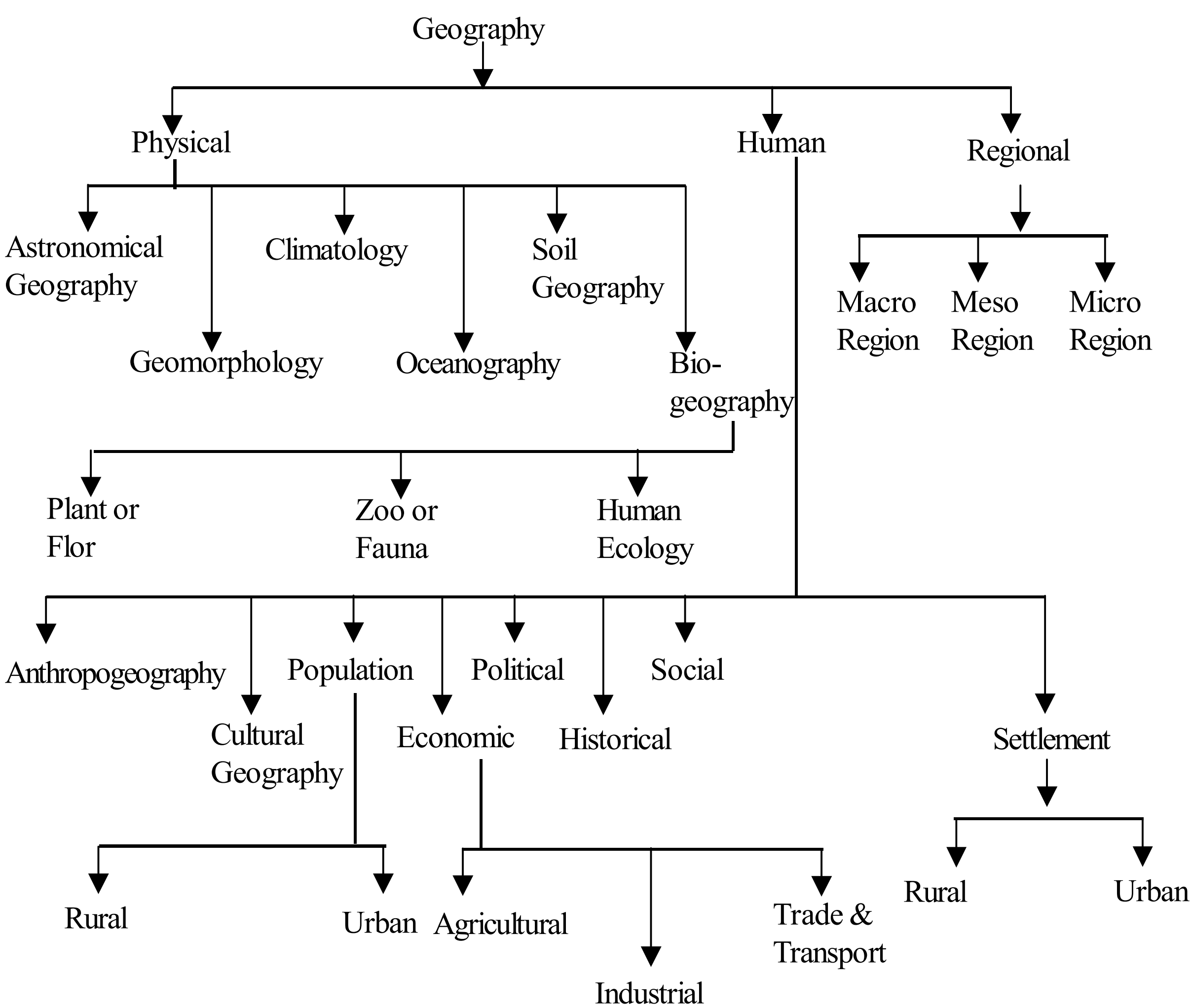


Fig 1.1: Branches of Geography

A. Physical Geography

Physical geography is concerned with the study and explanation of physical phenamena, encompassing the other such fields like geology, meteriology, zoology and chemistry. It became a very popular subject during the later part of the nineteen century. It has a number of sub-branches which treat different kind of physical phenomena.

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

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

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

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

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

(vi) 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, animals or faunal geography, and human ecology.

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 focusses on the origin, components and impact of human culturs, both material and non-material.

(iii) Economic geeography : 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 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 region.

(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.

(vi) Population geography : It is the study of various dimensions of population like its population distribution density, composition, ferrility, mortality, migration etc.

(viii) Settlement geography : It is the study of Rural/Urban settlements, their size, distribution, functions, heirach, and off 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.

INTEXT QUESTION 1.3

1. What are the two branches of geography ?

   (i)____________________________(ii)____________________________

2. Name the two techniques of geographical study ?

   (i)____________________________(ii)____________________________

3. What is Anthropogegraphy ?

   ____

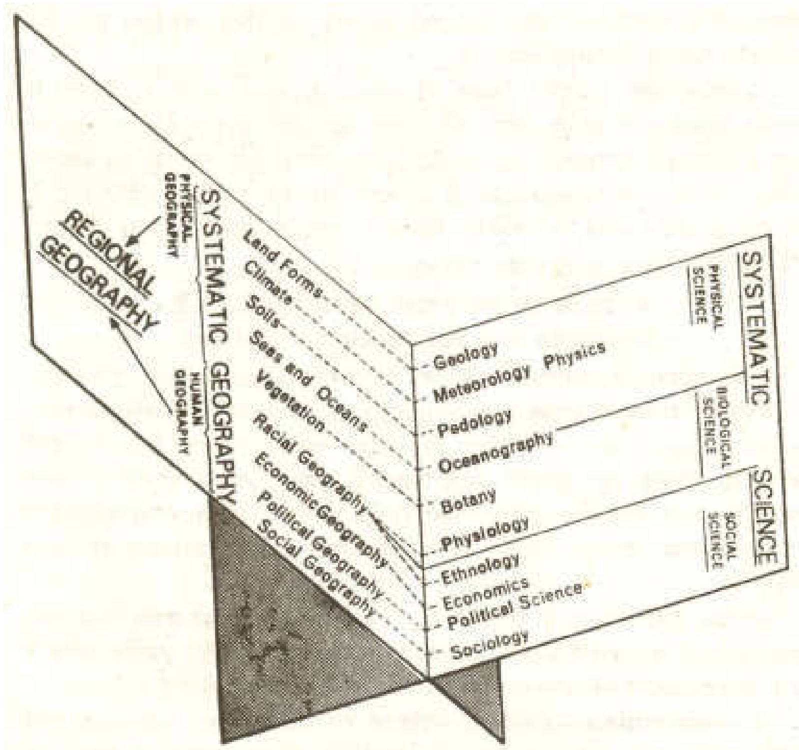


Fig. 1.2 Geography as an integrating science
(Based on Hettner and Harthshorne)

- Geography has three main branches : physical, human and regional.
- Physical geography deals with nature of physical phenomena such as climatology, soil and vegetation.
- Human geography deals with the relationship between human societies and the earth's surface.
- Geography as an inter disciplinary subject.

1.7 GEOGRAPHY AS AN INTERDISCIPLINARY SUBJECT

Geography has its strong relation with mathematices, natural sciences, and social sciences. While other sciences deal with distinctive types of phenomena, geography studies several kinds of phenomena,each already studied by another science. In an integrated manner thus, geography has firmly established itself as a discipline of systhesis. Fig. 1.2 Gives the idea of integrating science

WHAT YOU HAVE LEARNT

Geography is a science of space. Geography is both a natural and social science as it studies both enviroment and the people. It connects the physical and cultural world. Physical geography studies the earth systems that create natural environment. Human geography is concerned with the political, economic, social, cultural and demographic processes. It is concerned with the different ways in which resources are used.

Earlier geography merely described places. Even though, this is still a part of geography, the pattern of description has changed a lot in recent years.

Geographical phenomena and processes are generally described by two approaches viz. (i) regional and (ii) systematic. Regional approaches are charactrerized by understanding the formation and characterstic of regions. They try to focus on how and why areas are different from each other. Regions can be physical, social, economic, political, demographic etc.

Systematic approach is organized in terms of particular phenomena of general geographic significance. Each phenomena is studied in terms of the relations of its areal differentiations with the others.

Now we understand the cause and impact of natural and human phenomena in creating physical and human landscapes.

Geography has three main branches : Physical human and regional. Physical geography is further subdivided into several other branches namely. geomorphology, climatology, oceanography, soil and biogeography. Human Geography is also subdivided into other branches like, cultural, population, social, economic and political. Regional geography is subdivided in other branches like Macro, Meso and Micro.All these subjects are interrelated to each other.

TERMIANL QUESTION

1. Answer the following questions in brief :
   (i) Define the term Geography.
   (ii) Why is geography called the mother of all sciences.
   (iii) What are the two basic approaches in geography.
   (iv) What are the four phases of development of geography.
   (v) Define the terms physical and human geography.
2. Distinguish between the following
   (i) Systematic and regional geography.

(ii) Physical geograhy and biogeography.

(iii) Population and economic geography.

3. Why is human geography an important part of geography. Explain with suitable explains.
4. Discuss the techniques of geographical studies.

ANSWER TO INTEXT QUESTIONS

1.1

1. Geography is largely the study of the interaction of all physical and human phenomena and landscapes created by such interactions.
2. Earth surface is changing because of the continuous interaction between the environment in which we live in and the way we use it.
3. (i) Mathematical tradition,

   (ii) Geographic information through travel and field work.

1.2

1. (i) Physical Geography, (ii) Biogeography,

   (iii) Human Geography and (iv) Geographical Methods and techniques.
2. (i) Regional studies, (ii) Regional analysis,

   (iii) Regional development and (iv) Regional planning.

1.3

1. (i) Physical (ii) Human
2. (i) Cartography (ii) Quantitive methods or (iii) Regional science method
3. It deals largely with racial phenomena in their spatial context.

HINTS TO TERMINAL QUESTIONS

1. (i) Refer to para one.

   (ii) Refer to 1.1

   (iii) Refer to 1.4

(iv) Refer to 1.2

(v) Refer to part A and B of 1.6

2. (i) Refer to 1.4

   (ii) Refer to 1.6 (A)

   (iii) Refer to 1.6 (B)

3. Refer to 1.6 (B)

4. Refer to 1.4

2

EARTH'S INTERIOR AND ITS MATERIAL

The earth is the only known planet with developed life in the universe. Like most of the celestial bodies, the earth is spherical in shape. You also know that hot water and molten lava eject out from the earth's interior. This indicates that the temperature below the earth's surface is very high. World's deepest mining is limited only to the depth of less than 5 kilometers. These activities can be explained by getting a better understanding of Earth's interior. As we know that the land features seldom retain any fixed form. Their shape is constantly changing. One group of exogenetic forces includes those which weaken and disintegrate the rocks at their original location. The second group consists of indogenetic forces which remove the disintegrated rocks from high lands and deposit them in the Low lands. These two processes have been responsible for disintegrating rocks and shaping new landforms. They are also partly responsible for the formation of soil, which is very important for us.

In this lesson, we will study about the earth's interior and the materials that form the upper portion of the earth's crust. You will also learn about, weathering and its types, the process of gradation and the significance and formation of soils.

OBJECTIVES

After studying this lesson, you will be able to:

- explain the limitations of direct observations of the earth's interior;
- compare the different layers of the earth's interior with reference to thickness, temperature, density and pressure;
- distinguish between rock and mineral;

- classify rocks according to their mode of formation;
- describe the economic significance of rocks;
- explain the term weathering and describe its types with suitable examples;
- explain the various gradational processes changing the face of the land;
- differentiate between degradation and aggradations;
- relate weathering with soil formation and
- explain the various factors contributing to soil formation;

2.1 EARTH'S INTERIOR

It is not possible to know about the earth's interior by direct observations because of its huge size and the changing nature of its internal composition. Through mining and drilling operations we have been able to observe the earth's interior directly only up to a depth of few kilometers. The rapid increase in temperature below the earth's surface is mainly responsible for setting a limit to direct observation inside the earth. The temperature in the earth's interior is so high that it can even melt any tool used for drilling. This fact also restricts deep drilling, thus causing hindrance to direct observation of the materials of the earth's interior.

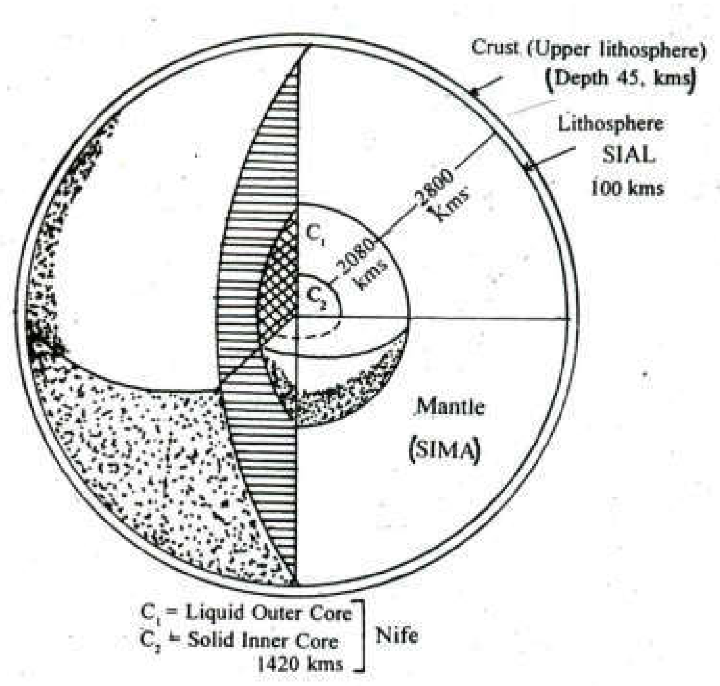


Fig. 2.1 Concentric Zones showing layers of the Earth's interior

The huge size of the earth and increasing temperature with depth has set a limit to direct observation of the earth's interior.

2.2 STRUCTURE OF THE EARTH'S INTERIOR

The above diagram (see fig. 2.1) shows the concentric layers of the earth's interior. The innermost layer surrounding the earth's centre is called core, which is about 3500 kms in radius. Core is the most dense layer of the earth with its density range from 9.5 to 14.5 and sometimes even higher. It is composed mainly of the iron and nickel thus commonly known as **Nife**. (Nickel+Ferrum). Core consists of two sub-layers. The inner one is solid (C_2 of fig. 2.1) and the outer one is semi-liquid (C_1 of fig. 2.1). The layer surrounding the core is known as mantle, a rock shell about 2900 kms thick and is composed of basic silicates. Major constituent elements of mantle are magnesium and silicon, hence, this layer is termed as **Sima** (Silica+Magnesium). The density of this layer varies from 3.3 to 5.7. Mantle is surrounded by the outermost layer of the earth, known as lithosphere and its density varies from 2.70 to 2.95. Major constituent elements of lithosphere are silica (Si) and aluminium (Al), thus this layer is termed as Sial (Silica+Aluminium). The outermost part of the lithosphere in known as crust, normally about 8 to 40 kms thick.

- Core, mantle and crust are the three main concentric layers of the earth's interior.
- Core is the innermost layer and has the highest density. It is made up mainly of nickel and iron.
- Mantle is the layer lying between the core and lithosphere. Its major constituents are silicon and magnesium.
- Crust is the outermost layer of the earth and is mainly composed of silicon and aluminium.

INTEXT QUESTIONS 2.1

1. Give the most important factor limiting direct observation of the earths interior to a few kilometers

   ____

2. Name the three layers of the earth's

   (a)________________(b) ________________(c) ________________

3. Name the innermost layer of the earth.

   ____

4. What is the density of the core?

   ____

5. Which layer includes the earth's crust?

6. Name the thinnest layer of the earth

2.3 TEMPERATURE, PRESSURE AND DENSITY OF THE EARTH'S INTERIOR

Temperature

Rise in temperature with increase in depth is observed in mines and deep wells. These evidences along with molten lava erupted from the earth's interior, support that temperature increases towards the centre of the earth. The different observations show that the rate of increase of temperature is not uniform from the surface towards the earth's centre.

It is faster at some places than at others. In the beginning this increase is at an average rate of 1^{0}C for every 32 metres increase in depth. At such a constant rate of increase in temperature, at 10 km depth, the temperature will be approximately 300^{0}C and at 40 km depth it will be 1200^{0}C. At this rate, earth's interior should be in a molten state. Yet it is not so because the rocks buried under the pressure of several km thickness of overlying rocks melt at higher temperature than similar rocks at the surface. A basaltic lava rock which melts at 1250^{0}C at the surface will melt at 1400^{0}C at 32 km depth. The extra heat required for melting is produced by radioactivity. It is the result of breakdown of atomic nuclei of minerals emitting radiant energy in the form of heat from the rocks. .

The behaviour of earthquake waves is another evidence for this phenomenon. They further confirm that the composition of different layers is as variable as is the rate of change of temperature. While in the upper 100 km, the increase in temperature is at the rate of 12°C per km, in the next 300 km it is 20°C per km but is only 10^{0}C per km below it. Thus the rate of increase of temperature beneath the surface decreases towards the centre. The temperature at the centre is estimated to lie somewhere between 3000°C and 5000^{0}C.Such a high temperature inside the earth may be due to chemical reactions under high pressure conditions and disintegration of radio active elements.

Pressure

The pressure also increases from the surface towards the centre of the earth due to huge weight of the overlying rocks. Therefore in deeper portions, the pressure is tremendously high. The pressure near the centre is considered to be 3 to 4 million times the pressure of atmosphere at sea level. At high temperature, the material beneath will melt towards the central part of the earth. This molten material under tremendous pressure conditions acquires the property of a solid and is probably in a plastic state.

Density

Due to increase in pressure and presence of heavier materials towards the earth's centers, the density of earth's layers also goes on increasing. Obviously the materials of the innermost part of the earth are very dense as already stated.

INTEXT QUESTIONS 2.2

1. What is the temperature at the centre of the earth?

   ____

2. How much is the pressure at the earth's centre?

   ____

3. Why does the density increase towards the centre of the earth?

   ____

2.4 MATERIALS OF THE EARTH'S CRUST

The outermost part of lithosphere is called crust. This is the most significant part of the earth because it is occupied by humans. The material of the crust is made up of rocks. The rocks are of different types. They are hard like granite, soft like clay and loose like gravel. Rocks have a great variety of colour, weight and hardness.

Rocks are composed of minerals. They are aggregates or physical mixture of one or more minerals. Minerals on the other hand are made up of two or more elements in a definite ratio. They have a definite chemical composition. Crust is made up of more than 2000 minerals, but out of these, 6 are the most abundant and contribute the maximum to this uppermost part of the earth. These are feldspar, quartz, pyroxenes, amphiboles, mica and olivine.

Granite is a rock and its constituent minerals bound together are quartz, feldspar and mica which make it a hard rock. Change in the ratio of these minerals give rise to granites of different colours and hardness. The minerals containing metals are called metallic minerals. Haematite, a major iron ore is a metallic mineral. Ores are metallic minerals which can be profitably mined. Rocks are of immense economic importance to us.

2.5 TYPES OF ROCKS

Rocks differ in their properties, size of particles and mode of formation. On the basis of mode of formation rocks may be grouped into three types:

(a) Igneous

(b) Sedimentary and

(c) Metamorphic

Igneous Rocks

The word igneous is derived from the Latin word 'ignis' meaning fire. Igneous rocks are formed by the cooling of highly heated molten fluid material, known as magma. The word magma is derived from a Greek word which means 'dough'. It requires a greater quantity of heat to melt the rocks under overlying pressure than at the surface. We do not know the exact depths at which magma forms but probably it is formed at different depths not exceeding 40 km. Molten rocks produce an increase in volume which is responsible for causing fractures or cracks in the crust. The overlying pressure gets weakened along these openings, thus forcing out the magma through them. Otherwise it can't escape due to great overlying pressure.

When magma is ejected to the surface, it is called lava. Igneous rocks are formed from solidified molten magma below or on the earth's surface. As they comprise the earth's first crust and all other rocks are derived from them, these are called the parent of all rocks or the 'primary rocks'. In simple words, all rocks can be described as of igneous origin because at one time or another, they were erupted to the surface: A younger series of igneous rocks is still being formed. About 95% of the volume of outermost 16 km of the earth is composed of them. These are largely hard and massive because of their magmatic origin and are crystalline in appearances.

On the basis of their mode of occurrence, igneous rocks can be classified as : extrusive or volcanic rocks and intrusive rocks.

(i) Extrusive igneous rocks are formed by cooling of lava on the earth's surface. As lava cools very rapidly on coming out of the hot interior of the earth, the mineral crystals forming these rocks are very fine. These rocks are also called volcanic rocks. Gabbro and basalt are very common examples of such rocks. These rocks are found in volcanic areas. Deccan plateau's regur soil in India is derived from lava.

(ii) Intrusive igneous rocks are formed when magma solidifies below the earth's surface. The rate of cooling below the earth' s surface is very slow which gives rise to formation of large crystals in the rocks. Deep seated intrusive rocks are termed as plutonic rocks and shallow depth intrusive rocks are termed as hypabyssal. Granite and dolerite are common examples of intrusive rocks. From this point of view, therefore, igneous rocks can, in accordance with their mode of formation, be classified as (a) Plutonic, (b) Hypabyssal and (c) Volcanic rockmasses. The huge blocks of coarse granitic rocks are found both in the Himalaya and the Decean Plateau.

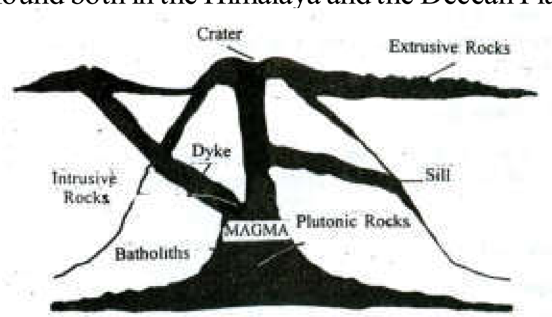


Fig. 2.2 Igneous Rocks

Let us look at the Fig. 2.2. It illustrates that magma, on cooling, produces rocks of different shapes and sizes, depending on the space available after it forces itself into the crust. Common forms of instrusive igneous rocks are batholiths, sills and dykes etc. Batholiths are huge masses of solidified magma. They vary in size; some are as much as several hundred kilometers across and thousands of kilometers thick. They generally form the core of the major mountains, as shown in this diagram. Their irregular dome shaped roofs sometimes appear on the surface after erosion of millions of years. *Sill* is the horizontal intrusion of solidified magma between the layers of pre-existing rocks. *Dyke* is similarly a more or less vertical formation from few metres to several kilometers in length and from few centimeter to hundreds of metres in thickness.

On the basis of chemical properties, igneous rocks are classified into acidic and basic rocks. These are formed as a result of solidification of acidic or basic lava. Acidic igneous rocks are composed of 65% or more of silica. These rocks are light coloured, hard and very strong. Granite is an example of an acidic rock. Basic igneous rocks contain less than 55% of silica and have more of iron and magnesium. These rocks are dark coloured and weak enough for weathering. Gabbro, basalt and dolerite are examples of basic rocks.

- Igneous rocks are formed by the solidification of hot molten material called magma or lava.
- Extrusive igneous rocks are formed by cooling of lava on the earth's surface e.g. basalt, gabbro.
- Instrusive igneous rocks are formed by solidification of magma below the earth's surface, e.g. granite.

INTEXT QUESTIONS 2.3

1. Define the term mineral.

   ____

2. Give the names of any three minerals which are found extensively on the earth's crust.

   ____

3. Give a term for each of the following

   (i) Deep seated intrusive igneous rock.

   ____

   (ii) A hot sticky molten materia1 erupted on the earth's surface.

   ____

4. How are dykes and sills formed?

   (i) ______________________________

   (ii) ______________________________

5. Tick (√) the correct answer

   (i) Igneous rocks are formed due to

   (a) cooling (b) heating (c) neither cooling nor heating

   (ii) Which one of the following is an example of intrusive igenous rock?

   (a) Granite (b) Basalt (c) Gabbro

   (iii) Primary rocks are the result of

   (a) sedimentation (b) solidification (c) metamorphism

Sedimentary Rocks

These rocks are formed by successive deposition of sediments. These sediments may be the debris eroded from any previously existing rock which may be igneous rock, metamorphic or old sedimentary rock. Sedimentary rocks have layered or stratified structure. The thickness of strata varies from few millimeters to several metres. So these rocks are also called stratified rocks. Generally, these rocks have some type of fossil between their strata. Fossil is the solid part or an impression of a prehistoric animal or plant embedded in strata of sedimentary rocks. Sedimentary rocks are widely spread on the earth surface but to a shallow depth.

The individual rock particles are first broken from rocks and then transported by running water, ocean currents, glaciers or even by wind from one place to another. The process by which rock forming material is laid down is called sedimentation or deposition. It may settle in calmer waters of lakes or oceans or at places where the transporting agent has no longer enough energy to carry them farther. These are identified as riverine, lacustrine (formed by lake), glacial or aeolian (formed by wind) sedimentary rocks with reference to their deposition near rivers, lakes, glacier or deserts respectively.

The sediments are often loose, unconsolidated, soft rock material, in the beginning like sand and clay, but in course of time they get hardened to a compact material by excessive pressure and cementation to form sedimentary rocks. The deposition of sediments in the beginning is generally horizontal but it may get tilted afterwards due to movements in the earth's crust. Sandstone, shale, limestone and dolomite are examples of sedimentary rocks.

Sediments get sorted by the transporting agents. Sediments of different sizes may get bound by cementing material under suitable conditions. Conglomerate is an example of such a sedimentary rock. This type of formation of consolidated material is termed as mechanically formed sedimentary rock. The consolidation of organic matter derived from plants and animals forms sedimentary rocks of organic origin. Coal and limestone are organic sedimentary rocks. The sediments may also result from chemical reaction. Direct precipitation of minerals from their solution in water may give rise to sedimentary rocks of chemical origin. Gypsum, rock salt and nitre are examples of such sedimentary rocks.

Huge folded mountains of the world like Himalayas, Andes etc. are made up of sedimentary rocks. All the alluvial deposits of the world are also due to sedimentary accumulations. All river basins, particularly their plains and deltas, e.g. Indo-Gangetic plain and Ganga-Brahmaputra delta are good examples of sedimentary accumulations.

- Sedimentary rocks are formed by the successive deposition of sediments.
- These rocks have layered structure, therefore they are also known as stratified rocks.
- Fossil is the solid part or an impression of a prehistoric animal or plant embedded in sedimentary rocks in which they are buried.

Metamorphic Rocks

Most rocks in mountainous regions show an evidence of change. All these in course of time become metamorphic or changed forms of rocks. Metamorphic rocks are formed under the influence of heat or pressure on sedimentary or igneous rocks. Tremendous pressure and high temperature change the colour, hardness, structure and composition of all types of pre-existing rocks. The process which bring about the change is known as Metamorphism and the ultimate products, formed due to operation of such processes are defined as the Metamrphic rocks.

Temperature, pressure stress and access of chemically reactive substances are the main agents, which are responsible for metamorphism. Heat causes the minerals to recrystallise in the rock. The process of change by heat is called thermal or contact metamorphism. When molten magma or lava comes in contact with surrounding rocks, it bakes them and changes them into metamorphic rocks. Similarly the formation of metamorphic rocks due to tremendous pressure is known as dynamic or regional metamorphism. Slate, gneiss, schist, marble and diamond are good examples of metamorphic rocks. Metamorphic rocks are hard and tough in comparison to the parent rocks from which they are formed. Examples of metamorphic rocks are given in the table 2.1 with their parent rock from which they have been formed.

Table 2.1

Parent Rock and its Metamorphic Changed Form

NAME OF THE ROCK	TYPE OF ROCK	NAME OF THE METAMORPHIC ROCK
Limestone	Sedimentary Rock	Marble
Dolomite	Sedimentary Rock	Marble
Sandstone	Sedimentary Rock	Quartzite
Shale	Sedimentary Rock	Slate
Slate	Metamorphic Rock	Phylite/Schist
Coal	Sedimentary Rock	Graphite/Diamond
Granite	Igneous Rock	Gneiss
Phyllite	Metamorphic Rock	Schist

Different types of metamorphic rocks are found all over the world. In India, marble is found in Rajasthan, Bihar and Madhya Pradesh, whereas slates are available in plenty in Orissa, Andhra Pradesh and Haryana. In Kangra and Kumaun regions of Himalaya, slates of different colours are found.

- Metamorphic rocks are formed by the effect of heat or pressure on sedimentary or igneous or even metamorphic rocks.
- Thermal metamorphism is the process by which a rock under-goes change as a result of great heat.
- Dynamic metamorphism is the modification of rock, by tremendous pressure during extensive earth movements.

2.6 ECONOMIC SIGNIFICANCE OF ROCKS

Man has been interacting with the surface of the earth since long. With time and advancement in technology he is making different uses of rocks and minerals. The importance of rocks is given below:

(a) **Soils:** Soils are derived from rocks. Soils provide suitability for that agricultural products that provide food for mention and provide raw material for many industries.

(b) **Building Material:** Rocks are the source of types of building material directly or indirectly. Granite, gneiss, sandstone, marble and slates are extensively used in the construction of buildings. Tajmahal is made of white marble, Red Forts of Delhi and Agra, are made of red sandstone. Slates are used for roof purposes in different parts of India.

(c) **Mineral Source:** Minerals are the foundation of the modern civilization. Metallic minerals provide all metals ranging from very precious gold, platinum, silver, copper to aluminium and iron. These metals are obtained from different rocks.

(d) Raw Material: Certain rocks and minerals are used as raw material for many industries. In cement industry and limestone kilns different type of rocks and minerals are used for production of finished goods. Graphite is used in crucible and pencil manufacturing as raw materials.

(e) Precious Stones: Precious stones and metals are obtained from different metamorphic or igneous rocks. Diamond is a precious stone used in jewelry and is a metamorphic rock. Similarly other precious stones like gems, rubies and sapphires are obtained from different type of rocks.

(f) Fuel: Fuel in the form of coal, petroleum, natural gas and nuclear minerals are derived from different rocks.

(g) Fertilizer: Fertilizers are also derived from some rocks. Phosphatic fertilizers are obtained from phosphorite mineral found in abundance in some parts of the world.

- Rocks and minerals are the main source of all metals, precious stones, solid fuel and raw materials for industries.

INTEXT QUESTIOS 2.4

1. What are rocks?

   ____

2. Classify rocks.

   ____

3. Give single term for each of the following

   (i) Process of the formation of metamorphic rock due to pressure.

   ____

   (ii) Rocks which contain strata.

   ____

   (iii) Rocks formed by the effect of heat or pressure on sedimentary or igneous rocks.

   ____

   (iv) Sedimentary rocks deposited in lakes

   ____

4. Tick (√) the correct answer;

   (i) Marble is

(a) a sedimentary rock (b) an igneous rock (c) a metamorphic rock (d) a plutonic rock

(ii) An example of sedimentary rock is

(a) granite (b) marble (c) sandstone (d) basalt

2.7 WHAT IS WEATHERING?

Weathering is the general term applied to the combined action of all processes that cause rock to disintegrate physically and decompose chemically because of exposure near the Earth's surface through the elements of weather. Among these elements temperature, rainfall, frost, fog and ice are the important ones. Weathering begins as soon as rocks come in contact with one or more than one elements of weather on the surface of the earth. In nature, generally both the disintegration and decomposition act together at the sametime and assist each other. We must remember that the weathered material (i.e. disintegrated and decomposed) lie in situ (i.e. at its original position). In this process no transportation or movement of material is involved other than its falling down under the force of gravity.

- Weathering is the process by which exposed rocks are disintegrated and decomposed in situ (i.e their original position).

2.8 TYPES OF WEATHERING

We can recognize three types of weathering?

1. Physical Weathering
2. Chemcial weathering
3. Biotic weathering

PHYSICAL WEATHERING

When the rocks are broken up into smaller fragments without any chemical change in their composition, it is called physical weathering. The term mechanical weathering is also used for physical weathering.

Physical weathering takes place in different ways in different types of areas. They have been explained here with examples.

(a) Block disintegration

We all know that the successive heating and cooling causes expansion and contraction of the rocks. In hot desert regions, day temperatures are very high while nights are very cold. This high diurnal range of temperature causes successive expansion and contraction of the rocks which tend to enlarge the joints. Finally the rocks disintegrate into smaller blocks. This process is known as block disintegration.

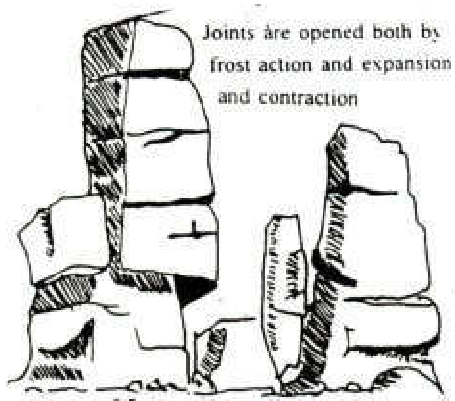


Fig. 2.3: Block Disintegration

(b) Exfoliation

Rocks are generally poor conductors of heat. As a result of intense heating the outer layers of the rock expand rapidly while the inner layers remain almost unaffected by heat. Due to successive expansion and contraction, the outer layer of the rock subsequently peels off from the main mass of the rock in the form of concentric shells. The peeling of rocks in layers by this process is very similar to the peeling of successive layers of an onion. The process is called exfoliation. Almost all rounded forms of dolerite blocks of rocks in Singhbhum district of Bihar are due to this process. Granite domes of Mahabalipuram, particularly *'Krishna Ka Laddu'* and those near Jabalpur on Madan Mahal Hill are good examples, of exfoliation.

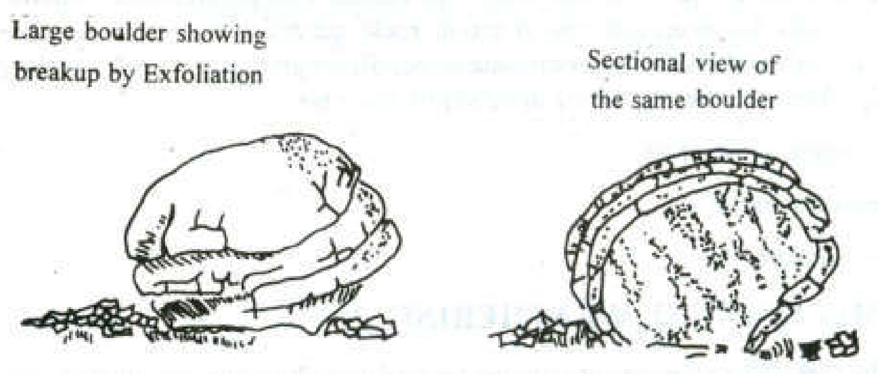


Fig 2.4 Peeling of Layer of the Rock

(c) Frost Action

One of the most important physical weathering processes in cold climates is frost action, the alternate freezing and melting of water inside the joints of the rocks, splits them into fragments. This is because conversion of water into ice increases the volume of water by 10 percent. In cold regions rocks are disintegrated into small particles through this process. It is called frost action.

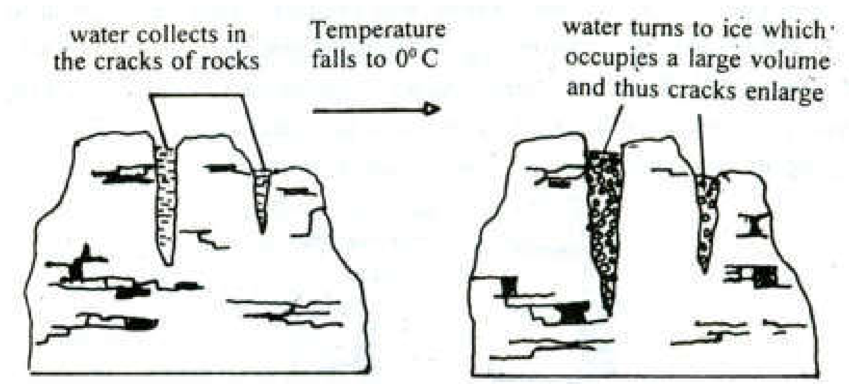


Fig 2.5 Frost Action

- disintegration of rocks into smaller fragments without any change in their chemical composition is called mechanical weathering.
- The rapid heating and cooling of the rocks creates a series of joints and cracks which lends to breaking up into smaller blocks. This process is known as block disintegration.
- A weathering process by which the outer layers of the rock peel out in concentric cells due to difference of temperature in the outer layers is called exfoliation.
- Breaking up of rocks due to freezing of water in the rock joints and cracks, in very cold regions, is called frost action.

INTEXT QUESTIONS 2.5

1. Name three types of weathering.

   (a) ________________ (b) ________________ (c) ________________

2. In which areas is mechanical weathering more pronounced?

   ____

3. Give appropriate technical terms for each of the following statements:

   (a) Peeling of successive layers of rocks like the layers of an onion

   ____

   (b) Widening of joints and cracks due to alternative freezing and melting of water in them

   ____

(c) Disintegration of rocks without any change in their chemical composition

____

CHEMICAL WEATHERING

Chemical change in the rocks through formation of new compounds or formation of new substances is called chemical weathering. Chemical processes include oxidation, hydrolysis, and acid solution.

- Decomposition of rocks by chemical processes with the help of water and atmospheric gases is called chemical weathering.

Chamical weathering involves four major processes:

(a) Oxidation

This is the process in which atmospheric oxygen reacts with the rock to produce oxides. The process is called oxidation. Greatest impact of this process is observed on ferrous minerals. Oxygen present in humid air reacts with iron grains in the rocks to form a yellow or red oxide of iron. This is called rusting of the iron. Rust decomposes rocks completely with passage of time.

(b) Carbonation

This is the process by which various types of carbonates are formed. Some of these carbonates are soluble in water. For example, when rain water containing carbon dioxide passes through pervious limestone rocks, the rock joints enlarge due to the action of carbonic acid. The joints enlarge in size and lime is removed in solution. This type of breakdown of rocks is called carbonation.

(c) Hydration

This is the process by which water is absorbed by the minerals of the rock. Due to the absorption of water by the rock, its volume increases and the grains lose their shape. Feldspar, for example, is changed into kaolin through hydration. Kaolin on Vindhyan Hills near Jabalpur has been formed in this manner.

(d) Solution

This is the process in which some of the minerals get dissolved in water. They are therefore removed in solution. Rock salt and gypsum are removed by this process.

- Chemical weathering involves the process of oxidation, carbonation, hydration-and solution.

INTEXT QUESTION 2.6

1. In which region is chemical weathering more effective?

   ____

2. Which process is involved when gypsum gets dissolved in water?

   ____

3. Which process of chemical weathering causes rusting of iron?

   ____

4. Which, chemical action is predominant in limestone region?

   ____

BIOTIC WEATHERING

Biotic weathering is carried out by plants, animals and man.

(a) Plants

Plants contribute to both mechanical and chemical weathering. The roots of the plants penetrate into the joints of the rocks. They grow longer and thicker. In this manner they exert pressure on the rocks and the rock joints are thereby enlarged and break into smaller fragments.

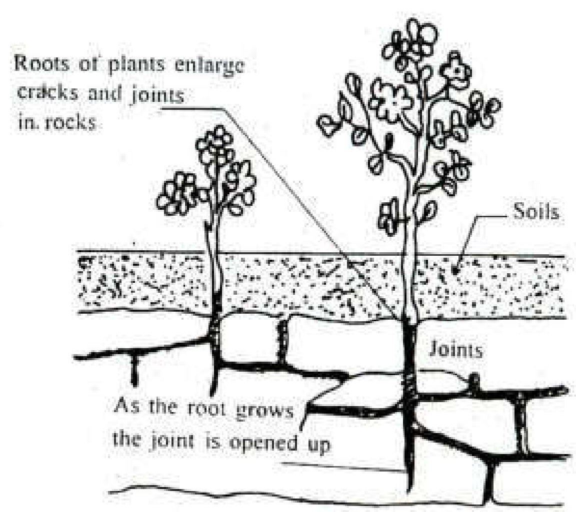


Fig. 2.6 Effect of Vegetation on Rocks

(b) Animals

Burrowing animals like earthworms, rats, rabbits, termites and ants break-down the rocks. These disintegrated rocks can easily be eroded or removed by wind etc. Hooves of animals break the soil and thus assist soil erosion. The role of earthworms and termites is of special significance. According to scientists, there is a possibility of occurrence of about 1,50,000 earthworms in an acre and they can convert 10 to 15 tonnes of rock mass into good soil and bring it to the surface.

(c) Man

Human beings play a very important role in weathering of various rocks. Man breaks a large amount of rocks in the course of his activities, like agriculture, construction of houses, roads etc. He quarries for mining minerals, thus helps in weathering by breaking, weakening and loosening the rocks.

- Biotic agents like plants, animals and man also contribute to physical and chemical weathering.

INTEXT QUESTIONS 2.7

1. Which important matter is formed by weathering?

   (a) ________________(b)________________(c)__________________

2. Where does humus in soils come from?

   ____

3. Give examples of two activities of man helping in weathering.

   (a) _________________(b)_________________(c)______________

2.9 WEATHERING AND SOIL

We have studied the process of weathering and have learnt how different types of land features are produced in areas of different types of climate through this process. Weathering also plays an important role in formation of soil which provides basis for agriculture and world's food supply.

Mechanical weathering of the surface rocks disintegrates the rock and converts it into a fine powder. These small particles are deposited in layers with the help of water. biotic weathering produces humus. This organic matter is formed through the action of plants and animals which helps in the formation of soil. Various processes of weathering help in giving different colours and properties of soil.

- The process of weathering contributes significantly to soil formation besides disintegrated of rocks.

2.10 GRADATION

Exogenetic forces are constantly working to bring about leveling or the gradation of land. They attempt to achieve a condition of balance between erosion and deposition which mean a graded position. The above forces operate through the process called the process of gradation. Agents of gradation like rivers, glaciers winds, sea waves and underground water perform their task with the help of the triple action of weathering, erosion and deposition. The leveling down of elevated portions of the earth's surface is done by erosion. The filling up of depressions is done by deposition of the eroded material transported by the external agents of gradation as spoken earlier.

We have studied that the endogenetic forces of the earth give rise to major landforms on the earth surface and the exogenetic forces level them down.

The work of gradation has two components (a) degradation and (b) aggradation.

(a) Degradation

When rocks are removed by scraping, scratching and cutting as a result of the process of erosion, thereby lowering the elevation of the land, it is called degradation. Degradation, first of all includes the work of weathering that is the movement of scarped and scratched material aided by the great force of gravity. It also includes the work of erosion implying the transportation of the rock material by an agent of gradation. The increase in the movement of rock- debris increases both its erosional and transportational capacities.

(b) Aggradation

Filling up of low-lying areas of depression by eroded material is called deposition. Deposition starts when the agents of gradation lose their force or have obstruction in their way. As a result eroded material is deposited in depressions which not only creates new landforms but also modifies the existing ones.

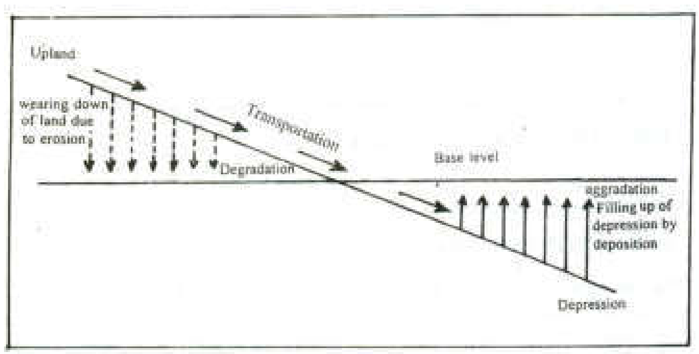


Fig. 2.7 Process of Gradation

Let us now look at the figure. It explains the total process of gradation and its two components-degradation and aggradation. It shows the elevated portions continuously being lowered by weathering and erosion. The debris consisting of the eroded material is transported and deposited in the low lying areas. The surface of the lower areas on the other hand is raised through deposition of this debris. Finally, the position of a uniform or near uniform level is achieved. The process of gradation is not performed by a single agent. It is rather a result of the work of all agents of gradation acting simultaneously. It is however possible for a single agent of gradation to be more active in particular area or at a particular time.

- Levelling and smoothening of land surface is called gradation includes both degradation and aggradation.
- The weathering of the land surface by erosion is called degradation and raising or filling up of depressions by deposition is called aggradation.

INTEXT QUESTIONS 2.8

1. Which process is involved in the levelling of the earth's surface?

   ____

2. Which two processes constitute gradation?

   (a)______________ (b)______________

3. Which term is used for raising or filling up of depressions by depositing?

   ____

4. What is degradation?

   ____

2.11 SOIL AND ITS FORMATION

Soil is the uppermost layer of the land surface that plants use and depend on for nutrients, water and physical support.

(A) FACTORS OF SOIL FORMATION

The five factors, which control the formation of soil are parent rock, relief, time, climate and plant and animal organisms. The former three are called the passive factors while the later two are the active factors. The parent material and climate are the most important because these two affect the other factors.

(a) Parent rock

A soil is derived from the underlying rock or the parent rock material containing different minerals. The parent rock gets broken into tiny pieces and is decomposed slowly by physical and, chemical weathering. It furnishes inorganic mineral particles of the soil. The parent rock also influences the rate of soil formation, the chemical composition, colour, texture, structure, mineral content and fertility.

(b) Relief

Topography of an area affects the degree of erosion of the parent rock material and the rate of surface run off of water. thus, the relief affects directly and indirectly the processes involved in soil formation. Steep slopes are subjected to more rapid run-off of surface water than the gentle slopes. Therefore, there is less infiltration of water on steeper slopes, which retards soil forming processes. In addition, rapid run-off on steep slopes often erodes their surface faster than soil can develop. It is because of this that the mountainous topography develops coarse, thin and infertile soil and the plain areas have rich well developed fertile soils.

(c) Time

The soil forming process is very slow. A well developed soil results as an end product of physical, chemical and biological processes operating collectively for a very long period of time.

(d) Climate

It is by far the most important factor in the sense that over a long period of time it not only tends to reduce the difference caused by the parent material but also influences biological activities within the soil. Due to this factor two different parent materials may develop the same type of soil in one type of climatic region. For example, granite and sandstone have developed into sandy soil in dry Rajasthan desert. On the other hand, two different types of soils may develop from the same parent material in two climatic regions. For example, the crystalline granites have developed laterite soils in monsoon regions and non laterite soils in sub humid regions.

The process of weathering, its effectiveness and the type of plant and animal organisms in a region are directly linked with the seasonal change of temperature and distribution and nature of precipitation. Hence, climate plays an important role in soil forming processes.

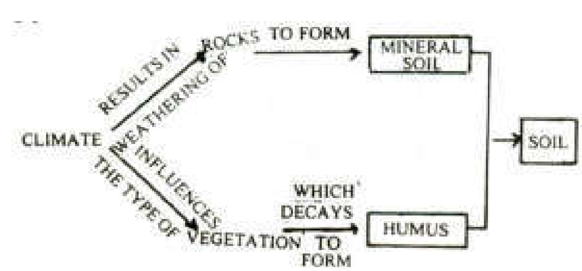


Fig. 2.8 Factors of Soil Formation

(e) Plant and Animal Organisms

Plants and animals play an active role in transforming parent materials into a mature soil. Dead plants and animals contribute to the organic content of the soil. The process of decay, added by bacterial action, transforms organic matter into humus. Humus is responsible for the fertility of the soil. It also enhances water retention capacity of the soil. This organic material helps the soil to support plant life. The plant cover in turn protects rich upper layer of the soil from erosion by increasing the proportion of rainfall entering into the soil rather than running off the surface. It also prevents greater evaporation of soil moisture by its thick canopy, thus allowing soil to mature and become fertile.

- The climate, plant and animal organisms are the active factors of soil formation.
- The parent material, relief and time are the passive factors of soil formation.

(B) SOIL HORIZONS

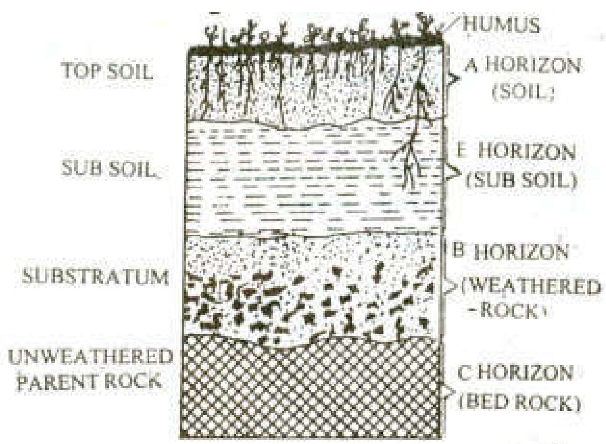


Fig. 2.9: Soil Horizons and Bedrock

A layer of soil which lies more or less parallel to the surface and has fairly distinctive soil properties is known as soil horizon. Soil horizons are distinctive layers found in soils that differ in physical or chemical composition, organic content or structure. The display of horizons on a cross section through the soil is termed as soil profile.

Let's review briefly the main types of horizons and their characteristics.

Four main horizons are important - A,E,B and C. The A horizon is the upper most horizon and rich in organic matter. Next is the E horizon. Clay particles and oxides of aluminum and iron are removed from the E horizon by downward seeping water, leaving behind pure grains of sand or coarse silt. The B horizon receives the clay particles, aluminum and iron oxides, as well as organic matter washed down from the A and E horizons. Beneath the B horizon is the C horizon, which is not considered part of the soil. If consists of the parent mineral matter of the soil.

- Soil profile is the arrangement of the soil into layer like horizons which are physically, chemically and biologically different from each other.

INTEXT QUESTIONS 2.9

1. Name two active factors of soil formation.

   (a)____________________________(b)_________________________.

2. Name the three passive factors of soil formation.

   (a)_________________(b)_______________(c)_________________.

3. Fill in the blanks with appropriate word given in the blanks below: (organic material, inorganic mineral particles, biological activities).

   (a) The parent material provides _________ within the soil.

   (b) The climate of a region influence __________ within the soil.

4. Give the Geographical term for each of the following.

   (a) The dynamic, upper layer of earth's crust composed of solid liquid and gaseous substances.

   (b) A vertical arrangement of different layers of soils.

   (c) The horizon of soil rich in humus.

   (d) The horizon of soil ,that accumulates soil colloids.

2.12 SOIL EROSION

The removal of soil at a greater rate than its replacement by natural agencies (water, wind etc.) is known as soil erosion.

(a) Type of Soil Erosion

Soil erosion is of four types: wind erosion, sheet erosion, rill erosion and gully erosion.

(i) Wind Erosion

Winds carry away vast quantity of fine soil particles and sand from deserts and spread it over adjoining cultivated land and thus destroy their fertility. This type of erosion is known as wind erosion. It takes place in and around all desert regions of the world. In India, over one lakh kilometers of land is under Thar Desert, spread over parts of Gujarat, Haryana, Punjab and Rajasthan states. These areas are subject to intense wind erosion.

(ii) Sheet Erosion

Water when moves as a sheet takes away thin layers of soil. This type of erosion is called sheet erosion. Such type of erosion is most common along the river beds and areas affected by floods. In the long run, the soil is completely exhausted due to removal of top soil and becomes infertile.

(iii) Rill Erosion

The removal of surface material usually soil, by the action of running water. The processes create numerous tiny channels (rills) a few centimeters in depth, most of which carry water only during storms.

(iv) Gully Erosion

When water moves as a channel down the slope, it scoops out the soil and forms gullies which gradually multiply and in the long run spread over a wide area. This type of erosion is called gully erosion. The land thus dissected is called bad lands or ravines. In our country, the two rivers Chambal and Yamuna are famous for their ravines in U.P. and M.P. states.

The controlling factors in the last two types of erosion are the velocity and amount of surface run off, the erodability of the soil, nature of slope, the texture and structure of the soil, nature of precipitation and vegetation cover. The speed and frequency of winds or dust storms and vegetation cover are the controlling factors in wind erosion. Seawaves are responsible for eroding soils along the coasts formed by weak rocks such as limestone etc. This type of erosion is wide spread along Kerala coasts. Substantial soil erosion is also caused by changing river channels and snowfall specially in river basins and hilly regions.

- The removal of soil material naturally or by human action is called soil erosion.
- Soil erosion is of four types : wind erosion, sheet erosion, rill erosion, gully erosion.
- Factors influencing soil erosion are velocity and amount of surface run off, nature of slope, texture and structure of soils and frequency and speed of winds.

2.13 SOIL CONSERVATION

Soil is one of the most important natural resources, which sustains different types of lives directly or indirectly. Moreover, soil forming is a slow natural process. The process of soil erosion not only destroys this wonderful gift of nature in a shorter span of time, It creates new problems like floods, damage to roads and rail bridges, hydro electric projects, water supply and pumping stations.

Soil conservation constitutes those methods which prevent soil from being removed. The methods to control soil erosion of different types in different parts of the world are as under:

(a) **Protection of forests :** Indiscriminate felling of trees in the forests has been one of the major causes of soil erosion. Since roots of the trees hold the soil material together, it is desirable to protect these trees from such felling. This has led governments to declare forests as reserved in which felling of trees has been banned. This method of soil conservation is most suited to all types of landscapes. Forests are also harbinger of rain which increases the process of soil formation.

(b) **Afforestation :** Planting of trees along river courses, waste lands and mountainous slopes is another method of soil conservation. It reduces excessive erosion taking place in these regions. Afforestation is also effective in controlling wind erosion along the desert regions. Tree plantation along desert boundary stops swallowing of agriculture land by desert sands. In our country large scale planting of trees is being carried out in Rajasthan, Haryana, Gujrat and Punjab to control the extension of Thar Desert.

(c) **Flood Control :** During rainy season, the amount of water in rivers, increases exceedingly which in turn increases soil erosion. Dams are being constructed to control floods and consequently the soil erosion. This can also be done by diverting river water to dry regions through canals and by other well planned methods of water conservation.

(d) **Planned Grazing :** Over grazing on hill slopes has helped loosening and washing away of soils in these areas. If grazing is carried out in a planned way it will reduce soil erosion by protecting vegetation cover in these areas which are comparatively more prone to soil erosion.

(e) **Bunding:** Construction of bunds or obstruction is applied in lands affected by gully erosion. This method is not only helpful in controlling soil erosion but also in maintaining soil fertility, conserving water resources and levelling of sloping lands.

(f) **Terracing:** To conserve poorly developed thin soils on mountain slopes, terracing is another method. Terracing refers to the construction of terraces across the slope in a mountainous region. This helps in controlling soil erosion and using water resources of these areas economically and effectively for growing different crops on these terraces.

(g) **Contour Ploughing :** This method of soil conservation is most suited to areas having rolling landscape. Ploughing and tilling of land along the contour levels in order to cause furrows to run across the landslope reduces the rate of soil erosion. This method is also applied to maintain the fertility and soil moisture.

(h) Adoption of Strip Farming: This method is most suited in rolling plains and regions situated in arid and semiarid regions. Field are divided into strips and the fanning in one year is done on one strip while the other strip is left uncultivated. The grassy vegetation cover of the left strip controls soil erosion and maintains fertility of soils. Next year, the process is reversed.

(i) Crop Rotation: Crop rotation refers to a systematic succession of different crops cultivated in a given piece of land in order to avoid exhaustion of the soil. Thus, rotation of crops is applied to conserve the fertility of soil from over cultivation of growing continuous crops from where population pressure is more on limited agricultural lands. This method is applied in most of the countries of the world.

(j) Reclamation of Lands: Soil erosion is also being controlled by levelling lands gullied down by water channels and converted in to waste lands or ravines. This methods of soil conservation is most suited in river basins and hilly terrains. Vast areas have been levelled in Chambal and Yamuna ravines, in our country.

- Soil conservation methods include protection of forests, afforestation, bunding, reclamation of lands; controlling floods, over grazing; terracing, strip farming, contour ploughing and crop rotation.

INTEXT QUESTIONS 2.10

1. Fill in the blanks with the appropriate words given in the brackets:

   (a) The complete removal of soil cover is known as ________________ (Gullying, wind, sheet erosion)

   (b) ________________ is the best suited method of soil conservation in desert outskirts, (strip farming, afforestation, bunding)

   (c) Sheet erosion is mostly caused by ________________ (foods, rains, deforestation).

2. Give the geographical term for each of the following:

   (a) Removal of soil material naturally or by man's action.

   (b) Removal of soil by water channel.

   (c) Planting of trees in deforested lands.

   (d) Removal of soil by dust storms.

   (e) Tilling of land along the contour levels.

WHAT YOU HAVE LEARNT

Earth is a spherical body. The direct observations into its interior are limited to a depth of a few kilometers. Temperature, pressure and density increase from the earth's surface to its centre. Earth's interior is divided into three concentric layers; Crust, mantle and core. Crust is the thinnest and outermost layer, mantle middle one whereas core is the innermost and the most dense layer of the earth. The material of the crust is composed of rocks. Rock is composed of one or more minerals. Minerals have a definite chemical composition. On the basis of their mode of formation, rocks are classified into three types - igneous, sedimentary and metamorphic. Igneous rocks are formed by the solidification of molten lava or magma. Granite, basalt and gabbro are examples of igneous rocks. Molten material solidified beneath the earth's surface to form intrusive and above the earth surface to form extrusive igneous rocks. Sedimentary rocks are formed by the consolidation of sediments. These are layered and may contain fossils. Shale, limestone and sandstone which are examples of sedimentary rocks. Metamorphic rocks are formed by the effect of heat or pressure on any pre-existing rock. Rocks are of immense use to us. They provide precious metals and stones, building material and fuel etc. for our use.

Landforms undergo a constant change. The exogenetic forces act upon them to make the surface level.

The rocks undergo various types of changes in their own location under the process of weathering. The rocks become weak due to the impact of the weather elements - temperature, moisture, frost etc. They develop cracks and disintegrate into small boulders, pebbles or fine fragments. This is called mechanical weathering. This type of weathering is more pronounced in areas of hot and dry or very cold climates. Rock minerals undergo chemical changes due to the effect of water and gases as a result of oxidation, carbonation, hydration and solution. This is called chemical weathering. This type of weathering is more important in areas of warm and humid climates. Plants, animals, insects and men are the agents of biotic weathering and they contribute to both mechanical and chemical weathering.

Soil is a natural resource of unestimated value to man as he gets his food, clothing and other things directly or indirectly from it. Soil is a thin layer of loose inorganic and decayed organic matter covering the earth's surface. Differente factors such as parent materials, climate, plants and animal organism, water and time along with processes such as mechanical, chemical and biological are responsible in making this valuable resource. Mature soils develop a profile which constitutes four horizons, each having different characteristics.

Soil erosion is a natural process of destruction and removal of soil material from its place. Running water, winds, sea waves and glaciers are the most active agents of erosion. Erosion of soils takes place in four ways viz., wind erosion, sheet erosion, rill erosion and gully erosion. Removal of soil cover depends on velocity and speed of water, nature of slope, texture and structure of soils, frequency of dust storms and nature of precipitation. Man through his misdeeds, has also helped natural forces in increasing the problem of soil erosion. Methods to prevent soils from being eroded constitute soil conservation. These methods are protection of forests, afforestation, contour ploughing, terrace and strip farming, bunding, flood control, etc.

TERMINAL QUESTIONS

1. What are the limitations of direct methods in the determination of the earth's interior?
2. Draw and label a diagram showing earth's interior and its density and depth of each layer.
3. Distinguish between a rock and a mineral with suitable examples.
4. Discuss the classification of various types of rocks on the basis of their mode of formation. Support your answer with examples.
5. Explain in brief the economic significance of rocks and minerals.
6. Compare the processes of formation of metamorphic and sedimentary rocks.
7. What is weathering? Name the different types of weathering.
8. How does chemical weathering take place?
9. Differentiate between
   (a) Disintegration and Decomposition
   (b) Degradation and Aggradation
   (c) Oxidation and Solution
10. Explain the process of gradation.
11. How does man become an important agent of weathering?
12. Explain the following processes of weathering by drawing simple diagrams:
    (a) Block disintegration
    (b) Frost action
    (c) By plant action
13. Give a brief account of soil profile. Illustrate your answers with a diagram.
14. Discuss various factors responsible for soil formation.

16. What is soil erosion ? Explain the different ways in which soil is eroded. Discuss the various methods being used to conserve soil.

ANSWER TO INTEXT QUESTIONS

2.1

1. Rapid increase of temperature below the earth's surface
2. (a) Lithosphere (b) Mantle (c) Core
3. Core or Nife
4. More than 11.0
5. Lithosphere
6. Lithosphere

2.2

1. 3000^0C to 5000^0C
2. 3 to 4 million times the atmospheric pressure at sea level.
3. Due to immense pressure of overlying rocks and the presence of heavier materials.

2.3

1. Mineral is a naturally occurring inorganic substance which posseses physical properties and has a definite chemical composition. 2. Feldspar /Quartz/ Pyroxenes/Amphiboles/Mica/Olivine 3. (i) Plutonic rocks (ii) Lava 4. (i) When the magma cools in their sheets in vertical fractures within the earth's crust dykes are formed and (ii) when it solidifies in horizontal starta it is called a sill. 5. (i) cooling (ii) Granite (iii) Solidification

2.4

1. Rocks are aggregates of Minerals and are the individual units constituting the crust of the earth. 2. Igneous, Sedimentary and Metamorphic rocks. 3. (i) Dynamic metamorphism (ii) Sedimentary rocks/Stratified rocks (iii) Metamorphic rocks. (iv) Lacustrine 4. (i) a metamorphic rock (ii) Sandstone.

2.5

1. (a) Physical weathering (b) Chemicals weathering (c) Biotic weathering.
2. In dry and very cold regions.
3. (a) Exfoliation (b) Frost action (c) Physical weathering.

2.6

1. In warm and humid regions.
2. Solution

3. Oxidation
4. Carbonation

2.7

1. (a) Plants (b) Animals (c) Man.
2. The cracks in rocks are widened and the rocks are broken.
3. (a) Agriculture (b) Mining

2.8

1. Gradation
2. (a) Degradation or lowering down of raised surfaces.
   (b) Aggradation or raising up of low lying areas.
3. Aggradation.
4. Lowering down of raised portions through erosion of material.

2.9

1. (a) Climate (b) Plant and animal organisms
2. (a) Parent rock (b) relief or topography (c) Time
3. (a) Inorganic mineral particles (b) Biological activities
4. (a) Soil (b) Soil profile
   (c) Top soil (d) zone of weathered parent rock

2.10

1. (a) Sheet erosion (b) Afforestation (c) Floods
2. (a) Soil profile (b) Gully erosion
   (c) Afforestation (d) Wind erosion
   (d) Contour ploughing

HINTS TO TERMINAL QUESTIONS

1. The rapid increase of temperature below the earth's surface. Mining activity restricted to few kilometres. High temperature melts drilling tools.
2. See Fig. 2.1 - Concentric zone showing layers of Earth's interior.
3. Rock is the solid part of the crust composed of minerals. They are aggregates or physical mixture of one or more minerals for e.g. granite. Minerals are inorganic substances made up of one or more elements in a definite ratio, e.g. feldspar. Change in the ratio of minerals gives rise to different rocks.
4. Igneous rocks, sedimentary rocks and metamorphic rocks (give definition of each with examples of each type of rock).
5. See economic significance of rock (para 2.6)

6. Sedimentary rocks are formed due to weathering, erosion and deposition of rock fragments of older rocks which become hard due to compaction, chemical changes or cementation of organic matter, whereas metamorphic rocks are formed due to the pressure and high temperature of the magma when it comes in contact with both igneous and sedimentary rocks.

7. Weathering is a process by which rocks are disintegrated and decomposed in situ. See para 2.7.

8. See para 2.8 under "Chemical weathering".

9. (a) disintegration of rock of physical breaking up or shattering of rock under the influence of temperature or frost action. Decomposition is due to chemical change by which rock minerals break up or get dissolved. Give example of each type.

   (b) See para 2.10 (a) and (b)

   (c) See para 2.8 (a) and (d) under "Chemical Weathering".

10. See para 2.10 (a) and (b) and Fig. 2.7

11. See para 2.8 (c) biotic weathering.

12. See Fig. 2.3, 2.5 and 2.6.

13. Points to be discussed in detail include:

    Meaning of soil profile-refer to 2.11 Section B. Answer is to be illustrated with the help of Fig. 2.9.

14. Points to be elaborated - parent rock, relief, time, climate and plant and animal organism (Active and non-active factors) Importance of each of these points should be highlighted (Refer 2.11 Section A).

15. Soil erosion refer 2.12 Section

    Types of soil erosion - wind erosion, sheet erosion, gully erosion (Refer 2.15 Section)

    Methods to conserve soils - Protection of forests, afforestation, flood control, planned grazing, reclamation of lands, bunding, terracing, contour ploughing, strip farming, crop rotation (Refer to 2.13 Section).

3

DYNAMIC SURFACE OF THE EARTH

In the previous lesson, we have learnt that the interior of the earth is very hot. Earthquakes and volcanoes are concentrated along a few narrow belts. The type and density of rocks of the crust are variable. The surface features are dynamic in character. This dynamism is due to two forces — endogenetic and exogenetic. Endogenetic forces are those which are caused from below the surface. Due to this, an area may get elevated or gets submerged. These forces try to make the surface irregular while exogenetic froces are those which operate from above the surface. They try to eliminate the irregularities of the surface through the process of denudation about which we will be reading in lesson. In this lesson we will be studying about the endogenetic forces.

OBJECTIVES

After studying this lesson, you will be able to :

- define isostasy;
- describe the variation in relief features on the earth's surface;
- explain the isostatic adjustment by various experiments;
- explain the views of Airy and Pratt and distinguish between the ideas of both;
- explain the concept of continental drift;
- enumerate the evidences of continental drift;
- explain the concept of plate tectonics;
- identify and locate different plates on the world map;

- explain the mechanism of plate movement;
- identify various plate boundaries and associated features;
- explain the distribution of land and water on the globe and
- associate earthquakes and volcanoes with plate boundaries.

3.1 CONCEPT OF ISOSTASY

The term "Isostasy" is derived from "Isostasios", a word of Greek language meaning the state of being in balance. You already know and must have seen that the mountain have many peaks and relatively great heights. Similarly plateau and plain have flat surfaces. They have moderate and lower height, respectively. On the contrary oceanic beds and trenches have greater depths. There is a great difference in height among these features. You also know that the earth is rotating while keeping perfect balance among its various features. Thus, our earth is considered to be in isostatic equilibrium.

Example:- Suppose you are holding one stick each in your both hands vertically with varying heights, say 5' and 15' and you are moving in a particular direction. Do you have any difficulty in maintaining a balance in congruence with your body as well as two sticks together? Definitely, smaller stick will be easy to make a balance than the longer one. It is just because of the centre of gravity. The centre of gravity with smaller stick will be nearer to your holding hand in comparasion to the longer stick. In the same way smaller surface features like plains are more stable than the tall mountains.

A. Isosatic Balance: views of Airy

Airy, a geologist, considered the density of different columns (plains, plateaus, mountains, etc.) to be the same. Hence, he proposed the idea of **'uniform density with varying thickness'**. We know that the upper crust of the earth is made up of lighter material. In this layer, silica and aluminium are found in abundance, hence it is known as 'Sial'. It is less denser than the lower one. Airy assumed that the Sialic crust is floating over the Sima (silica and magnesium, lower denser layer). Crustal layer is uniform in terms of density with varying length of columns. Therefore, those columns are projecting down into the asthenosphere depending upon the proportions of the column. It is due to this reason that the root has developed or the sima has been displaced from below.

To prove this concept, Airy took an example of wooden blocks of various sizes and immersed them into water (Figure 3.1). All blocks are of same density. They get immersed differently in proportion to their sizes. In the same way higher features with great height seen on the surface of the earth have deeper roots whereas short in length has shorter roots beneath. It is the concept of root which is sustaining the higher elevation. He is of the openion that the landmasses are floating like a boat in the substratum (magmatic asthenosphere). According to this concept, the root beneath the Mt. Everest would be 8848X8 = 70784 metre below the sea level. On this bases Airy has been criticized that the root is not possible to be at such a great depth. Because the root material will melt due to higher temperature found at that depth.

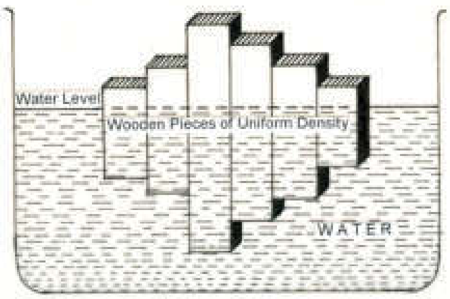


Fig. 3.1(a) :Illustration of the concept of Airy on isostasy

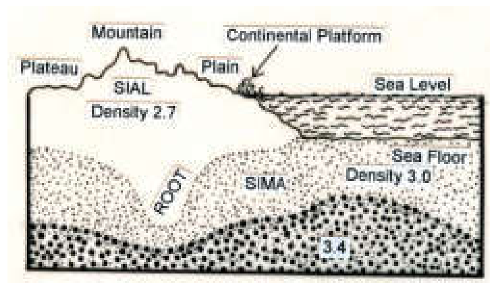


Fig. 3.1(b) : Condition of Isostary (based on A. Holmes and D.L. Holmes)

B. Isostatic Balance: views of Pratt

Pratt considered landblocks of various heights to be different in terms of their density. The taller landmass has lesser density and smaller height features to be denser. In other words, there is an inverse relationship between height and density. If there is a higher column, density will be lesser and if there is a shorter column, density will be higher. Assuming this to be true, he accepted that all blocks of different height get compensated at a certain depth into the substratum. In this way a line is being demarcated above which there is equal pressure with varying heights. Thus, he denounced the root concept of Airy and accepted the 'concept of a level of compensation'. For proving his concept he took a number of metal bars of varying density with same weight and put them into mercury (Figure 3.2). In this way they form a line by all those bars, which he regarded to be the level of compensation.

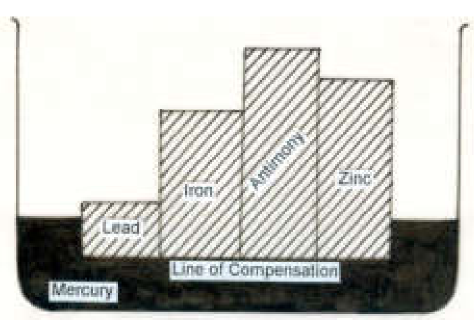


Fig. 3.2a Experiment of the concept of Pratt on Isostasy.

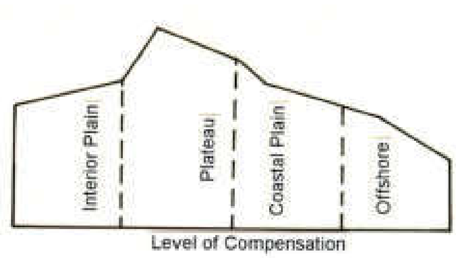


Fig. 3.2b. Illustration of Lithospheric block being compensated

Differences between the views of Airy and Pratt

The differences between the views of Airy and Pratt can more clearly be presented in a tabular form:-

	Views of Airy	Views of Pratt
1.	Uniform density of crustal material.	Varying density of crustal material.
2.	Varying depth upto which root penetrates.	Uniform depth upto which crustal material reaches.
3.	Deeper root below the mountain and smaller beneath plain. (Figure 3.1)	No root formation, but a level of Compensation. (Figure 3.2)

C. Global Isostatic Adjustment

It is quite apparent that there is no complete isostatic balance over the globe. The earth is unstable. Endogenetic forces often disturb the crustal balance. The regular earthquakes and volcanic eruptions along a particular belt do not signify any balance but a sort of adjustment is needed continuously. Endogenetic forces and their tectonic effects are the causes of imbalance on the surface but nature always tries to make an isostatic adjustment with itself.

Exogenetic forces are trying to eliminate the differences on the surface of the earth and in this process they are peeling off, transporting down to far flung places, and depositing them. In this process, isostatic balance is maintained by the underneath flowage of material by subsidence at the place of deposition and upliftment at the peeling of place in their proportion to the denudation (Figure 3.3).

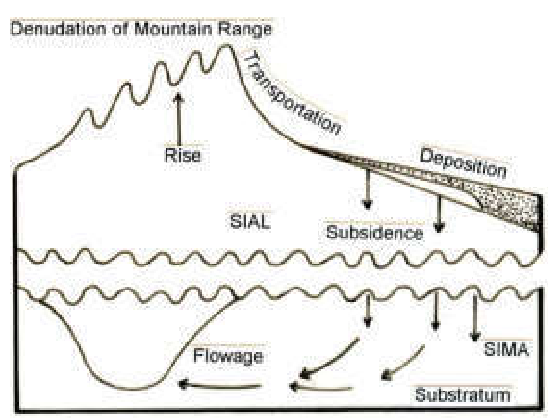


Fig. 3.3 : Mechanism of isostatic adjustment

INTEXT QUESTIONS 3.1

Fill in the blanks:-

1. Isostasy means _____________.

2. Airy considered the density of different columns to be ____________.

3. Pratt considered landblocks of various height to be different in terms of their __________.

4. According to Airy there is __________ root below the mountain and _______ beneath plain.

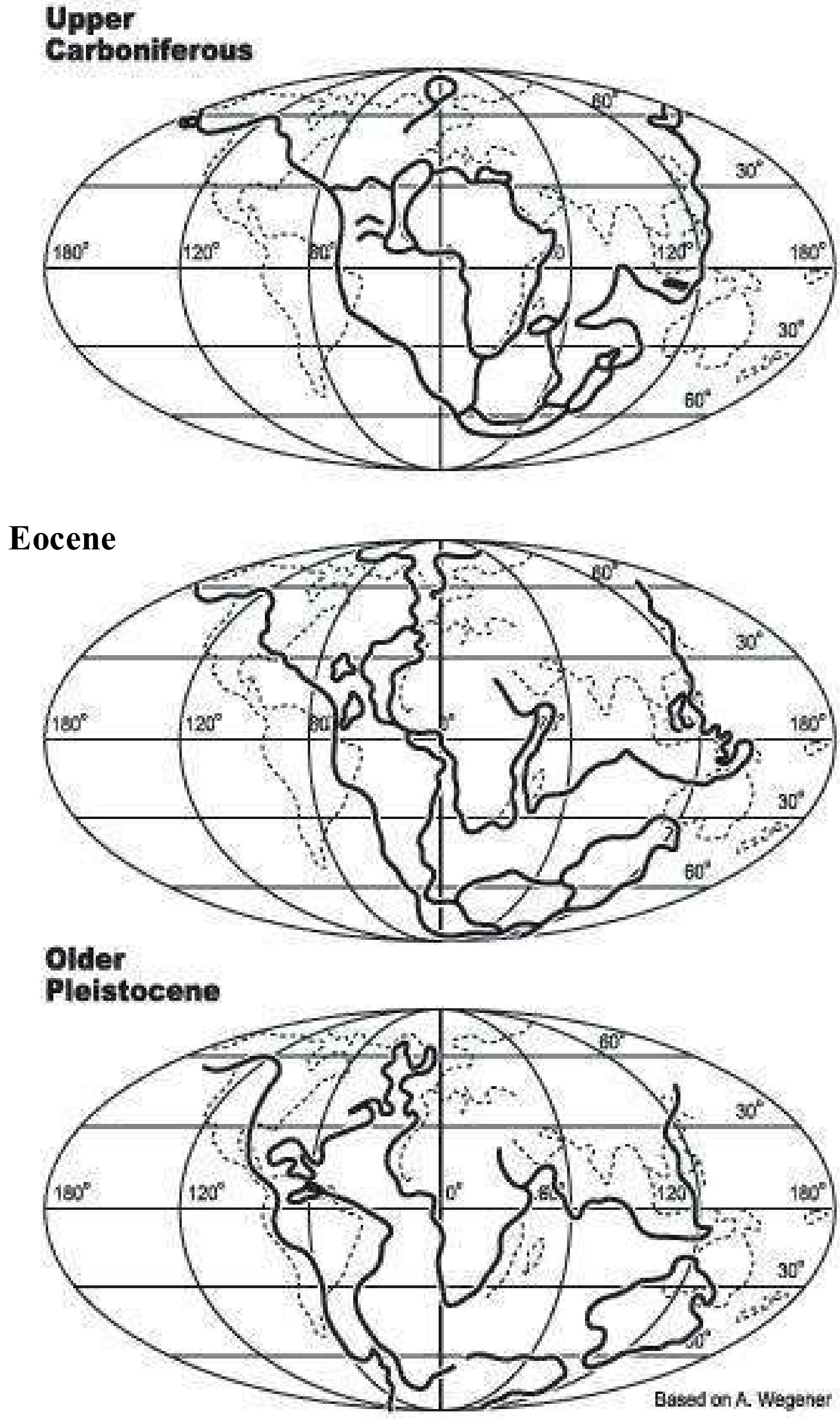
5. Pratt postulated the concept of ________ root formation but a __________ of compensation.

6. Endogenetic forces often __________ the crustal balance.

7. Regular earthquakes and volcanic eruptions along a particular belt does not signify ___________________ but a sort of continuous___________ _________.

3.2 CONTINENTAL DRIFT

According to Alfred Wegener, the entire landmass of the globe was together about 280 million years ago. It was termed as Pangea, a super continent. The huge water body surrounding the Pangea was known as Panthalasa. From 280 to 150 million years ago, Pangea was broken latitudinally into northern and southern parts known as Laurasia (Angaraland) and Gondwanaland, respectively. Both of them drifted away and in between a shallow sea emerged by filling up the water from Panthalasa. It was known as Tethys sea. Later on Laurasia and Gondwanaland rifted and finally drifted to form the present day distribution of land and water on the earth (Figure 3.4).



Pangea

Fig. 3.4 Pangea

Evidences of Drift

Wegener gave a number of evidences in support of the unification of land-mass in geologic past. They are such which cannot be negated even today.

a. Jig-saw-fit:- Eastern coast of South America is identical to Western coast of Africa which fits to a certain depth in the ocean. To a certain extent coastal areas and continental shelves have been modified by oceanic waves through denudation (Figure 3.5)

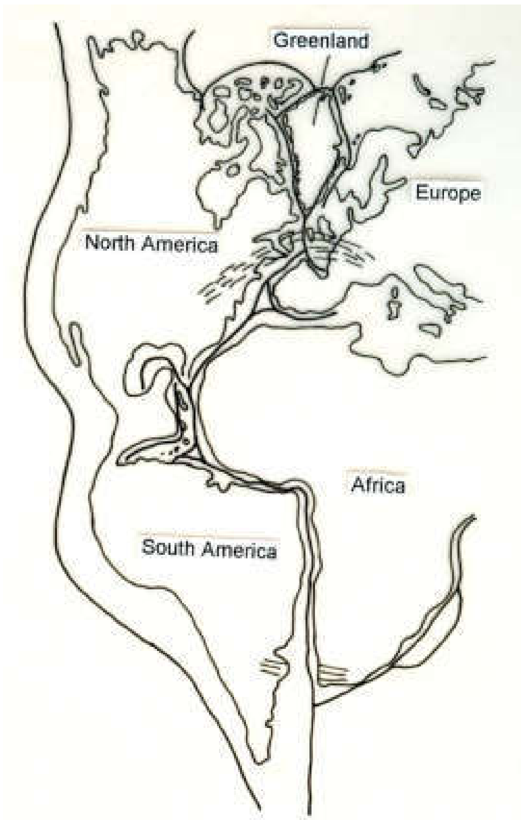


Fig. 3.5 Wegners map of continental drift-Fitting of the continents bording the Atlantic Ocean

b. Geological similarities:- The mountain systems of Southern Atalantic coast in South America and Africa show the similarity of the extension in both continents.

c. Coal and Vegetation evidences:- The distribution of coal and vegetation over South America, Africa, India and Australia proves that they were together in geological past. The classical glacial deposits during carboniferous period over these landmasses resemble each other which tells the story of togetherness. Today they lie in different climatic zones.

Apart from above evidences put forward by Wegener, other evidences (known later) are also there which support the idea of continental drift.

d. **Evidences from paleomagnetism :–** Paleomagnetism is the study of the direction of pole through ages. Magnetically susceptible minerals like haematite, pyrhotite magnetite etc. get aligned with the magnetic pole of the earth and recorded in the solidification of magma during that time. It is found that periodic changes have occurred and poles have wandered which is not possible for the entire earth. Hence, it is the twist and turn of the landblock and not for the entire earth which has again explained that the continents have shifted their positions.

e. **Sea floor spreading :–** Along the mid Atlantic ridge, magma comes out at the sea bed and gets solidified. A new zone is formed and this process is continuing since millions of years. It is leading for diversion of continental block, and hence the size of the Atlantic ocean is increasing which is termed as sea floor spreading. It is the classical example of the shifting of continents. The explanation of continental drift through sea floor spreading and the study of paleomagnetism is commonly known as Plate Tectonics. (Figure 3.6)

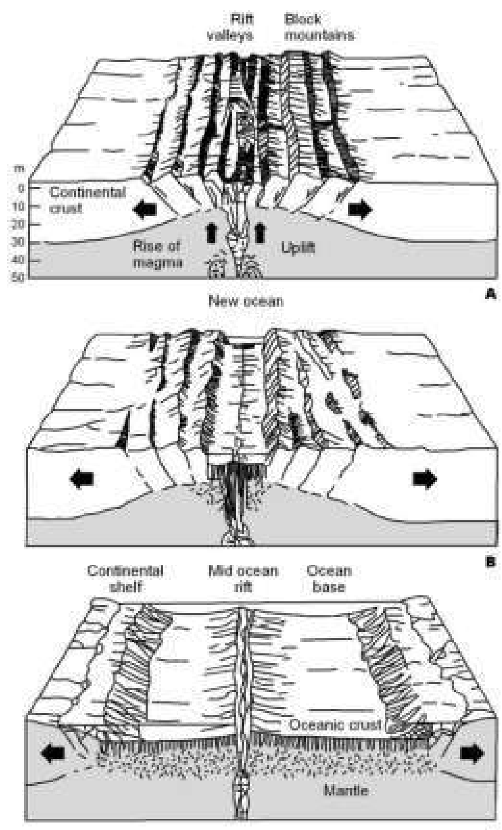


Fig. 3.6 Stages in continental rapture and the opening-up of a new basin

INTEXT QUESTIONS 3.2

1. Fill in the blanks:-

   a. Alfred Wegener termed the supercontinent as ____________.

   b. Premordial ocean was known as ______________.

   c. Pangaea was broken into two _____________ in the north and __________ in the south.

   d. North and South America drifted towards ___________.

   e. Tethys sea emerged between ____________ and ___________ by filling up of the water of ___________.

2. Name three evidences of continental drift put forwarded by Wegener -

   a. ____

   b. ____

   c. ____

3. Name two evidences of continental drift, but not mentioned by Wegener

   a. ____

   b. ____

3.3 PLATE TECTONICS

The uppermost outer solid and rigid layer of the earth is called crust. Its thickness varies considerably. It is as little as 5 km thick beneath the oceans at some places but under some mountain ranges it extends upto a depth of 70 km. Below the crust denser rocks are found, known as mantle crust. This upper part of mantle upto an average depth of 100 km from the surface is solid. This solid mantle plus upper crust form a comparatively rigid block termed as lithosphere. Mantle is partially molten between 100 to 250 km depth. This zone is said to be asthenosphere, also known as Mohr discontinuity, a simplification of Mohorovicic, the name of the seismologist who discovered it. All these things you have already read in the previous lesson.

The lithosphere is broken into several blocks. These blocks are known as plates, which are moving over asthenosphere. There are seven major plates. (Figure 3.7)

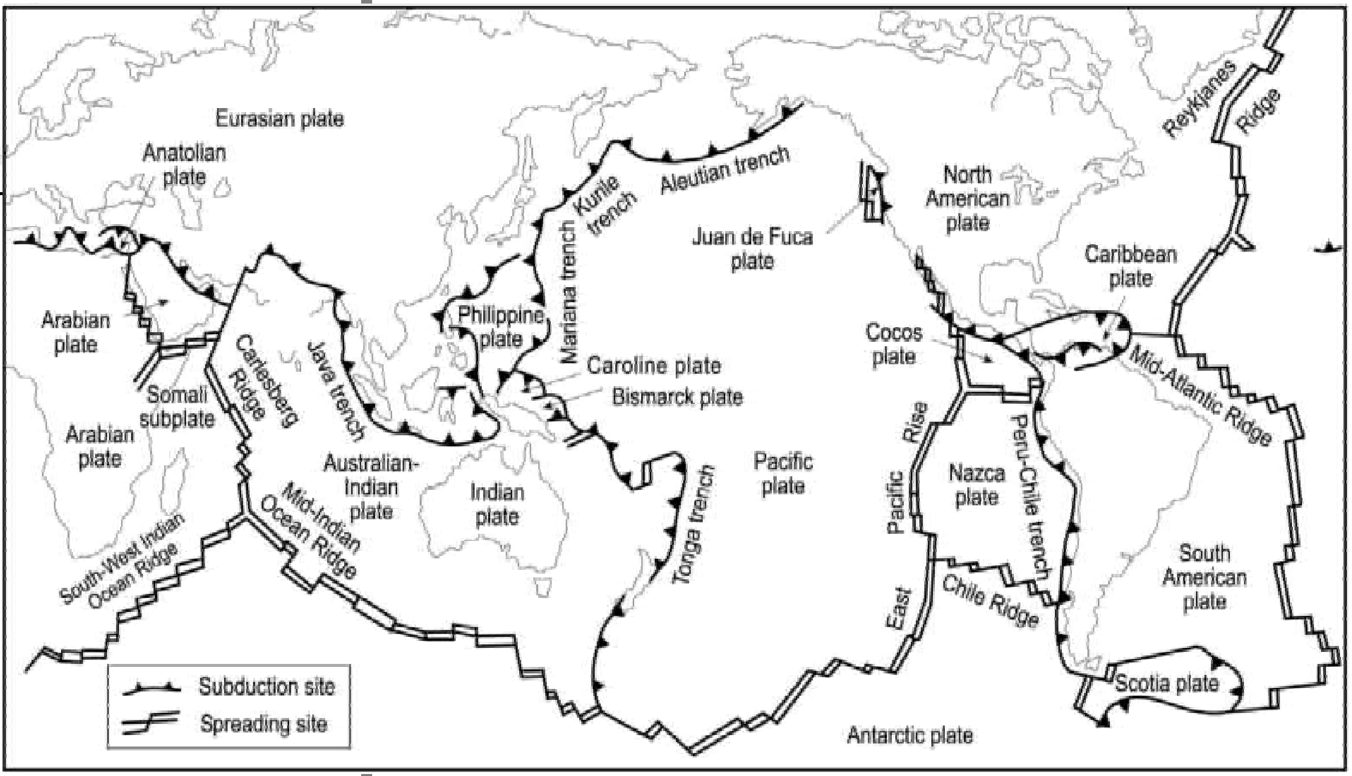


Fig. 3.7 Tectonic plates, spreading sites and subduction sites

1. Eurasian plate,
2. African plate,
3. Indo-Australian plate,
4. Pacific plate,
5. North American plate,
6. South American plate and
7. Antarctic plate.

Apart from these major plates minor plates are about 20 in number, a few important among them are :-

Arabian plate,
Philippine plate,
Cocos plate,
Nazca plate,
Caribbean plate,
Scotia plate, etc.

The major and minor plates constitute the whole surface of the earth.

Plate tectonics is a method or way of understanding the land-water distribution of the earth. Tectonics is a sort of movement of plates. Through the movement, internal forces are explained which are responsible for the distribution of earth's crust, formation of mountain chains and distribtion of earthquakes and volcanism.

Mechanism of plate Movement

Arthur Holmes, a British geologist, in 1928 – 1929, proposed that convectional currents exist underneath the lithosphere. The centre of convectional current is not exactly known, but it is believed that it has an average depth of about 100 to 250 km below the surface. The inception of the current is initiated by heat generation due to radio-active minerals. Due to integration and disintegration of atomic minerals heat is produced and hence the melting of surrounding rocks. In this way currents start operating. These currents are classified into rising and falling with divergence and convergence activities, respectively.

With rising convectional current, transport of hot and viscous matter takes place upwardly. After reaching about 100 kms below the surface that current gets diverged leading to split into the upper part. The molten material penetrates into the split and thus creation of new surface and the draft of the mammoth plate in opposition direction. It happens below the mid-oceanic ridge. On the other hand two sets of diverging thermal convectional currents brings two plates together and it is called convergent boundary where subduction takes place. Plates of lithosphere are constantly in motion because of convectional currents. Their relative motion depends upon the force operating over them.

Plate boundaries are very important and significant structural features. Boundaries are very distinct and easy to identify. They are associated with newly formed mountain systems, oceanic ridges and trenches. Plates are moving continuously and have relative direction of movement. Based on the direction of movement three types of plate boundaries can, easily, be identified. (Figure 3.8)

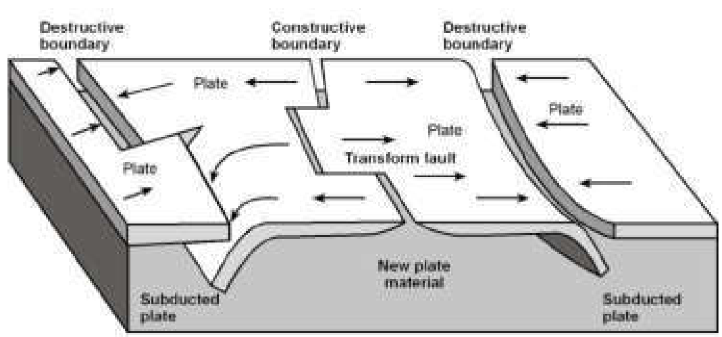


Fig. 3.8 Types of plate boundaries

(i) Divergent boundary
(ii) Convergent boundary
(iii) Fracture or transform boundary fault

The convectional current are caused due to radio-activity. These currents get diverted on approaching the crust layer. Diverging currents produce tension at the contact-zone of crust leading to fracture. Maganatic material penetrates into the fractroges and gets solidified. This continuous process pushes the blocks in opposite direction and creates a new zone, known as "zone of construction".

At convergent boundary, two adjacent plates come further and further closer to each other and collide. When both sides are of continental nature, a mountain formation is evident. When one of the two is continental and the other maritime again mountain comes into being along the boundary. In this case, continental plate overnides the maritime. When both plates are of maritime, both of them break, subduct and penetrate below and, hence, trenches are formed. Along this boundary earthquakes and volcanic activities are prominent. In all these three situations, surface area is reduced, therefore, this is also known as "zone of destruction".

Transform fault is the one when two adjacent plates slide past each other. Direction of movement may be along or against but they move parallel to each other. Therefore, neither there is any construction of fresh area nor it has any destruction. Hence, it is known as "zone of preservation".

Plates are not a permanent features but they vary in size and shape. Plates can split or get welded with adjoining plate. Almost all tectonic activities occur along the plate boundaries.

Prior to the advent of plate tectonic theory, the continental drift theory which was proposed by Wegener was criticized, particularly about the forces. In fact, it was outrightly rejected inspite of apparent evidences. But further reserches about the material of sea floor and paleomagnetism supported the theory but the proposition of plate tectornic theory in 1960's has solved the problem of the mechanism of movement.

Plate Tectonics Vs Earthquakes and Volcanoes

The distribution of earthquakes and volcanoes over the globe (Figure 3.9) clearly reveals that they are strongly associated with the boundaries of plates. Plate boundaries are the zones where every sort of tectonic activity does take place. The release of energy created because of the movement of plates is manifested in this zone in the form of earthquakes and volcanic eruption.

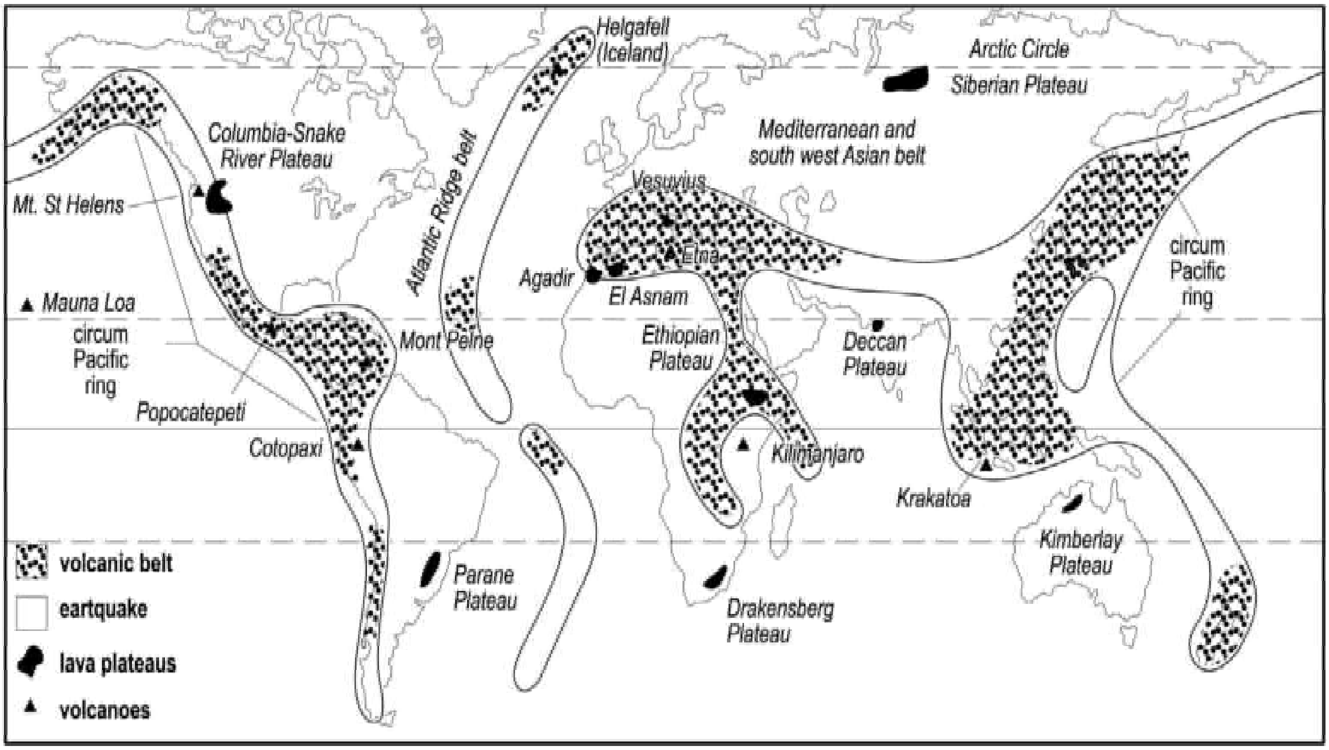


Fig. 3.9 The Major Earthquake and volcanic belts of the world

INTEXT QUESTIONS 3.3

1. Fill in the blanks:-
   a. The uppermost outer __________ layer of the earth is called ____________.
   b. Crust and upper part of mantle upto an average depth of ___________ is __________.
   c. Lithosphere includes __________ and ___________.
   d. Tectonics is sort of ____________ of lithospheric plate.
   e. The concept of convectional current was first explained by __________ in _____________.
   f. Convectional currents are classified into ____________ and ____________; they ___________ and _______________, respectively.
   g. Plate boundaries are associated with ____________, ____________ and __________.
2. Name seven major plates
   a. ____
   b. ____
   c. ____
   d. ____
   e. ____

f. ____________________

g. ____________________

3. Name some important minor plates –

a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

4. Enumerate different types of plate boundaries

a. ____________________

b. ____________________

c. ____________________

WHAT YOU HAVE LEARNT

The surface of the earth is dynamic. This dynamism is due to the forces operating from inside the surface (endogenetic forces) as well as on the surface/atmospheric forces (exogenetic forces). It is existing on the earth while itself is rotating and revoling. The surface is irregular. Hence, a sort of dynamic equalibrium is always in operation which is termed as isostasy. Apart from many scholars the views of Airy and Pratt are more distinct. Airy propounded the idea of uniform density of all rocks on the surface but has its roots depending upon the height of the column. A greater root will be found beneath the higher and lofy body of mountains and having smaller root under lower columns like plateau or plain. Pratt accepted that the rocks found on the earth have different densities. At a particulars depth, the weight of all columns of varying height will be compensated. Hence, higher column of mass will have lower density and lower column will have higher density. Therefore, both of them are explaining the same problem of isostatic balance, but with different perspective.

The distribution of land and water on earth surface is not static. It has changed, it is changing and it will change in future too. This changed position is said to be continental drift in crude way which was conceived by Wegener, but the mechanism explained by him was not scientific. Therefore, his ideas of continental drift was denounced inspite of his strong unfutile and testifying evidences.

With the concept of convectional current theory of Holmes and proposition of plate tectonics, a new thinking came in understanding the surface of the earth. Study on paleomagnetism as well as sea floor spreading have supported the plate tectonics theory. According to this theory, the earth surface is made up of several broken blocks of enormous size with great depth considered to be a plate. There are seven bigger size plates and twenty seven smaller size plates. As per the concept of convectional current, their movement takes place in three possible ways. First, two adjacent plates move away (divergent) and where a new zone is constructed. Second, two adjacent plates come closer (convergent) and get subducted and where a zone is destroyed. Third, in which two adjacent plates slide past each other (fracture) where the margins of both plates are preserved. Because of these different tectonic activities, earthquakes and volcanoes are associated with plate margins.

TERMINAL QUESTIONS

1. What is isostasy?
2. Explain the concept of isostasy according to Airy.
3. Explain the isostatic balance of the earth as proposed by Pratt.
4. Differentiate the ideas between Airy and Pratt.
5. Discuss the isostatic balance at global level.
6. Discuss the evidences of continental drift.
7. What is plate? Explain the mechanism of plate movement.
8. Discuss the activities at plate margins.
9. Describe the distribution of earthquakes and volcanoes with the help of plate boundaries.

ANSWERS TO INTEXT QUESTIONS

3.1

1. the state of being balance
2. same
3. density
4. deeper, lower
5. no, level
6. disturb
7. any balance, adjustment is needed.

3.2

1. a. Pangeea
   b. Panthalasa
   c. Laurasia (Angaraland), Gondwanaland
   d. West
   e. Angaraland, Gondwanaland, Panthalasa
2. a. Jig-saw-fit
   b. geological similarities
   c. coal evidences
3 a. evidences from paleomagnetism
   b. sea floor spreading

3.3

1. a. solid and rigid, plate
   b. 100 km, solid
   c. upper solid mantle, crust
   d. movement
   e. Arthur Holmes, 1928-29
   f. Rising, falling; diverge, converge
   g. Newly formed mountain systems, oceanic ridges, trenches
2. a. Eurasian plate
   b. African plate
   c. Indo-Australian plate
   d. Pacific plate
   e. North American plate
   f. South American plate
   g. Antarctic plate
3. a. Arabian plate
   b. Philippine plate
   c. Cocos plate
   d. Nazca plate
   e. Caribbean plate
   f. Scotia plate

4. a. divergent boundaries
   b. convergent boundaries
   c. fracture or transform fault/boundaries

HINTS TO TERMINAL QUESTIONS

1. Please refer to section 3.1
2. Please refer to section A of 3.1
3. Please refer to section B of 3.1
4. Please refer to section C of 3.1
5. Please refer to section 3.2
6. Please refer to section 3.2, Evidence of drift.
7. Please refer to section 3.3
8. Please refer to section 3.3
9. Please refer to section 3.3

4

EVOLUTION OF LANDFORMS DUE TO INTERNAL FORCES

We live on an unstable earth, the surface of which is uneven. While travelling, we come across a variety of landforms such as mountains, hills, plateaus, plains, cliffs and ravines. We also come across tilted, broken and twisted layers of rocks which are originally deposited in horizontal forms. You have already studied about different types of rocks, their formation and characteristics. There is a close relationship between rock types and the shape of landforms. But all deformation on the face of the earth are due to the continuous influence of internal and external forces. In this lesson, we will study about the internal forces deriving their strength from earth's interior and playing their role in shaping what we see on the earth's crust:

OBJECTIVES

After studying this lesson, you will be able to :

- explain the endogenetic forces and the landforms produced by them;
- distinguish between sudden and slow movements;
- differentiate between vertical and horizontal movement;
- differentiate between folding and faulting;
- explain the causes of volcanic activity;
- describe the different types of volcanoes ;
- locate on the outline map of the world, important volcanoes and areas affected by earthquakes;
- explain the causes of earthquakes and their effects.

4.1 INTERNAL FORCES

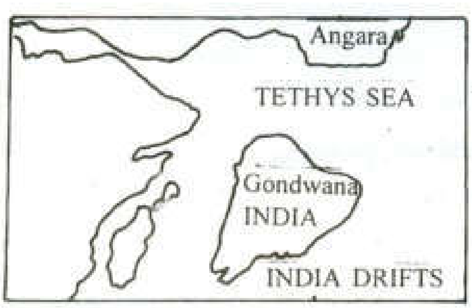
The variety in the types of land forms on the earth is the end result of two types of forces working simultaneously and continuously both inside and outside on its surface. The forces which originate from within the earth's crust or inside the earth are called internal or endogenetic forces. The sources providing them energy are the internal heat, chemical reactions taking place within the earth, and the transfer of rock materials on the earth's surface by external forces.

4.2 EARTH MOVEMENTS

Though we generally hear people using phrase like "as hard as rock" and "as stable as the earth", but these phrases are not true. Neither the earth is stable nor are the rocks of which its crust is made, are so hard. Since the origin of earth, there have been major changes in the distribution of continents and oceans, the land and the oceans.The earth has experienced innumerable earth movements which have brought about vast changes in its surface. Some of the examples of these movements are submergence of forest in Bombay harbour, the Mahabalipuran temple now standing on the sea and changes in the ground level in Rann of Kuchchh of India.

The forces working from inside the earth in turn cause movements in its crust.These movements are called earth movements. Since, these movements pertain to or rise from, the movements of the actual structure of the earth's crust, they are also called tectonic movements. The word tectonic is derived from the Greek word, "tekton" which means builders. This word is true to its meaning because these are the earth movements which are constructional and have been responsible for buildings of different types of land forms.

From Figures 4.1. (a) and 4.1. (b) it is quite evident that the physiography of India was entirely different about 60 million years ago. The vast Tethys sea existed in that area where the Himalayan ranges and Indo-Gangetic plain exist. The Tethys sea was gradually filled up by the sediments brought by rivers from the surrounding regions. Later, the sedimentary rocks formed in the beds of this sea gradually emerged in the form of the Himalayas in the north and Indo-Gangetic plain to its south.



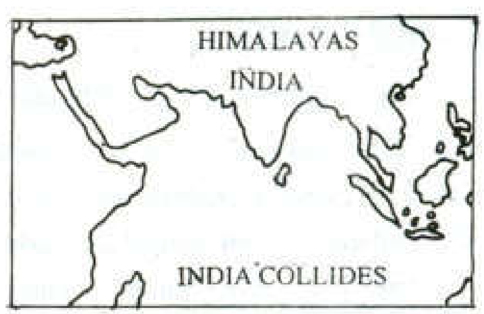


Fig. 4.1 (a) 60 Million Years ago Fig. 4.1 (b) Present configuration

The Malwa plateau and Deccan traps of India, Columbia and Snake Rivers Plateau of North America, Kimberlay Plateau of Australia and Parana and Patagonian Plateaus of South America were also formed by the solidification of molten lava which had escaped from the earth's interior to its surface at different geological times. The evidences clearly show that the surface of our earth never remained the same as it is today and neither it will be the same in future.

- Movements caused by internal or endogenetic forces affecting the earth's crust are known as Earth Movements.
- Earth movements are also called tectonic movements as they help in building the relief features on earth's crust through subsequently or simultaneously undergoing changes.

4.3 CLASSIFICATION OF EARTH MOVEMENTS

The earth movements are classified on various basis. On the basis of time taken by such movements, they are divided into:

(a) slow movement and

(b) sudden movement.

(a) Slow Movement

The movement which bring about changes on the Earth's crust very gradually or slowly taking hundreds or thousands of years and which cover a period much longer than a human life span are called slow movements. These movements act on the earth's crust either vertically or horizontally. Acting vertically, they cause uplift or subsidence of a part of the crust. The raised sea-beaches along the Kathiawar coast of India which contain the shells of marine life clearly point out that this coast was once below the sea level. Similar raised beaches are found In Orissa, Andhra Pradesh, and Tamil Nadu along the eastern coast of India as well. These beaches have been. uplifted to a height ranging between 15 to 30 metres above the mean sea level.

On the other hand there are numerous examples of submergence. Such as the presence of peat and lignite beds found below the sea-level in Sunderban Delta, the submerged forest in Tirunelveli in Tamil Nadu and the submerged forest on the east coast of Bombay Island.

(b) Sudden Movements

Contrary to the slow movements, there are certain movements which bring about abrupt changes in the crust. The examples of such movements are volcanic eruptions and earthquakes. The changes brought about by these two events are so sudden that the courses of rivers undergo a change, and the lava flow result.in the formation of mountains, uplands and plateaus in a matter of days. Landslides occur in mountainous regions due to these movements.

- Sudden movements bring about abrupt changes on the earth's surface
- Volcanic eruptions and earthquakes are the result of sudden movements
- The movement which bring changes slowly and gradually over a long period of time are known as slow movements.
- Uplift, submergence and subsidence of the earth's crust are the result of slow movements.

INTEXT QUESTIONS 4.1

1. Give geographical term for internal forces

   ____

2. What is Earth Movement?

   ____

4.4 VERTICAL AND HORIZONTAL MOVEMENTS

The slow movements can further be divided into vertical and horizontal movements on the basis of the uplift or subsidence of a part of the Earth's surface.

(a) Vertical movements

Vertical movements originate from the centre of the earth and affect its surface. Consequently large scale uplift or subsidence of a part of the earth's surface takes place. These movements are slow and wide spread and do not bring changes in the horizontal rock strata. These movements are mainly associated with the formations of continents and plateaus, hence these are also known as continent building or plateau building movements. Besides, these movements are also called epeirogenetic movements. 'Epeiros' in Greek language means 'continent' In the previous lesson on rocks, you have studied that sedimentary rocks are deposited and formed in the oceans and seas. The presence of these sedimentary rocks is wide-spread in continents. This clearly shows that these were uplifted or raised to form continents.

Contrary to the above, there are countless evidences of submerged buildings, river -valleys and cities due to subsidence into the sea. Some of such examples include the submerged ancient buildings in Mediterranean in its Crete Island and the ancient city of Dwaraka in Saurashtra, India. These changes clearly point out the downward movement of the Earth's surface.

- Large scale uplift or subsidence create continents, plateaus and oceans.
- Vertical movements are also known as epeirogenetic movements.

(b) Horizontal Movements

There are forces which act on the earth's crust from side to side i.e. horzontally or tangentially. Naturally, they cause a lot of disruption in the horizontal layer of strata as they do involve a good deal of compression and tension of the preexisting rocks since these forces act horizontally or tangentially to the earth's spherical surface. These are known as horizontal or tangential movements.

We can divide them into two types:

(i) Forces of compression, and

(ii) Forces of tension.

(i) Forces of compression: involve pushing of the rock strata against a hard plane from one side or from both sides. To understand their working, let us take a piece of cloth and spread it on the table. Push the cloth with your both hands towards its centre, it will form wrinkles rising into up and down folds. Likewise rock strata also bend in the same fashion when forces of compression act on them from opposite directions. In this way, the compressional forces lead to the bending of rock layers and thus lead to the formation of fold mountains. In them the rock strata primarily of sedimentary rocks get folded, into wave like structure. This process of bending, sometimes warping and twisting of rock strata is referred to as their folding. The upfolds are called anticlines and downfold are called synclines.(Fig 4.2).

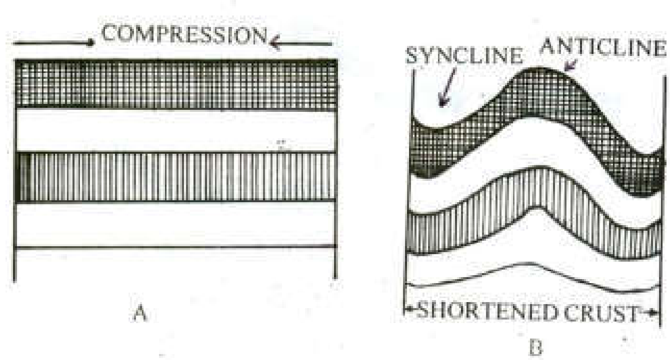


Fig. 4.2 The Earths crust before (A) and after folding (B)

When folding takes place on a gigantic scale, it represents the mountain building process. Most of the great mountain chains of the world viz, the

Himalaya, the Rockies, the Andes, the Alps and others of this sort have been formed by compressional forces resulting in mountain building on a large scale. These are also called Orogenetic Movements.

- Horizontal movements are produced by forces of compression and tension.
- Folding is the bending of rock strata due to compression.
- Upfolds are called anticlines and downfolds synclines.
- Folding on gigantic scale results in mountain building movement generally referred as orogeny.

(ii) Forces of tension: are produced when these forces are working horizontally in opposite directions i.e, away from a given plane or point. Under the operation of intense tensional forces, the rock strata is broken or fractured. As a result cracks and fractures develop. The displacement of rocks upward or downward from their original position along such a fracture is termed as faulting. The line along which displacement of the fractured rock strata takes place is called the fault line. Like wise the plane along which displacement of rock strata takes place is known as fault plane (Fig.4.3)

- Forces of tension produce faults.
- The plane along which displacement of fractured rock strata takes place is called its fault plane.

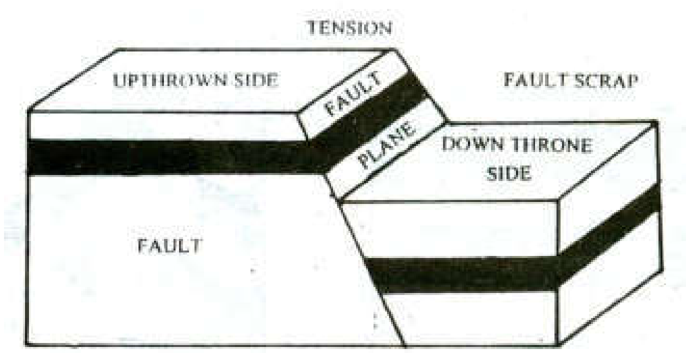


Fig.4.3 A Fault

Forces of compression give rise to the operation of the forces of tension. Thus faults are closely related to the formation and occurrence of folds. It implies that folding generally leads to or is accompanied by fracturing and faulting in rock strata.

Faulting results in the formation of well known relief features such as rift valleys and the block mountains. A rift valley is formed by sinking of rock strata lying between two almost parallel faults. (fig. 4.4). The classical

Notes

examples of rift valleys in the world include the Midland Valley of Scotland, the Rhine Valley, the Valley of Nile, the Dead Sea basin and the Great Rift Valley of East Africa comprising few lakes of this region. Some geographers are of the opinion that the Narmada and Tapti valleys are also rift valleys. The coal deposits of the Damodar valley are said to be originally laid in a synclinal trough resembling a rift valley.

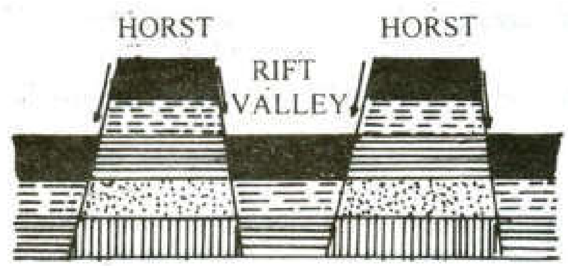


Fig. 4. 4 A Rift valley and Block mountain

A rift valley is a trough with steep parallel walls along the fault lines. Such a valley is also called a graben. A rift valley may also be formed by upliftment of two blocks along the fault line. These uplifted blocks are called horsts or block mountains. The well known examples of horsts are the Vosgesand the Black forest mountains on both sides of Rhine rift valley and the Plateaus of Palestine and Trans Jordan.

The escarpments (escarp/faces see Fig 4.3) are the characteristic features of rift valleys and horsts. They are very steep or have highly precipitous slopes in a continuous line facing one direction. The escarpments of Western Ghats ones looking the Arabian Sea are thought to be the result of faulting. The escarpments of Vindhyachal Mountain are also ascribed to the faulting and formation of narrow Narmada Valley.

- Faulting leads to the formation of rift valleys, horsts and escarpments.
- A rift valley is a trough with steep parallel walls along the fault line.
- A horst is a uplifted land mass with steep slopes on both the sides.
- An escarpment is a very steep slope in a continuous line along a fault.

INTEXT QUESTION 4.2

1. Name the earth movements caused by forces of compression.

---

2. Give geographical term for mountain building movements.

4.5 VOLCANOES

Have you ever seen an active volcano. Even if you have never seen a volcano, you have probably seen pictures or films of erupting volcanoes. These conical forms are one example of the land forms we will study in this chapter.

A volcano is a vent or an opening in the earth's crust through which molten rock material, rock fragments, ash, steam and other hot gases are emitted slowly or forcefully in the course of an eruption. These materials are thrown out from the hot interior of the earth to its surface. Such vents or openings occur in those parts of the earth's crust where rock strata are relatively weak.

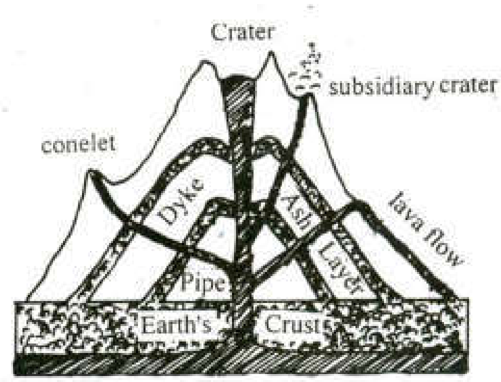


Fig. 4.5 A Volcanic Cone

You may be wondering why such eruptions take place. Actually, vo1canoes are evidence of the presence of the intense heat and pressure existing within the earth. Hot molten rock materials beneath the solid outer crust is known as magma. When this magma is thrown out from the magma chamber to the earth's surface it is known as lava (Fig 4.5). The magma and the gases stored within the earth's surface keep trying to come out to the surface through a line of weakness anywhere in the crust. The tremendous force created by magma and its gases creates a hole in the crust and the lava spreads out on the surface along with ash and fragmented rock material. The process by which solid liquid and gaseous materials escape from the earth's interior to the surface of the earth is called vulcanism.

- A volcano is an opening in the earth's crust through which molten rock material are thrown out slowly or forcefully depending upon the force of eruption.
- The cause of volcanic eruption is the excessive pressure exerted by the magma and hot gases on the earth's crust.

- The process by which solid, liquid and gaseous materials escape from the earth's interior to its surface is known as Vulcanism.

The volcanic materials accumulate around the opening or hole taking the form of a cone. The top of the cone has a funnel shaped depression which is called its crater (Fig 4.5).

(A) TYPES OF VOLCANOES

Volcanoes are classified on the basis of the nature of vulcanism. The basis include the frequency of eruption, mode of eruption or fluidity and the manner in which volcanic material escapes to the surface of the earth.

On the basis of the frequency of eruption, volcanoes are of three types:

(i) Active

(ii) Dormant and

(iii) Extinct.

The volcanoes which erupt frequently or have erupted recently or are in action currently are called active volcanoes. Important among these include Stromboli in Mediterranean, Krakatoa in Indonesia, Mayon in Philippines, Mauna loa in Hawai Islands and Barren Island in India. The volcanoes which have not erupted in recent times are known as dormant volcano. They are as such the 'sleeping volcanoes'. Important among these are Vesuvious of Italy, Cotopaxi in South America.

Contrary to these two, there are volcanoes which have not erupted in historical times. These are called extinct volcanoes. Mount Popa of Myanmar (Burma) and Kilimanjaro of Tanzania are important extinct volcanoes. It is not, always very simple to categorise a volcano as dormant or extinct. For example the Vesuvious and Krakatoa became suddenly active after lying dormant for hundreds of years.

- On the basis of the frequency of eruption, volcanoes are classified into active, dormant and extinct volcanoes.
- Active volcanoes are erupting currently or have erupted recently.
- Dormant are those volcanoes which have erupted at least once in human history and are not active now.
- Extinct volcanoes are those which have not erupted during long human history.

On the basis of mode of eruption, volcanoes are divided into two types:

(i) Central type of volcanoes and

(ii) Fissure type volcanoes

When the eruption in a volcanoe takes place from a vent or a hole, it is called a central type of volcano. Different types of domes or conical hills are formed by this type of erruption depending on the nature of erupted materials. Majority of volcanic eruptions in the world are of this type. The other characteristic of this mode of eruption is that it is marked by violent explosion due to sudden escape of gases and molten rocks through the hole. Visuvious and Fuji-yama belong to this group of volcanoes.

Sometimes, deep elongated cracks develop due to earthquakes or faulting. The magma starts flowing through them quietly. This mode of eruption is called fissure type of eruption. This eruption helps in the formation of thick horizontal sheets of lava or a low dome shaped volcano with broad base. It may also form what are identified as lava plateaus, and lava shields, Deccan Traps of India is one example of fissure type of eruption.

- Central type of volcanoes erupt from a vent or hole and result in the formation of a conical hill.
- Fissure type of volcanoes erupt through a crack or fissure and cause formation of plateaus and shields.

On the basis of the fluidity of lava there are two types of volcanoes :

(i) Volcanoes of basic lava and

(ii) Volcanoes of acid lava.

Since the basic lava is rich in metalic minerals and has a low melting point, it has greater fluidity. In this type of eruption, lava flows far and wide quietly with greater speed and spreads out in thin sheets over a large area. Thus, it leads to the formation of shields and lava domes. The shield volcano of Hawaian Island in Pacific ocean is one of these volcanoes.

Contrary to basic lava, acid lava is rich in silica and has a relatively high melting point. Therefore: it is highly viscous and solidifies quickly. Hence, the, acid lava volcanoes cause the formation of usually higher land features with steeper slopes. Acid lava cones are of steeper slopes than basic lava shields. (Fig. 4.6).

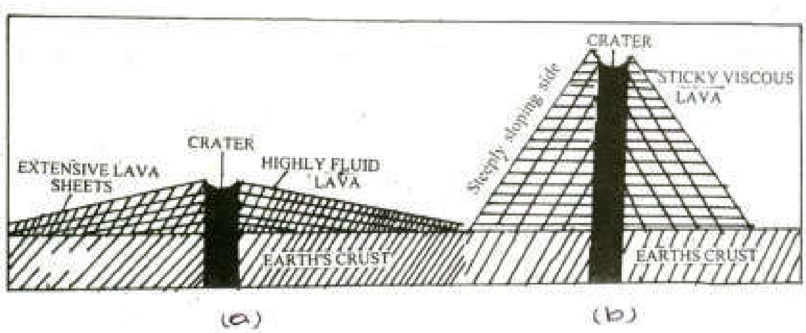


Fig. 4.6 (a) Basic lava shield (b) Acid lava cone

Notes

- Basic lava is highly fluid and flows readily and extensively. It causes the formation of shields.
- Acid lava is highly viscous. This type of eruption of steep sided cones.

(B) DISTRIBUTION OF VOLCANOES

There are about 500 volcanoes in the world. Most of these volcanoes are found in three well defined belts, The Circum-Pacific belt, the Mid-World Mountain belt and the African Rift Valley belt. Thus, volcanoes are closely related to the regions of intense folding and faulting. They occur along coastal' mountain ranges, on islands and in the mid-oceans. Interior parts of continents-are generally free from their activity. Most of the active volcanoes are found in the pacific region. About 83 active volcanoes are located in Mediterranean region (Fig. 4.7).

Circum-Pacific region has the greatest concentration of volcanoes, that is why, it is called 'Pacific Ring of Fire', This ring extends along Andes mountains of south America to Alaska and from the Aleutian Islands to Japan, Philippines, Indonesia to NewZealand.

The Mid-world mountain belt occupies the second position with regard to the numbers of volcanoes. It runs from Alps in Europe to Asia Minor and crossing through Himalayan region joins the Circum-Pacific belt. The African rift valley region ranks third. Most of the volcanoes are extinct here. Mt. Cameroon is the only active volcano which is situated in Central West Africa.

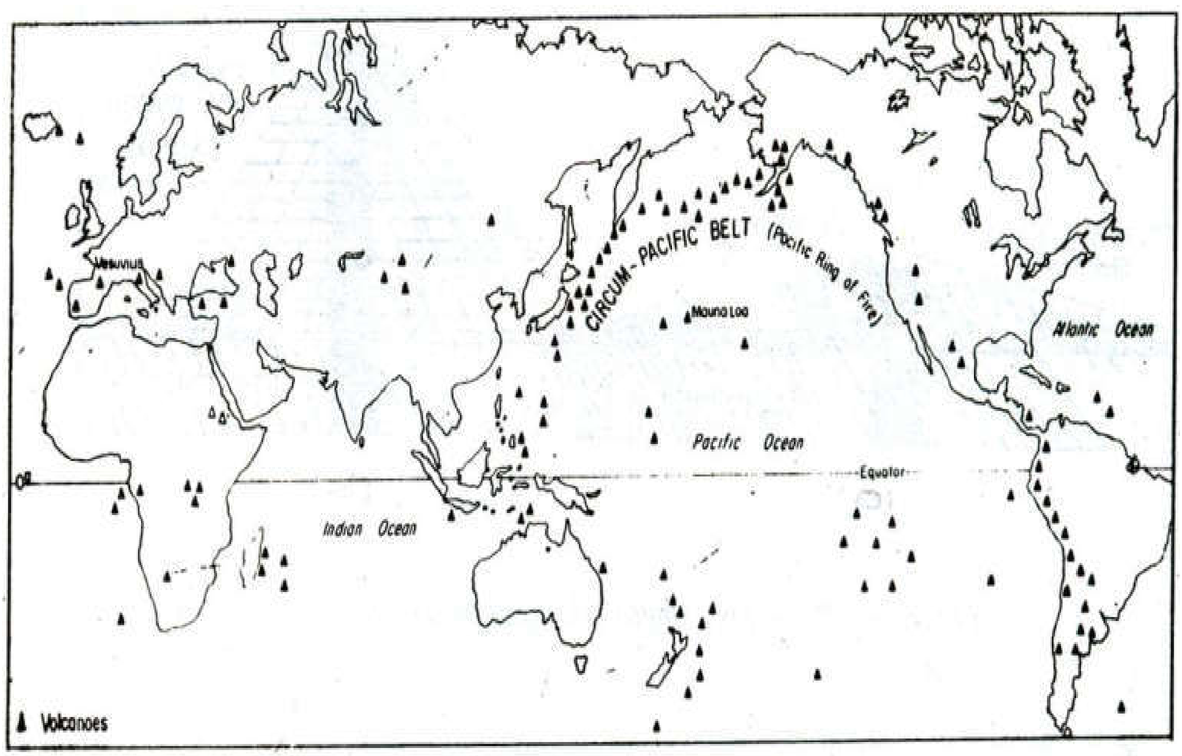


Fig. 4.7 The Distribution of Volcanoes

- There are about five hundred volcanoes in the world. They are located in three well defined belts namely the Circum-Pacific, the Mid World Mountain and East African Rift Valley belts.
- Most of the active volcanoes are located in Circum-Pacific belt which is known the Pacific Ring of Fire.

INTEXT QUESTIONS 4.3

1. Answer the following questions:-

   (i) Name the process by which magma is ejected out of the earth's interior

   ____

   (ii) Name three types of volcanoes on the basis of the frequency of eruption.

   (a) ______________(b)______________(c)______________

   (iii) Name two types of volcanoes on the basis of the mode of eruption

   (a)________________ (b) ________________

   (iv) State two types of lava on the basis of their fluidity

   (a)______________________ (b) ______________________

4.8 EARTH QUAKE

You have probably seen television news accounts of disastrous earthquakes and destruction caused by them. An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking building apart. The earthquake is a form of energy of wave motion transmitted through the surface layer of the earth.

All the earthquakes are not of the same intensity. Some of them are very severe, others are very mild and still others are not even noticed. Major or strong earthquakes are only a few. Though our earth experiences many earthquakes everyday, however the frequency of earthquakes varies largely from place to place. The network of seismographic stations all over the world records dozens of earthquakes every day. But, occurrence of severe earthquakes is limited to a few regions. The instrument used for recording the earthquakes is known as seismograph. 'Sesamos' is a Greek word which means an earthquake.

The point within the earth's crust where an earthquake originates is called the focus. It is also referred as seismic focus. It generally lies within the depth of 60 kilometres in the earth crust.

The point vertically above the focus on the earth's surface is known as 'epicentre'. The impact of the earthquake is carried from the point of its origin by earthquake waves. These earthquake waves originating from the focus travel in all directions. But their intensity is the highest at the epicentre That is why the maximum destruction occurs at and around the epicentre. (Fig 4.8). The intensity of vibrations decreases as one moves away from the epicentre in all directions.

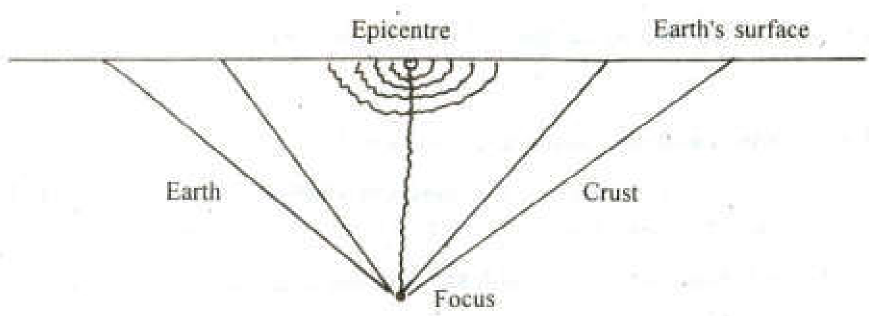


Fig 4.8 Focus and epicentre of an earthquake

- An earthquake is a motion of the ground surface, ranging from a faint tremor to a wild motion capable of shaking buildings apart.
- A seismograph is an instrument used for recording earthquakes.
- Focus is the point within the earth's crust where the earthquake originates.
- The epicentre is the point on the earth's surface vertically above the focus.

(A) CAUSES AND EFFECTS OF EARTHQUAKES

Folding, faulting and displacement of rock strata are the main causes of earthquakes. Some examples of this type of earthquakes are the San Francisco earthquakes of California in 1906, the Assam earthquakes of 1951, the Bihar earthquakes of 1935.

The second important cause lies in the plenomenon of volcanic eruption. The violent volcanic eruptions put even the solid rocks under great stress. It causes vibrations in the earth's crust. But, these earthquakes, are limited to the areas of volcanic activity. Its important example is the earthquake which continued for six days preceeding the eruption of Mauna Loa volcano of Hawaii Island in 1868.

Minor earthquakes often accompany or are the result of landslides, seepage of water causing the collapse of the rocks of cavern or underground mines and tunnel. These are least damaging earthquakes.

Violent earthquakes are generally very disastrous. They may themselves cause land-slides, damming of river course and occurance of floods, and sometimes, the depressions leading to the formation of lakes. An earthquake often forms cracks and fissures in the earth's crust. It changes the drainage system of an area as was witnessed in Assam after its 1951 earthquake. Earthquakes also cause vertical and horizontal displacement of rock strata along fault line. They prove most catastrophic and devastating when they cause fires and seismic sea waves. Such tidal waves are called Tsunamis. These waves may wash away coastal cities. Buildings and bridges collapse causing death of the thousands of people. Lines of transport, communication and of electric transmission get disrupted. The after effect of earthquake is spread of epidemics like cholera.

(B) DISTRIBUTION OF EARTHQUAKES

The occurrence of earthquake is a phenomenon of almost every part of the world. But, there are two well-defined belts where they occur more frequently. These belts are the Circum-Pacific belt and the Mid-world mountain belt.

The first belt i.e., the Circum Pacific comprises the western coast of North and South America; Aleutian Islands and island groups along the eastern coasts of Asia such as Japan and Philippines. As it encircles the Pacific Ocean from end to end, it is named as such. The earthquakes in this belt are associated with the ring of mountains and volcanoes. It is estimated that about 68 percent of earthquakes of the world occur in this belt alone.

The second belt-extend from Alps with their extension into Mediterranean the Caucasus and the Himalayan region and continues into Indonesia. About 21, percent of total earthquakes of the world originate in this belt. Remaining 11 percent occur in the other parts of the world.

- Most of the earthquakes of the world occur in two belts namely the Circum Pacific and Mid world mountain belts.

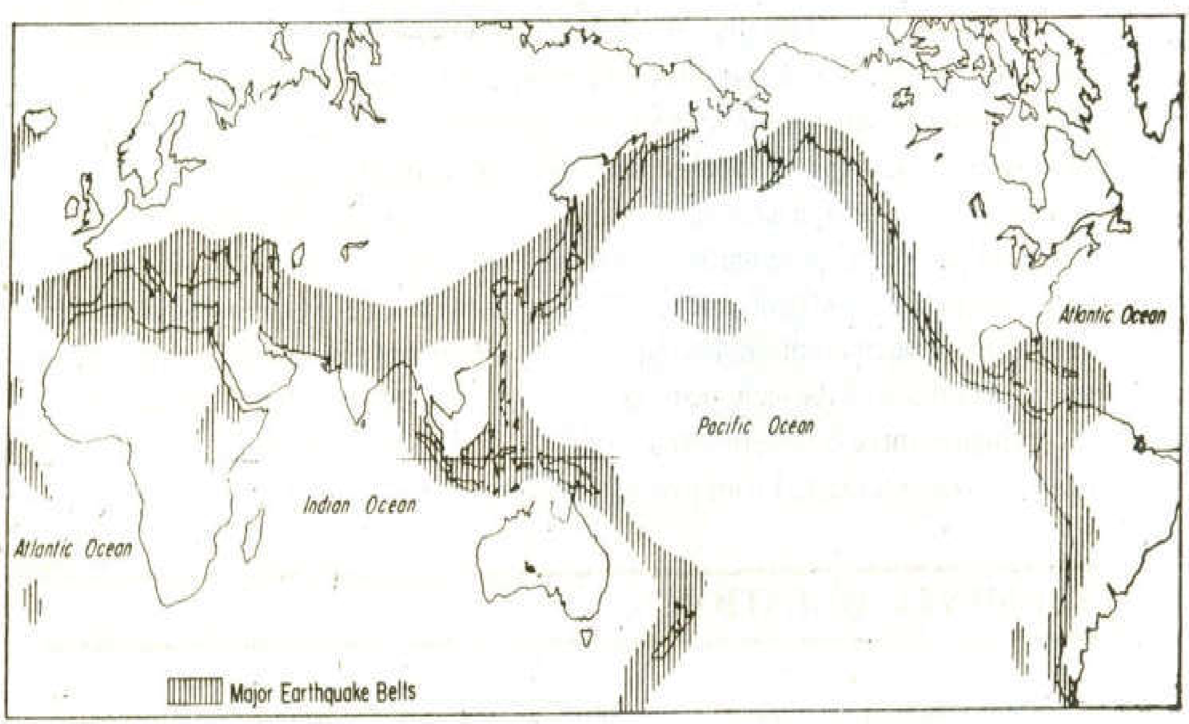


Fig. 4.9 Major Earthquake Belts

Notes

INTEXT QUESTIONS 4.4

1. Define is earthquake?
2. Which instrument record the earthquake waves?
3. Define 'Focus'.
4. How is 'Tsunami' caused ?

WHAT YOU HAVE LEARNT

Land forms of different types present on the earth's surface are the result of continuous work of both internal and external forces. Internal forces are responsible for creating inequalities in altitudes of different relief features. These forces originate in the interior of the earth. They are also known as endogenetic forces. These forces cause movements of the earth's crust which are called earth movements. Slow movements bring slow and gradual changes in the relief features while sudden movements bring abrupt and rapid changes. Internal forces affect the earth into two way radially and horizontally. When they affect radially they cause subsidence or upliftment of the earth's crust. Such earth movements are called vertical movements. Contrary to this; when these forces affect horizontally or side to side, they result in folding and faulting of the rock strata. These are called horizontal movements. Volcanoes are landforms marking the eruption of lava at the earth's surface. The shape and size of volcano depends on the frequency of eruption, fluidity of lava and type of eruption. Earthquakes are vibrations of the earth's crust cause by the operations of the tectonic forces and. volcanic activity. The volcanic activity is confined to three well defined belts of the world. The occurrence of earthquakes is also closely connected with two of these belts.

TERMINAL QUESTIONS

1. What is meant by internal forces? List causes of the origin of these forces.
2. Give four examples to prove that the earth's crust is unstable.
3. Draw diagrams to show
   (i) Displacement of rock strata along a fault plane,
   (ii) Anticline and synclines of rock strata.
4. Differentiate between vertical and horizontal movements.
5. Distinguish between folding and faulting.

6. What is a volcano? Describe different types of volcanoes with examples.
7. Distinguish between acid and basic lava and land forms developed by each of them.
8. What causes an earthquake?
9. List the effects of earthquakes on earth's surface.
10. Define the following terms:

    (a) Fault plane (b) Central type eruption (c) Fissure type eruption (d) Dormant volcano.
11. Locate and label the following in the outline map of the world :

    (a) An active volcano in India (b) A volcanic plateau in south America. (c) A rift valley in Europe (d) An extinct volcano in Myanmar (e) An extinct volcano in Africa (f) A volcano in Hawaii island.

ANSWER TO INTEXT QUESTIONS

4.1

1. Endogenetic forces
2. Movement caused by internal forces affecting the earth's crust are known as 'Earth Movement'.

4.2

1. Horizontal movements 2. Orogenetic movements

4.3

1. (i) Vulcanism (ii) (a) Active (b) Dormant (c) Extinct (iii) (a) Central type (b) Fissure type (iv) Basic lava (b) Acid lava

4.4

1. An earthquake is a motion of ground surface, ranging from a fain tremor to a wild motion capable of shaking building apart.
2. Seismograph
3. This point within the earth's crust originate of called the 'Focus'.
4. The seismic sea waves which originate due to earthquake in octaves, are called 'Tsunami'.

HINTS TO TERMINAL QUESTIONS

1. Refer to Section 4.1

2. Refer to Section 4.2
3. Refer to Figure 4.1
4. Refer to Section 4.4
5. Refer to Section 4.4 (b) (i) and (ii)
6. Refer to Section 4.5
7. Refer to Section 4.6
8. Refer to Section 4.6
9. Refer to Section 4.6 (A)
10. (a) The plane along which displacement of rock strata takes place is known as fault plane.

    (b) When the eruption in a volcano takes place from a vent or hole, it is called central type eruption

    (c) When the eruption takes place through deep elongated cracks, it is known as fissure type eruption

    (d) The volcanoes which have not erupted in recent times is known as dormant volcano.
11. Refer Maps.

5

THE WORK OF RUNNING WATER AND UNDERGROUND WATER

In the previous lesson we have learnt that the ultimate result of gradation is to reduce the uneven surface of the earth to a smooth and level surface. These agents produce various relief features over the course of time. Amongst all the agents of gradation, the work of running water (rivers) is by far the most extensive. In this lesson we will study how running water and underground water act as agents of gradation and help in the formation of different relief features.

OBJECTIVES

After studying this lesson, you will be able to :

- explain the three functions of running water viz erosion, transportation and deposition, in the different parts of the river's course;
- explain with the help of diagrams the formation of various erosional and depositional features produced by the action of running water;
- explain the cause of fluctuating water table from place to place and season to season;
- explain with the help of diagrams the formation of various relief features formed by underground water;
- distinguish between (i) stalactites and stalagmites, (ii) wells and artesian wells, (iii) springs and geysers.

5.1 THE THREE FUNCTIONS OF A RIVER

Running water or a river affects the land in three different ways. These are known as the three functions of a river. They are (i) erosion (ii) transportation and (iii) deposition. Throughout its course a river displays all the three activities to some extent.

(1) EROSION

Erosion occurs when overland flow moves soil particles downslope. Weathering and erosion supply this rock material which is the load of the river. This load acts as the grinding tool. It thus helps in cutting the bottom and sides of the river bed, resulting in deepening and widening of the river channel.

Both the cutting and removal of rock debris by the river is called river erosion. The work of river erosion is accomplished in four different ways, all of which operate together. These four ways are:

(a) Corrasion or Abrasion

As the rock particles bounce, scrape and drag along the bottom and sides of the river, they break off additional rock fragments. This form of erosion is called corrasion. This is the mechanical grinding of the rivers against the banks and bed of the river. Corrasion takes place in two different ways :

(i) **Lateral Corrasion:** This is sideways erosion which widens the river valley.

(ii) **Vertical Corrasion :** This is the downward erosion which deepens the river valley.

(b) Corrosion or Solutions

This is the chemical or solvent action of water on soluble or partly soluble rocks with which the river water comes in contact. For example, limestone or calcium carbonate, when it comes in contact with water, it is easily dissolved and removed in solution.

(c) Hydraulic Action

This is the mechanical loosening and sweeping away of material by the sheer force of river water itself. No load or material is involved in this process. Some of the water splashes against the river banks and enters into cracks and crevices. This undermines the soft rocks with which it comes in contact. It picks up the loose fragments from its bank and bed and transports them away.

(d) Attrition

This is the wear and tear of the transported materials themselves when they roll and collide with one another. In the process the coarser boulders are broken down into smaller pieces. The angular edges are smoothened and rounded to form pebbles.

(2) TRANSPORTATION

River carries rock particles from one place to another. This activity is known as transportation of load by a river. The load is transported in four ways.

(a) Traction

The heavier and larger rock fragments like gravel, pebbles etc. are forced by the flow of river to roll along its bed. These fragments can be seen rolling, slipping, bumping and being dragged. This process is known as traction and the load is called traction load.

(b) Saltation

Some of the fragments of the rocks move along the bed of a stream by jumping or bouncing continuously. This process is called saltation.

(c) Suspension

The holding-up of small particles like sand, silt and mud by the water as the stream flows is called suspension.

(d) Solution

Some parts of rock fragments are dissolved in the river water and are thus transported (See fig.5.1)

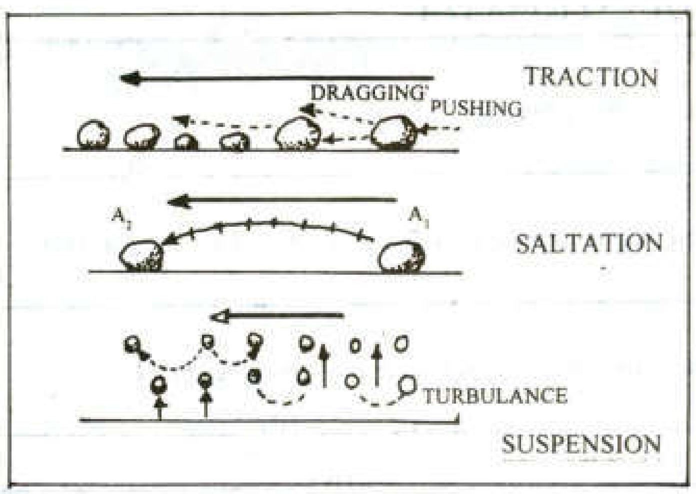


Fig. 5.1 Traction, Saltation and Suspension

- The river transports its load in four ways viz. traction, saltation, suspension and solution.
- The transporting power of a river mainly depends upon its velocity, volume and size of particles.

(3) DEPOSITION

When the stream comes down from hills to plain area, its slope becomes gentle. This reduces the energy of the stream. The decrease in energy hampers transportation; as a result part of its load starts settling down. This activity is known as deposition. Deposition takes place either due to decrease in slope or due to fall in the volume or velocity of river water. Deposition takes place usually in plains and low lying areas. When the river joins a lake or sea, the whole of its load is deposited.

- Deposition takes place either due to decrease in slope or decrease in volume or velocity of water.

INTEXT QUESTIONS 5.1

1. Which are the three functions of a river?

   (i)________________(ii) ________________(iii) ________________

2. What name is given to the rock material carried away by a river?

   ____

3. Name the four ways in which river erosion takes place.

   (i) ________________(ii) ________________(iii) ________________

   (iv) ______________

4. Name four ways in which a river transports its load.

   (i) ________________(ii) ________________(iii) ________________

   (iv) ______________

5. Name two conditions which favour the deposition of river load.

   (i) ________________________(ii) ________________________

6. Name the areas where deposition takes place.

   ____

5.2 DEVELOPMENT OF A RIVER VALLEY

The erosional and depositional land features produced and modified by the action of running water may be better understood if we note the stages through which a stream passes from its source to its mouth. The source of a river may lie in a mountainous region and the mouth may meet the sea or lake. The whole path followed by a river is called its course or its valley.

The course of a river is divided into three sections:

(i) The upper course or the stage of youth

(ii) The middle course or the stage of maturity

(iii) The lower course or the stage of old age. (See Fig. 5.2)

- Upper, middle and lower are the three courses into which a river valley is divided.

(i) THE UPPER COURSE

The upper or mountain course begins from source of the river in hilly or mountainous areas. The river tumbles down the steep slopes and as a result its velocity and eroding power are at their maximum. Consequently valley deepening assumes its greatest importance at this stage. Normally, weathering also plays its part on the new surfaces exposed along the banks of the stream. The weathered rock material is carried into the stream partly through the action of gravity and partly by rain water flowing into the river. Weathering helps in widening a valley at the top giving it a typical 'V' shaped cross section. Such valleys are known as 'V' shaped valleys.

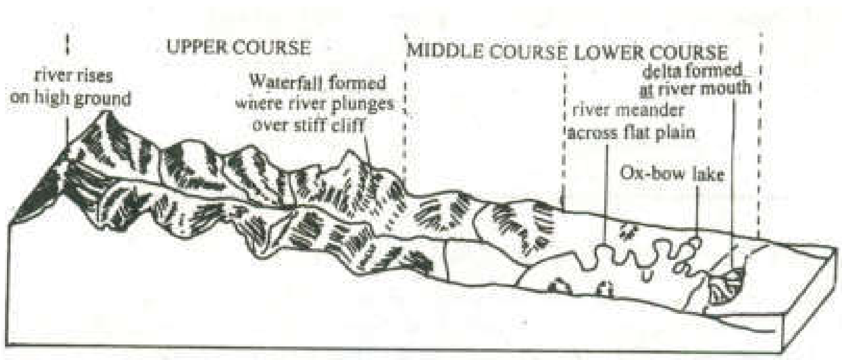


Fig. 5.2 (a) The Upper, Middle and Lower Courses of River

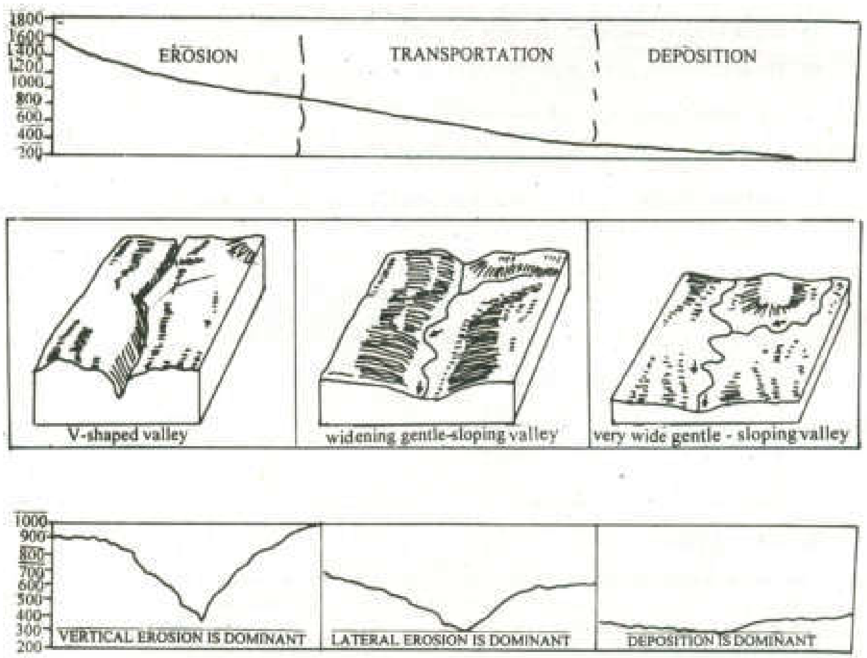


Fig. 5.2(b) The Graded Long Profile and Cross-section of a River Valley from Source to Mouth

If the bed rock is hard and resistant, the widening of the valley at its top may not take place and the down cutting process of a vigorous river may lead to the formation of a gorge i.e. a river valley with almost vertical sides.

In India, deep gorges have been cut by the Brahmaputra and the Indus in the Himalayas. Deep gorges also develop in limestone regions and in rocks lying in dry climates. The narrow and very deep gorge or the canyon with vertical walls is also known as 'I' shaped valley. A canyon is 'very deep gorge with steep sides running for hundreds of kilometers, e.g. Grand Canyon of the river Colorado in U.S.A. Some of the more outstanding features that are developed in the upper course of a river include rapids, cataracts, cascades and waterfalls.

- The land features carved by a river in its upper course are gorges, canyons, 'V' shaped valleys, rapids, cataracts, and waterfalls.

(ii) THE MIDDLE COURSE

In the middle course, lateral corrasion tends to replace vertical corrasion. Active erosion of the banks widens the 'V' shaped valley. The volume of water increases with the confluence of many tributaries and this increases the river's load. Thus work of the river is predominantly transportation with some deposition. Rivers which sweep down from steep mountain valleys to a comparatively level land drop their-loads of coarse sand and gravels as there is sudden decrease in velocity. The load deposited generally assumes a fan like shape, hence it is called an alluvial fan. (See Fig. 5.3)

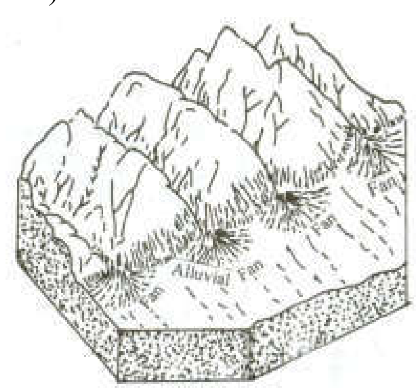


Fig. 5.3 Alluvial Fans

Sometimes several fans made by neighbouring streams often unite to form a continuous plain known as a piedmont alluvial plain, so called because it lies at the foot of the mountain.

In this section even minor obstacles force a river to swing in loops to go round the obstacles. These loops are called meanders, a term derived from the winding River Meanderes in Turkey.

- Some of the land features formed by a river in its middle course are alluvial fans, and meanders.

(iii) THE LOWER COURSE

The river moving downstream across a broad, level plain is heavy with debris brought down from the upper and middle courses. Vertical corrasion has almost ceased, the lateral corrasion still goes on to erode its banks further. The work of the river is mainly deposition, building up its bed and forming an extensive flood plain. Many tributaries join the river and the volume of water increases, coarse materials are dropped and the fine silt is carried down towards the mouth of the river. Large sheets of material are deposited on the level bed and the river splits into a maze of channels. Such a stream is called a braided stream (See Fig. 5.4)

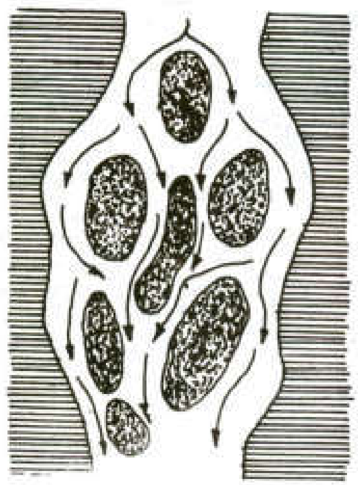


Fig. 5.4 Braided Stream

During annual floods large quantities of sediments are spread over the low lying adjacent areas. A layer of sediments is thus deposited during each flood gradually building up a fertile flood plain. A raised ridge of coarse material is formed along each bank of the river. Such ridges are called levees. (See Fig. 5.5)

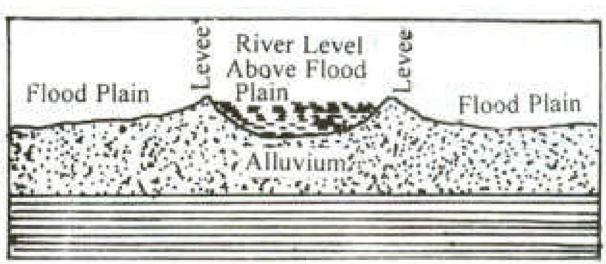


Fig. 5.5 Flood Plain and Levees

In the lower course of the river, meanders become much more pronounced. The outer bank or concave bank is so rapidly eroded that the meander becomes almost a complete circle. A time comes when the river cuts through the narrow neck of the loop. The meander, now cut of from the main stream, takes the form of an oxbow lake (See Fig. 5.6).

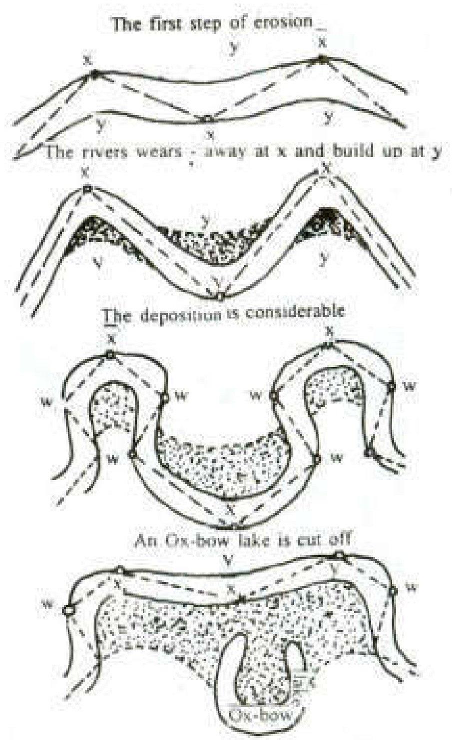


Fig. 5.6 Stages in the Formation of a Oxbow lake

This lake gradually, turning into swamps disappears in course of time. Numerous such partially or fully filled oxbow lakes are marked at short distance from the present course of river like the Ganga.

Upon entering a lake or a sea, the river deposits all the load at its mouth giving rise to the formation of a delta (See Fig. 5.7). Delta is a triangular relief features with its apex pointing up stream and is marked as a fan-shaped area of fine alluvium. The Greek letter (Δ) pronounced delta closely resembles the triangular delta of the river Nile. Some deltas are extremely large. The Ganga-Brahmaputra Delta is the largest delta in the world.

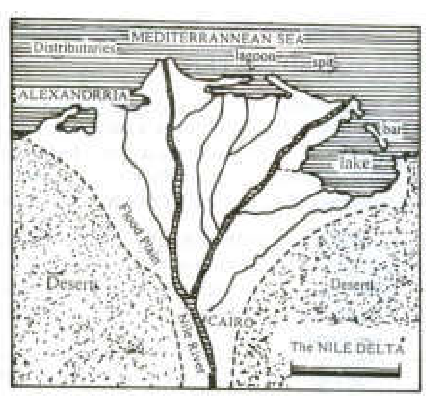


Fig. 5.7 Formation of a Delta

The following conditions favour the formation of deltas:

(1) active vertical and lateral erosion in the upper course of the river to supply large amount of sediments;

(2) tideless, sheltered coast;

(3) shallow sea, adjoining the delta and

(4) no strong current at the river mouth which may wash away the sediments.

Due to the obstruction caused by the deposited alluvium, the river discharge its water through several channels which are called distributaries. Some rivers emptying into sea have no deltas but instead they have the shape of a gradually widening mouth cutting deep inland. Such a mouth is called estuary. The formation of estuaries is due to the scouring action of tides and currents. But in most of the cases the original cause is the subsidence of the earth's crust in the area of the outlet. The two west flowing rivers of India, the Narmada and the Tapi do not form deltas. They form estuaries when they join the Arabian Sea.

- In the lower course land features produced by river are meanders, flood plains, braided steam, oxbow lakes, deltas and estuaries.

INTEXT QUESTIONS 5.2

1. Fill in the blanks:

   (a) The course of river from its source to mouth has been divided into three parts.

   These are (i)____________ (ii)___________ (iii)____________

   (b) A narrow and steep sides valley is called a ________________.

2. Fill in the blanks

   (a) The winding sections or loops of a stream are known as __________.

   (b) The load deposited by a river at the foot of a mountain while descending from it, is called ____________.

3. How is a piedmont alluvial plain formed?

4. Fill in the blanks

   (a) The meander completely cut off from the main river takes the form of a lake which is known as______________________________.

   (b) A number of branches of the main river carrying water to the sea are called ______________________________________.

   (c) A triangular shaped land feature made by a river at its month is called ____.

   (d) Instead of deltas, rivers Narmada and Tapi form ______________.

5.3 UNDERGROUND WATER

Seepage and water-holding capacity of the rock depend upon its space. If the rock is porous like sandstone, it will allow water to easily pass through it. Such rocks are called permeable rocks. On the other 'hand, if the rocks are not porous and do not allow water to pass through them, they are called impermeable rocks. However, if there are any cracks or joints in such rocks, water may pass through them.

- The part of rain or snow- melt water which accumulates in the rocks after seeping through the surface is called underground water.
- The rocks through which water can pass easily are called permeable rocks, and the rocks through which water cannot pass through are called impermeable rocks.

Although the amount of underground water varies from one place to another, its role in shaping the surface features of the earth is quite important. Most of its work is confined to subsurface areas though it plays an important role on surface also.

5.4 WATER TABLE

The water table marks the upper surface of the saturated zone of the ground water, where pores are completely full of water. The zones or horizons of permeable and porous rocks which are fully filled with water are called the zones of saturation. The upper level of this zone, below which the rocks are completely saturated with water is called the underground water level or the water table.

- The rocks containing underground water are called aquifers.
- The underground horizon of porous and permeable rocks which is filled with water is called zone of saturation.
- The level of underground water, below which the rocks are fully filled with water is called water table.

5.5 TYPES OF WATER TABLE

The level of the ground water table always fluctuates. It is never the same in any area. The level of the water table is controlled by the nature of land surface, variation in the amount of rainfall and the character of the underlying rocks. Water table is generally higher in areas of high precipitation and also in areas bordering rivers and lakes. Water-table changes according to seasons. It is higher in rainy season and lower during summers. On the basis of the variability, the water-table is of two type: (a) The permanent water table and (b) The temporary water table.

(a) Permanent Water Table

When the water table is stable or static and never falls below a particular level, it is called the permanent water-table. It is not affected by seasonal change. Wells dug upto this depth provide water in all seasons. They are perennial wells.

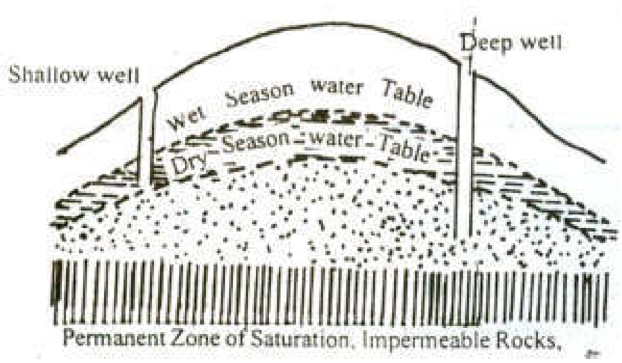


Fig. 5.8 Water Table

(b) Temporary Water Table

This is also known as seasonal water table. The level at which the water-table is not stable, keeps changing with season is called temporary water table. It means that during the wet season, the water table will be higher than it is during the dry season. It is the water table of the wet season that is temporary. Wells dug upto this level are not perennial. They dry up during the summer season. (See Fig. 5.8). You might have seen wells drying up during the summer season and becoming filled with water during the rainy season. It is because such wells are dug upto the temporary water-table.

- Nature of land surface, variations in amount of rainfall and the nature of rocks affect the underground water table of any area.
- The level below which the water table never falls is called the permanent water table.
- The water table which changes with seasons is called the temporary or seasonal water table.

INTEXT QUESTIONS 5.3

1. Fill in the blanks with the appropriate word given in the bracket against each statement.

   (a) The water which accumulates in the rocks after seeping through the surface is called ____________________(underground water, water-table)

   (b) The rocks filled with underground water are called ______________(Zones of Saturation, acquifers)

2. Name two types of water- table.

   (a)______________________________(b) ______________________

3. Name three factors affecting water-table.

(a)____________________(b) ______________(c) ______________

5.5 WELLS, TUBEWELLS & ARTESIAN WELLS

You must have seen wells and tubewells. They are man made holes dug into the earth's surface through which underground water is drawn for drinking purpose and for irrigation. They are either bored mechanically as in the (case of tubewells) or are dug by man (as in the case of wells) to reach a permanent water table.

A special type of well in which water rises automatically under its own pressure to the surface, either through a natural or a man made hole is called an artesian well. The name artesian has been derived from the province of Artoi in France, where the first well of this type was dug. Certain conditions are prerequisite of an artesian well.

(a) Arrangement of Rocks : For an artesian well, there should be layer of permeable rock lying between two impermeable rock layers. In such case, water present in the permeable rock does not escape. (See fig. 5.9)

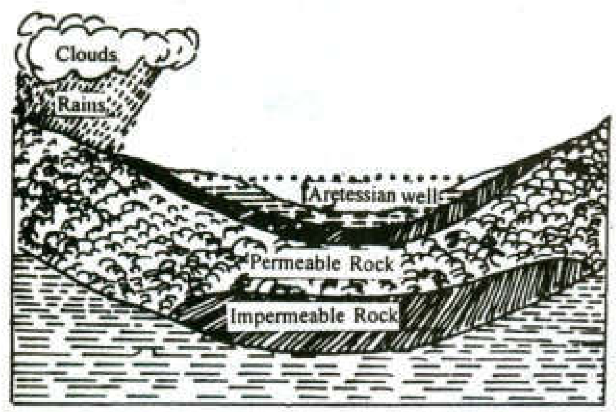


Fig 5.9 Artesian Well

(b) Structure of Rock Strata: Second condition for the occurrence of artesian wells is that the rock must have a synclinal or tilted structure.

(c) Intake Area of the Rock: It is necessary that the permeable rock should be exposed at the ground surface, so that rock can soak rainwater. This intake area should be sufficiently high so that enough hydraulic pressure will be developed to force the water upward in the well.

(d) Availability of Water: There should be sufficient amount of precipitation of infiltration of water in the area where the permeable rock is exposed at the surface.

- A man-made hole on the earth's surface through which underground water is obtained is called a well.
- A well in which water flows out automatically under its own pressure is called an artesian well.
- The necessary conditions required for occurence of artesian wells are - arrangement of rocks, structure of rock strata, high intake area of the permeable rocks and availability of water.

5.6 SPRINGS & GEYSERS

Springs are surface outflow of ground water through an opening in a rock under hydraulic pressure. In such cases the aquifer is either exposed at the surface or it underlies an impermeable rocks. The amount of water in the aquifer depends upon the amount of rainfall in that area, landform characteristic and the size of the aquifer. (See fig. 5.10)

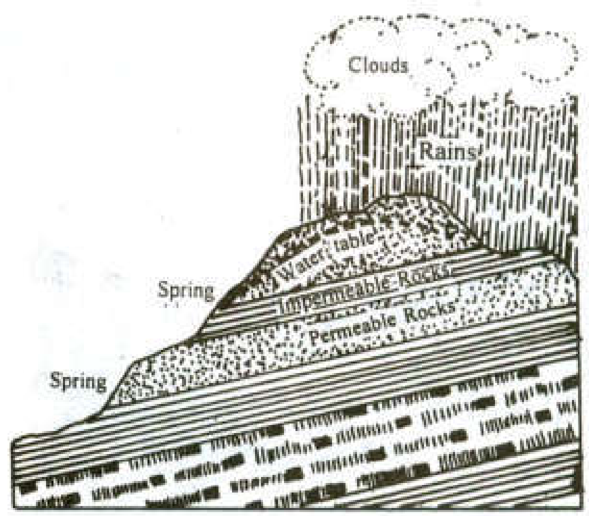


Fig. 5.10 Formation of Spring

(a) Hot Spring

Sometimes the water that flows out of the spring is hot. Such springs are called hot springs. They generally occurs in areas of active or recent vulcanism. In volcanic regions the underground water gets heated up by coming in contact with hot rocks or steam. Hot springs are found in many parts of India, especially in the Himalaya in Jammu and Kashmir and Himachal Pradesh. They also occur in Uttarakhand, Jharkhand, Haryana and Assam. Manikaran in Kulu Valley, Tatapani near Shimla, Jwalamukhi in Kangra, Sohna in Haryana, Rajgir and Sitakund in Jharkhand and Badrinath in Uttarakhand have hot springs.

(b) Geyser

Springs emitting hot water and steam in forms of fountains or jets at regular intervals are called geysers. The term geyser has been derived from Icelandic word *geysir*. In case of a geyser, hot water is ejected violently because of the pressure created by steam. The water does not come out continuously but it flows out intermittently. The period between two emissions is sometimes regular. The best example of geysers working at a regular interval is the Old Faithful in the Yellowstone National Park of U.S.A which is situated in the Rocky Mountain region. Its regularity is so accurate that tourists correct their watches by it. Geysers are found in Iceland, Yellowstone National Park of U.S.A and the northern part of New Zealand. (See Fig. 5.11)

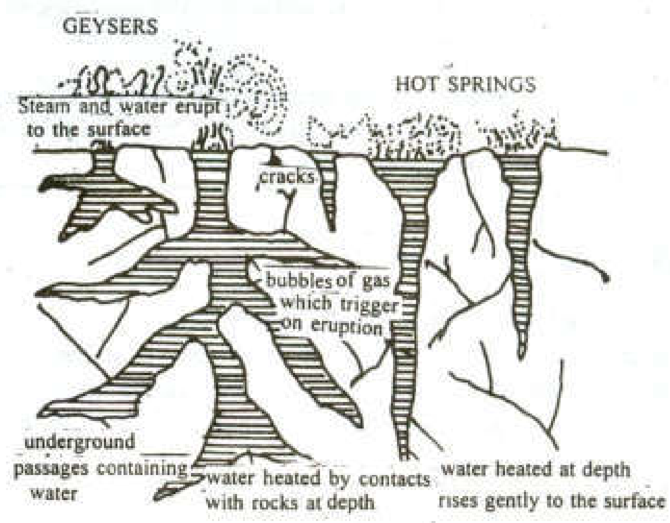


Fig. 5.11 Geyser

- The surface outflow of ground water through an opening in a rock under hydraulic pressure is called a spring.
- They can be hot or cold water springs.
- A geyser is a hot spring in which water is forced out by steam pressure at intervals.

INTEXT QUESTIQNS 5.4

1. Give one word answers for the following questions:

   (a) In which province of France was the first artesian well dug?

   ____.

   (b) Name the place in Kulu Valley where hot springs are found

   ____.

   (c) In which country is Old Faithful geyser located?

   ____.

(d) What should be the shape of the rock strata for occurrence of the artesian wells?

____.

5.7 LANDFORMS PRODUCED BY UNDERGROUND WATER

Underground water is also an agent of gradation like surface water. It also does the work of erosion, transportation and deposition, which results in formation of a number of picturesque topographical features. Topographical features formed by underground water can be seen particularly, in an highland composed of limestone on a large scale. This distinctive topography formed due to the action of underground water in limestone region is known as Karst topography. 'Karst' word comes from the Karst region of Adriatic Sea coast in Croatia (Yugosalvia) where such formations are noticeable. This region is made up of limestone rocks, where underground water is the most active agent of gradation.

- The distinctive topography formed by underground water in limestone region is called Karst topography
- Mechanical weathering and solution of limestone in water help the erosional work of underground water.

The topographical features created by the work of underground water on limestone are of two types.

(a) Topographical features formed on the surface, like sink holes and swallow holes.

(b) Topographical features formed underground like caverns, stalactites and stalgmites.

(i) Sink Holes

A sinkhole is a surface depression in a region of limestone or chalk terrain. Some sinkholes are filled with soil washed from nearby hillsides, while others are steep-sided, dugholes. They develop where the limestone is more susceptible to solution, weathering or where an underground cover near the surface has collapsed.

(ii) Swallow Holes

They are cylindrical in shape lying underneath the sinkholes at some depth. In limestone regions, the surface streams often enter the sinkholes and then disappear underground through swallow holes. It is so, because these holes are connected to the underground caverns on their other side.

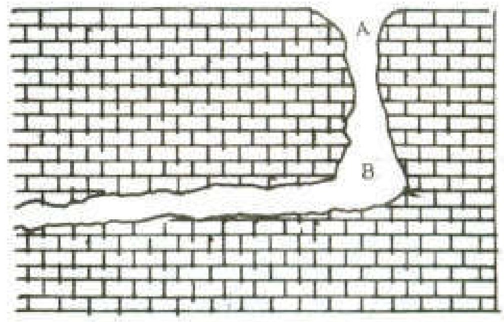


Fig. 5.12 A Sinkholes on the Surface of Limestone Rock
B-Swallo Holes at the bottom of a Funnel Shaped Sinkhole

(iii) Caverns

Caverns are interconnected subterranean cavities in bedrock formed by the corrosions action of circulating underground water on limestone. They are found near Dehradun in Uttarakhand and in Almora in Kumaon Himalayas. The caves of Kotamsar in the tribal district of Bastar in Chhattisgarh are famous caverns of India.

- The funnel-shaped depressions in limestone regions are called sink holes.
- Cyclindrical shape tubes lying underneath the sink holes are called swallow holes.
- Underground caves formed due to solvent action of underground water in limestone region are called caverns.

(iv) Stalactites and Stalagmites

They are the major depositional features formed in the caverns in limestone regions. The water containing limestone in solution, seeps through the roofs of the caverns in the form of a continuous chain of drops. A portion of the water dropping from the ceiling gets evaporated and a small deposit of limestone is left behind on the roof. This process continues and deposit of limestone grows downwards like pillars. These beautiful forms are called stalactites.

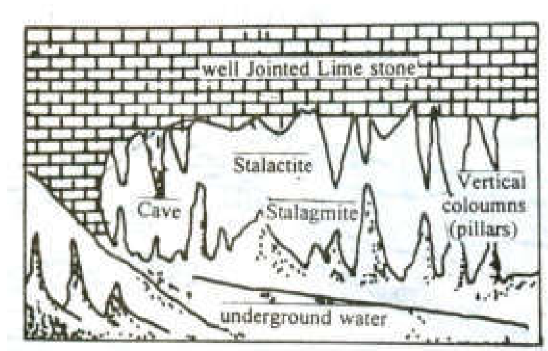


Fig. 5.13 Stalactites and Stalagmites

When the remain in portion of the water dropping from the roof of the cavern falls on the floor, a part of it is again evaporated and a small deposit of limestone is left behind. This deposit grows upward from the floor of the cavern. These type of depositional features are called stalagmites. As the process grows, both stalactite and stalagmite often join together to form vertical columns in the caverns.

- Solid conical depositional features hanging from the cavern's roofs are called stalactites.
- Broad conical pillars developing on the floor of the caverns in limestone regions are called stalagmites.

INTEXT QUESTIONS 5.5

1. Answer following questions in one or two words:

   a. Name the cavern located in Chhattisgarh.

   ______________________________________.

   b. In which country is "Karst" region located.

   ______________________________________.

   c. Name three regions of the world where hot spring and geysers are found

   (i)________________(ii)________________(iii)_____________

   d. Name two topographical features formed on the surface through the activity of underground water.

   (i)_________________________(ii)_____________________

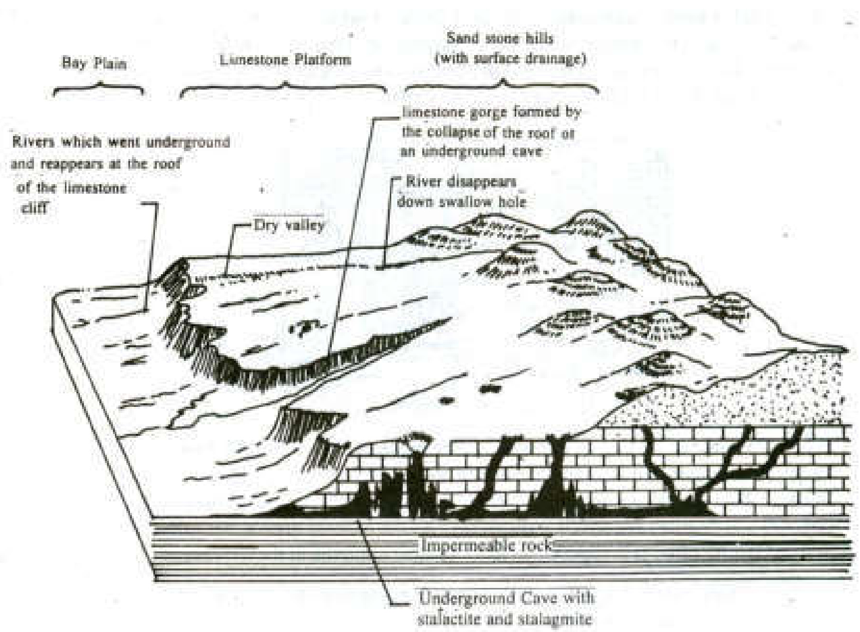


Fig. 5.14 : Limestone Landscape

WHAT YOU HAVE LEARNT

Among the agents of gradation, the running water is most effective and important.

A river has three fold action- (a) erosion (b) transportation (c) deposition. The rock material carried by river water is called its load. The ability of a river to move rock material depends upon- (a) the speed of water (b) the volume of water (c) the land structure and (d) the size, shape and weight of load. The work of river erosion is accomplished in four different ways-corrasion, corrosion, hydraulic action and attrition. The river transports its load in four different ways-by traction, saltation, suspension and solution. The deposition starts in plains and low lying areas. The whole path followed by a river is called its course. The course of a river is divided into three sections-(1) the upper course (2) the middle course (3) the lower course. The upper course lies in mountain. Here vertical cutting is more important. The land features produced are gorges, canyons, rapids, waterfalls. The middle course lies at the junction of mountain and plains. Here the work of river is mainly transportation with some deposition. The land feature produced is meander. The lower course lies in the plain area. Here the work of river is mainly deposition. The land features produced are ox-bow lakes, braided streams, alluvial and flood plains, delta and estuary.

The water which percolates inside the earth is called underground water. The upper limit of underground water is called water-table. The level of water table is not uniform but it varies seasonally. Consequently the water-table is of two types permanent water table and temporary water table. Underground water comes to the surface through wells, tubewells and springs. Wells and tubewells are manmade holes dug into the earth surface through which water is obtained. In addition to these ordinary wells, there is a special type of well in which water flows out automatically under hydraulic pressure. They are called artesian wells. Surface outpour of ground water that from rock opening under its own pressure is called a spring. Sometimes the water flows out of springs is hot, such springs are called hot springs. When the hot springs emits water in the form of a fountain, they are called geysers. Geysers are found mainly in Iceland, Yellowstone National Park, USA and New Zealand.

Underground water does the work of erosion, transportation and deposition which result in number of topographical features. The major depositional features made by underground water are stalactites and stalagmites, which develop in the caverns.

TERMINAL QUESTIONS

1. Answer briefly the following questions :

   (a) In what different ways does a river transport its load?

(b) List out factors which affect (1) energy of a stream and (2) carrying capacity of streams.

(c) In what different ways is the work of river erosion accomplished?

2. Distinguish between the following pairs:

   (a) estuary and deltas (b) flood plain and braided stream

3. The following landforms have been formed by rivers. Group them under erosional and depositional features.

   Gorge, V -shaped valley, meander, flood plain, alluvial fan, and canyon.

4. Explain the formation of the following with suitable diagrams:

   (a) Oxbow lake (b) Delta

5. Explain systematically the work of river as an agent of gradation at each of the three stages of its course.

6. Answer the following questions in brief:

   (a) Explain the meaning of the term underground water.

   (b) How do streams in limestone regions suddently disappear?

   (c) Why is construction of rails and roads difficult in areas of sinkholes.

   (d) Permanent watertable and temporary watertable.

   (e) Sinkhole and swallow hole. (f) Stalactite and stalagmite.

   (g) Permeable rocks and impermeable rocks. (h) Hot spring and geyser.

7. What is meant by 'Karst' topography? Name any five topographical features of karst topography and explaion any two of these with the help of diagrams.

ANSWERS TO INTEXT QUESTIONS

5.1

1. (i) Erosion (ii) Transportation (iii) deposition
2. Load
3. (i) Corrasion (ii) Corrosion (iii) Hydraulic action (iv) Attrition.
4. (i) Traction (ii) Saltation (iii) Suspension (iv) Solution.
5 (i) decrease in slope or in velocity of water (ii) decrease in volume of water.
6. Plains, low laying areas, lakes and seas.

5.2

1. (a) (i) upper (ii) middle (iii) lower course. (b) Gorge

2. (a) Meanders (b) Alluvial fan

3. By deposition of load at the foot of mountains.

4. (a) Oxbow lake (b) Distributaries (c) Delta (d) Estuaries.

5.3

1. (a) Underground water (b) Acquifers,
2. (a) Permanent water table (b) Temporary water-table.
3. (a) Nature of surface (b) Rainfall (c) Nature of rocks.

5.4

1. (a) Arto region (b) Manikaran (c) U.S.A. (d) Synclinal or titled.

5.5

(a.) Kotamsar b. Croatia (Yugoslavia) c. (i) Iceland (ii) Yellowstone National Park, USA (iii) New Zealand

d. (a) Sinkholes (b) Swallow holes.

HINTS TO TERMINAL QUESTIONS

1. (a) The river transports its load in four ways by traction, by saltation, by suspension and by solution.

   (b) (i) Slope, velocity, structure of river bed. (ii) Velocity, volume and size of particles.

   (c) The work of river erosion is accomplished by corrasion, corrosion, hydraulic action and attrition.

2. (a) Estuary- The funnel shaped mouth of river, where tides flow in and out and where fresh water and sea water mix. They are formed by drowning of coastal lowlands by a relative rise of sea level.

   Delta - A more or less triangular and level tract of alluvium formed at the mouth of river and traversed by the distributaries of the river.

   (b) Flood Plain - A plain bordering a river formed as a result of sediments deposited by a river and is generally liable to flooding.

   Braided stream - A river that gets divided into a network of interconnected channels, forming bars and sand island in between.

3. Work of Erosion - Gorge, 'V' shaped valley, Meander, Canyon.

   Work of Deposition- Meander, Flood plain, Alluvial Fan.

4. (a) Ox-Bow lake- The meanders develop in the middle course of the river. In course of time the strip of land between two loops becomes

narrower and narrower till the river cuts through this strip and takes a straight course. The former loop or meander is left behind completely cut off from the main channel forming an Ox-bow lake.

(b) Delta- A more or less triangular and level tract of alluvium formed at the mouth of river and traversed by the distributaries of the river.

5. River is the most important agent of gradation. The river has three stages. It remains busy doing the work of gradation in the three stages,

Upper Stage:- Gorge, waterfall, canyons are formed.

Middle Stage: Meanders, alluvial fans are formed.

Lower Stage:- Flood plains, braided stream, ox-bow lake, delta and estuary, are formed by the river.

6. (a) Underground water is that part of the rainwater which percolates through the ground and accumulates below the surface, is called underground water.

(b) A large number of sinkholes and swallow holes are found in limestone regions. The water of the streams enters these openings and the surface flow becomes underground. In this manner the streams in the limestone regions become underground.

(c) Construction of roads and railways is difficult in regions having a large number of sink holes and swallow holes due to which the level of the ground sinks in such regions.

(d) **Permanent water table:** This is the level of the water under the surface below which the water-table never falls. This water-table is not affected by seasonal change. Wells dug upto this depth are never dry. (See fig. 5.8)

Temporary water-table: In some regions the water-table is not permanent and it keeps changing with seasons. The water-table changing with seasons is called temporary water-table. Wells dug upto this depth become dry during the dry season.

(e) **Sink holes:** These are funnel-shaped openings in the limestone region. Their depth varies from 3 to 9 metres and the diameter of the mouth is more than one metre. (See Fig 5.12) Construction of roads and railways is difficult in areas having a large number of sink holes.

Swallow holes: They are cylincdrical tube-like openings which are connected to the lower part of the sink hole. Rivers of the limestone regions become underground through swallow holes.

(f) **Stalactite:** A portion of the water dropping from the ceiling gets evapourated and a small deposit of limestone is left behind on the roof. This process continues and deposit of lime stone grows downwards like pillars. These beautiful forms are called stalactites.

Stalagmites: When the remaining portion of the water dropping from the roofs of the cavern falls on the floor a part of it is again evaporated and a small deposit of limestone is left behind. This deposit grows upward from the floor of the cavern. These type of depositional features are called stalagmites.

(g) **Permeable rock:** The rock through which water can percolate are called permeable rocks. **Impermeable rocks:** The rocks through which water cannot percolate are called impermeable rocks.

(h) **Hot springs:** The springs emitting hot or warm water are called hot springs. These springs are found in areas of present or past volcanic activity. In such regions the underground water gets heated up by coming in contact with hot rocks or steam.

Geysers: Hot springs emitting hot water and steam at almost regular intervals are called geysers. The water in geysers is ejected with force as in case of a fountain.

7. For Karst topography see following figures 5.12, 5.13 and 5.14

(i) Sinkholes (ii) Swallow holes (iii) Caverns (v) Stalactites (iv) Stalagmites.

See description of these figures in Section 5.8.

6

THE WORK OF MOVING ICE, WIND AND SEA WAVES

You have learnt in the previous lesson about the gradational role of running water and underground water. In addition to these two agents, moving ice, wind and sea-waves too are powerful agents of gradation. These three agents too perform the threefold function of erosion, transportation and deposition. In other words, they are removing the weathered material, transporting it from the elavated ground and are depositing the same into low lying areas. This process also tends to 'grade' or 'level off' all irregularities on the surface of the earth in the areas of their operation. We will learn during the course of this lesson how each of these three agents of gradation functions as well as note the details of topographical features formed by each of them.

OBJECTIVES

After studying this lesson, you will be able to :

- define glacier, snow-line, snowfield, continental and valley glaciers;
- explain with the help of diagrams the formation of main erosional and depositional features produced by glaciers;
- differentiate among the various types of moraines;
- explain the features formed by the wind with the help of diagrams;
- explain with the help of diagrams the various relief features formed by sea-waves;
- give examples of features formed by these three agents of gradation preferably from India.

6.1 SNOW - FIELDS

In regions where the temperature always remains below freezing point, precipitation occurs in the form of snowfall. Wherever the rate of snow melting or its evapouration is lower than the rate of snowfall in a year, snow accumulates into great mass of ice. Permanently snow covered regions of this type are called snow - fields. Snow - fields occur in polar regions and on high mountainous areas. Snowfields are always found above the snow line. Snow line is an imaginary line above which there is permanent snow. The height of the snow - line is not uniform and is affected by latitude, amount of snowfall, direction of winds and slope.

- Region permanently covered by snow and ice is called snow- field.
- Snowline is the lowest limit of permanent snow. Factors affecting snowline are-latitude, amount of snowfall, direction of winds and slope of the land.

6.2 GLACIER

In region experiencing snowfall, the snow keeps on accumulating in layers one above the other. Its overlying pressure is applied to the underlying snow. It is so great that snow in lower layers becomes granular, hard and compact. The pressure also quickens the melting of some of the snow, which on refreezing starts turning into a granular ice. Again it is the pressure of the overlying layers which makes this solid mass of ice mobile. This great mass of ice moving more under its own weight is called a glacier. Its velocity is very low and it moves from a few centimetres to a few metres in a day.

Types of Glaciers

On the basis of their location or area of origin, glaciers are divided into two types:

(i) continental glaciers and (ii) valley glaciers.

(i) Continental Glaciers

A thick ice sheet covering vast area of land is called a continental glacier. The thickness of ice in such regions goes upto thousands of metres. Glaciers of this type build up at the centre and move outward in all directions. Continental glaciers of today are found mainly in Antarctica and Greenland. The precipitation in these regions occurs in the form of snow. It gets accumulated year by year because of relatively slower rate of its melting.

(ii) Valley Glaciers

When a mass of ice from the high mountainous regions starts moving down into the pre-existing valleys, it is called a valley glacier or a mountain glacier. The shape of the valley glaciers depends on the valley it occupies. Where the valley is broad, the glacier spreads outwards and where the valley is narrow, the glacier contracts.

The longest glacier in India is the Siachen Glacier in Karakoram range which is 72 kilometres long. Gangotri Glacier in Uttarakhand is 25.5 kilometres long. There are many smaller glaciers in other parts of the Himalaya. Their length varies from 5 to 10 kilometres. The two important rivers of India, the Ganga and Yamuna, originate from Gangotri and Yamunotri glaciers respectively.

- A moving mass of ice and snow is called a glacier. Glaciers are of two types-continental glaciers and valley glaciers.

INTEXT QUESTIONS 6.1

Answer the following questions briefly:

1. What is the name given to a moving mass of ice and snow?

   ______________________________.

2. What is the name given to the areas lying above the snow-line?

   ______________________________.

3. What is the name given to the lowest limit of snow - fields?

   ______________________________.

4. Name two types of glaciers.

   (a) ______________________________

   (b) ______________________________

6.3 LANDFORMS PRODUCED BY GLACIER

Like running water and underground water, glacier also does the work of erosion, transportation and deposition. Although the zone of action of glaciers is rather limited, topographical features made by them are frequently found spread over even in areas once affected by glacial action.

(A) Erosional work of glacier

As a glacier moves over the land, it drags rock fragments, gravel and sand along with it. These rock fragments become efficient erosive tools. With their help glacier scrapes and scours the surface rocks with which it comes in contact. This action of glacier leaves behind scratches and grooves on rocks.

The landforms created by glacial erosion are:

(i) Cirque (or Corrie)

Snow collects at the upper end in a bowl shaped depression, is called cirque. Layers of snow in the process of compaction and recrystallization are called firn. Sometimes the deepest parts of these hollows are occupied by accumulated-water, to form Corrie Lake (or Tarn).

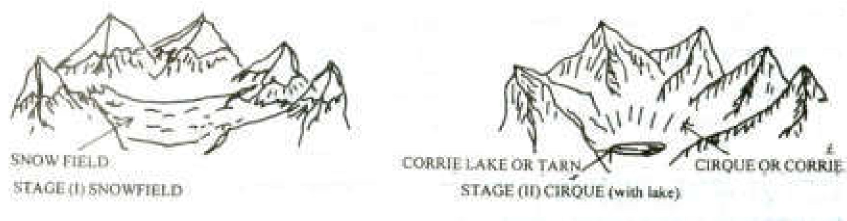


Fig. 6.1 Formation of Cirque

(ii) 'U' - shaped Valley

The glacier does not carve a new valley like a river but deepens and widens a preexisting valley by smoothening away the irregularities. In this process the glacier broadens the sides of the valley. The shape of the valley formed in this manner resembles the letter 'U'. It is therefore called a 'U' - shaped valley. (See Fig. 6.2). Such a valley is relatively straight, has a flat floor and nearly vertical sides.

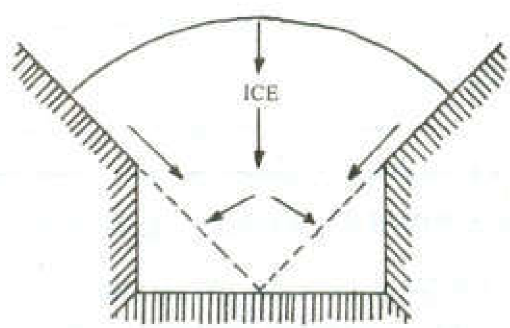


Fig. 6.2 U-shaped Valley

(iii) Hanging Valley

Just like tributary streams of river, there are tributary glaciers also which join the main glacier after moving over their mountainous path. These tributary glaciers like the main glaciers carve U - shaped valleys. However, they have less volume of ice than the main glaciers and thus their rate of erosion is less rapid. As a result their valleys are smaller and not as deep as that of the main glacier. Due to this difference in deepening; the valley of the tributary glacier is left at a higher level than that of the main glacier. The valley of the tributary glacier just looks like hanging downwards at the point of its confluence with the main valley. This type of a topographical feature is called a hanging valley. This feature is visible when ice has melted in both the valleys. (See Fig.6.3 and 6.4). When the ice in the hanging valley melts, a waterfall is formed at the point of confluence of this stream with the main river.

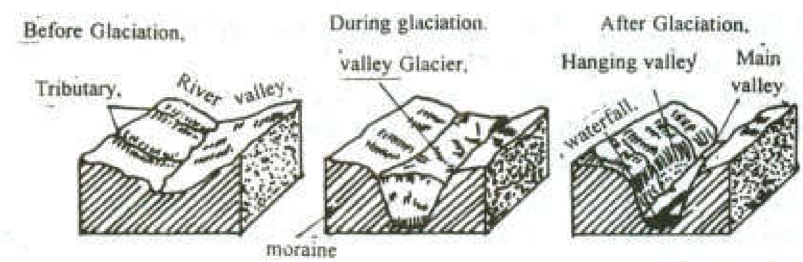


Fig. 6.3 Stages in the development of a glaciated valley

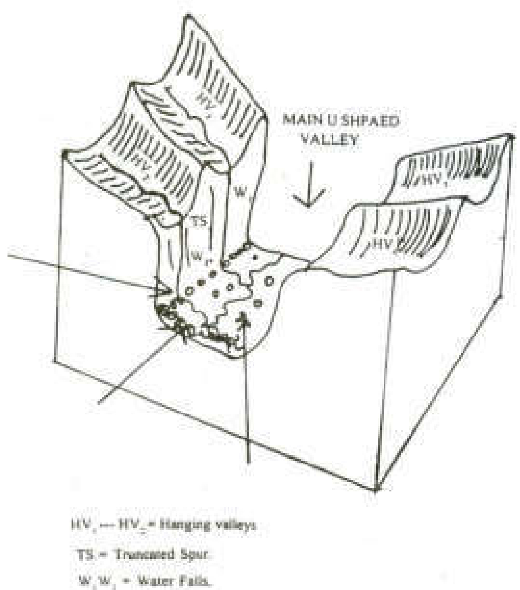


Fig. 6.4 Main Features of a Glaciated Valley

- The main erosional features formed by a valley glacier are (i) Cirque(or Corrie), (ii) U-shaped valley and (iii) hanging valley.

(B) Transportational work of Glacier

Although the glacier moves very slowly, it drags with it large boulders and rock fragments. Glacier gets this material from the mountain slopes, valley sides, valley bottom and from air. This material is called the load of glacier.

(C) Depositional work of Glacier

When the glacier melts or retreats, it deposits its load in different parts. The debris thus deposited are called moraines. Depending upon their location in the valley. moraines are of four types:- (i) terminal moraine, (ii) lateral moraine, (iii) medial moraine and (iv) ground moraine. (See fig. 6.5)

(i) **Terminal Moraine :** When the glacier melts, the debris are deposited at the end of the valley glacier in the form of a ridge. It is called terminal moraine. Morainic material ranges from fine clay to large angular boulders.

(ii) **Lateral moraine:** The moraine which is deposited on either side of a glacier is called lateral moraine.

(iii) **Medial moraine:** When two glaciers join each other their lateral moraines also join. Moraines thus formed on the confluence of two glaciers are called medial moraines.

(iv) **Ground moraine:** It consists of deposits left behind in areas once covered by glaciers. It is seen only after the glacial ice has disappeared by melting.

Fig. 6.5 A Glacier with Small Tributaries (showing moraines)

- Morains are accumulation of angular blocks of rocks, boulders, pebbles and clay that has been deposited by melting glacier or ice-sheet at the edges.
- The moraines deposited at the end of the valley glacier is called terminal moraine.
- Moraine deposited on the sides of the glacier is called the lateral moraine.
- Moraine deposited at the confluence of two glaciers is called the medial moraine.
- Moraine deposited at the bottom of the glacier is called ground moraine.

INTEXT QUESTION 6.2

1. Name three topographical features made by glacial erosion.

   (a) ________________(b)________________(c)__________________

2. Name one topographical feature made by glacial deposition.

____

3. Name three functions of glacier.

(a) ____________ (b) ____________ (c) ____________

6.4 LANDFORMS PRODUCED BY THE WIND

Wind action moves mineral particles when they are in a dry state and unprotected by a vegetation cover. These conditions are found in deserts and semiarid regions of the world, as well as on sandy shorelines.

(A) EROSION BY WIND

Wind performs three kinds of erosional work abrasion, attrition and deflation. Loose particles laying on ground surface may be lifted into the air or rolled along the ground by wind action. In the process of wind abrasion, wind drives sand and dust particles against an exposed rock or soil surface. When the wind borne material strike against each other, they are reduced in smaller particles. This process is known as attrition.The removal of loose particles from the ground is termed "deflation".

Landforms Produced by Wind Erosion

Some of the topographical features made by wind erosion are as follows: **(i) Mushroom Rocks (Or Rock Pedestals)**

When rocks, consisting of alternate hard and soft layers are subjected to wind abrasion, differential erosion results. The soft layers are easily eroded but the hard layer's resist erosion. As a result of undercutting near the base (due to greater amount of sand and rock particles being transported close to the ground), the resulting feature resembles a rock pillar shaped like a mushroom, It is aptly called rock pedestal or mushroom rock, Such formations are common in the Sahara Desert, and are also seen near Jodhpur. (See fig. 6.6)

Fig. 6.6 Mushroom Rock

(ii) Wind Eroded Basins

A land form produced by deflation is a shallow depression called a "blowout". The Quattara depression in Egypt is perhaps the finest example of such a hollow.

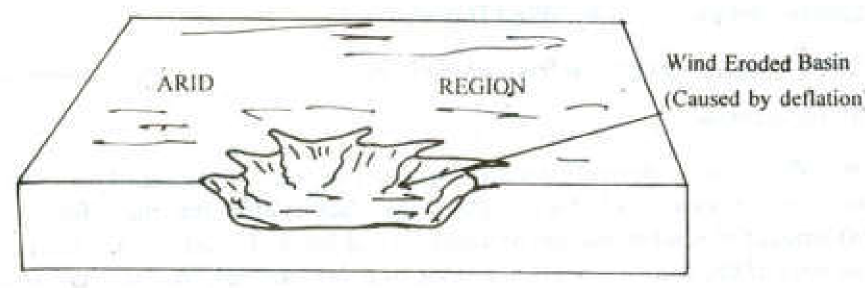


Fig. 6.7 Wind Eroded Basin

- Mushroom rocks are formed in the desert regions by means of wind erosion.
- Wind-eroded basins are formed by wind deflation.

(B) TRANSPORTATION BY WIND

Wind is an important agent of transportation in the arid region. The transported material is sometimes deposited in areas very far away from the place from where the dust particles have been picked. Winds blowing from Gobi Desert carry dust to the northern parts of China. In our country also winds blowing from Thar Desert bring dust particles to western Uttar Pradesh and the adjoining parts of Haryana & Punjab. This transported material is deposited in the fertile plains of Uttar Pradesh.

(C) DEPOSITION BY WIND

Under certain conditions, the material transported by wind starts getting deposited at a particular site along its running track. The conditions favouring it are:

(i) When the amount of dust particles present in the air exceed its carrying capacity, a part of the material being transported is deposited. This is the material which is in excess of the transportation capacity of the wind.

(ii) When the speed of the wind is reduced, its carrying capacity is also reduced. The material in suspension is thus deposited.

(iii) When an obstruction comes in the path of the wind, air has to rise above this obstruction. When it rises, the velocity of the wind is reduced and it starts dropping its load. This material is deposited in the form of a mound at the foot of the obstruction.

Landforms produced by Wind Deposition

Some of the topographical features made by wind deposition are as follows:

(i) Sand Dunes

Sand dunes are a special feature of the desert regions. They are of different types and have a variety of shapes. The major factors affecting their formation are (a) amount of sand available (b) direction and force of wind, (c) an obstruction in the path of the wind e.g. a bush, a stone or a dead animal. As long as the wind is strong enough to carry the sand, the sand dunes are mobile and they keep on shifting from one place to another. If vegetation or a line of trees starts growing on the dunes they become fixed. They also become stationary when they are blocked by a hillock. In case there is no such obstruction, sand dunes may bury agricultural land, plains and settlements.

There are two main types of sand dunes:

(a) Barchan

One common type of sand dune is an isolated heap of free sand called a barchan, or crescentic dune. This type of dune has the outline of a crescent, and the points of the crescent are directed downwind. On the upwind side of the crest, the sand slope is gentle and smoothly rounded. They are found in large numbers in the Sahara Desert.

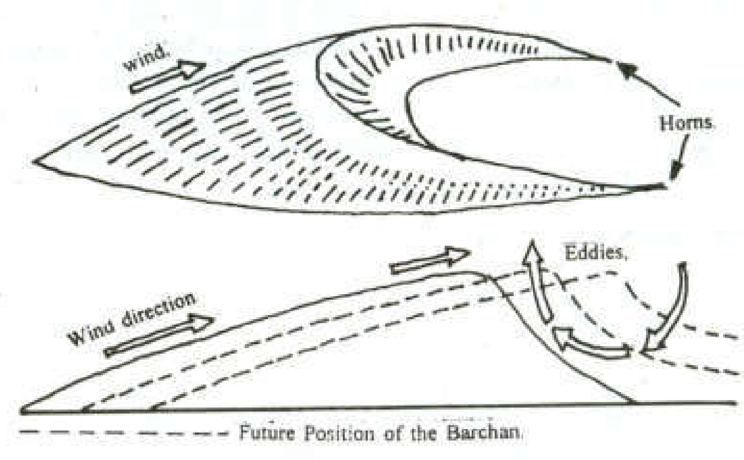


Fig. 6.8 Barchan and its Migration

(b) Seif Dunes

These are long, narrow ridges of sand that lie parallel to the direction of the prevailing winds. The winds blow straight along the corridors between the lines of dunes, sweeping the corridors clear of the sand, However, eddies set up in the winds blow towards the sides of the corridors, depositing sand there to form these narrow elongated dunes. Seif dunes are common in the western part of the Thar Desert of India.

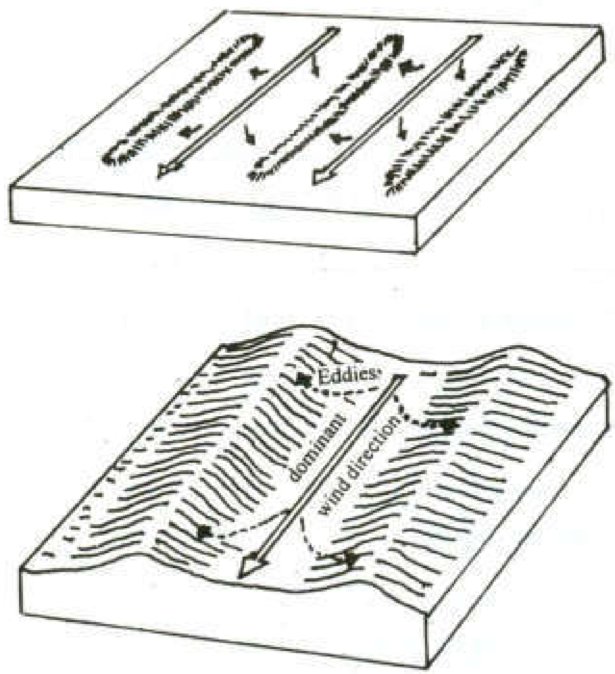


Fig. 6.9 Seif Dunes

(c) Loess

In several large areas of the world, the surface is covered by deposits of wind-transported silt that has settled out from dust storms over many thousands of years. This material is known as loess.

Loess tends to break away along vertical cliffs whenever it is exposed by the cutting of a stream or grading of a roadway. It is also very easily eroded by running water and is subject to rapid gullying when the vegetation cover that protects it is broken. The thickest deposits of loess are in northeast china, where a layer over 30m deep is common and a maximum thickness of 100m has been measured. Besides China, deposits of loess occur in Mississippi Valley of North America and north of Central European Upland in Germany, Belgium and France. Loess deposits are found in Austalia also.

- Depositional work of wind results in formation of topographical features like sand dunes, Barchan, seif dunes and loess.

INTEXT QUESTIONS 6.3

(a) In which region is the work of wind more effective?

____

(b) Name three important works of wind.

(i)_______________(ii)_______________(iii)_______________

(c) Which major topographical features are made by wind erosion?

(i) ____________________ (ii)_________________________

(d) Name three important topographical features made by wind deposition.

(i)_______________(ii)_______________(iii)_______________

(e) Where are the maximum deposits of loess found?

____.

6.5 LANDFORMS PRODUCED BY SEA WAVES

We are aware of the fact that the water in the oceans is never at rest. The tides, waves and ocean currents contribute to the restlessness of ocean. Their continuous effect on coast creates a number of relief features. The work of sea waves as an agent of gradation includes erosion, transportation and deposition. A number of topographical features are made through these actions of waves. Such features are found in the coastal regions. Let us study the work of sea waves in some more details.

(A) EROSION BY SEA WAVES

Sea waves have a great erosive force. In their role of an erosional agent they perform four functions. When the sea water loaded with rock fragments and sand attack the coastal rocks it is called *abrasion*. The rock particles present in the water hit against each other and break into progressively smaller particles. This process is called *attrition*. Thirdly the broadening of cracks and crevices in the cliffs along the coast due to the attack of the sea waves is called the *hydraulic action*. The rocks made up of limestone are subjected to *solution action* by the sea waves. All these processes help in formation of new features on the coastal margins.

- The three major works of sea waves are erosion, transportation and deposition.
- Abrasion, attrition, solution and hydraulic action are the processes which help in erosion by the sea waves.

Landforms Produced by sea Wave Erosion

Waves, like streams erode the coastal rocks with the help of rock fragments present in the water. Due to the continued erosion by waves, the coastline keeps retreating and a number of topographical features are formed in the process. Some of the important features made through sea wave erosion are mentioned here:

(i) Sea Cliff

The maximum impact of the sea waves is observed on the lower part of the coastal rocks and consequently the lower part of the rocks is eroded more rapidly than the upper part. This results in the formation of a hollow under the rock and with the passage of time this excavation in the lower part of the rock keeps on becoming larger.

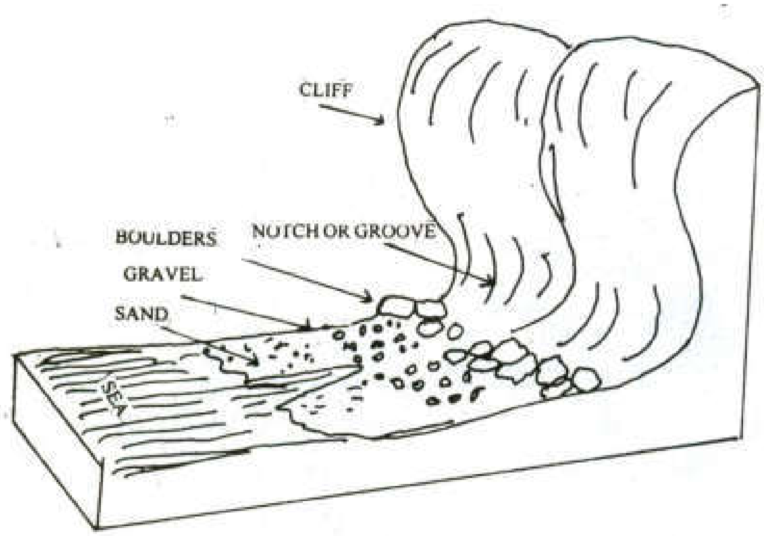


Fig. 6.10 A Sea Cliff

The upper part of the rock is thus left projecting out towards the sea. After sometime, this projecting part fall into the sea under its own weight. As a result a vertical wall is left. This vertical wall is called a cliff. In India a number of sea cliffs are found along the Konkan Coast of India.

(ii) Sea Caves

When the upper part of the coastal rock is hard and the lower part is soft, the erosion is not uniform. The lower part of the rock in such circumstances is eroded much faster than the upper part. Due to differential erosion a hollow is created in the lower part of the rock. When the waves pound against this hollow, air present in the hollow gets compressed. When the wave comes out of the hollow, the pressure on air is also released and it expands. Due to continuous compression of the air in the hollow, the rocks are subjected to a great pressure and they break. in this process, the hollows in the lower part of the rock keep on enlarging. With passage of time they attain the form of caves and are known as sea caves. Formation of caves depends upon the nature of the coastline and the force of the waves.

(iii) Sea Arches

When a part of coast extends to some distance into the sea, sea waves working from opposite directions cut a passage through the soft rocks. In the initial stages, this passage is a narrow hole but it enlarges into a broad arch. These broad door-like features are called sea arches or natural bridges.

(iv) Sea Stacks

When the roof of an arch is broken by erosion or under its own weight or due to any other reason a part of the original rock remains standing as a solitary mass. It may be the rock forming the side of the arch. This type of a feature is called a sea-stack. Stacks are of a number of types depending upon their shape and the nature of the rocks. Sometimes they take the shape of islands but such islands are not permanent. Small underwater stacks are known as stumps.

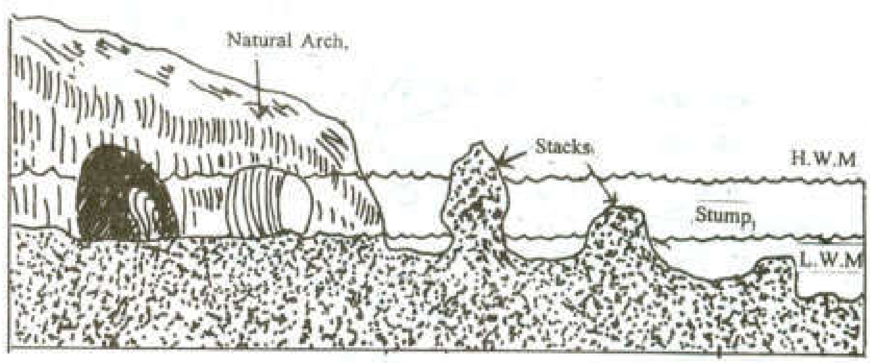


Fig. 6.11 Topographical features made through wave erosion

- Wave erosion is responsible for the formation of sea cliffs, sea caves, sea arches and sea stacks.

(B) Transportation by Sea Waves

Sea waves, currents and tides are the main agents of transportation of eroded material in the coastal regions. However, the role of waves is more important in connection with the formation of coastal relief features. The material deposited on the coasts by the rivers and glaciers etc. is removed and transported by the waves. Transportation by sea waves is carried out in two ways:

(i) Removal and transportation, towards the sea, of the material deposited by river etc. on the coast.

(ii) Carrying of material found in the sea to the coastal areas. During this process, the oceanic materials like pearls, conches and other shells are brought to the coast.

- Transportation by sea waves is responsible for ocean ward transportation of the material deposited on the coast and coastward transportation of the material found in the sea.

(C) Deposition by Sea Waves

Sea waves are helpful in the deposition of the material eroded from the coastal areas. Oceanic current are also helpful in deposition of the transported material. Deposition of the material along the coast is selective. The larger particles are deposited first therefore they are found near the coast. On the other hand, the finest particles are deposited last and they are deposited generally away from the coast. This selective deposition is sometimes altered or affected by a change in the intensity or force of the waves. Thus it is sometimes possible to find very fine particles deposited near the coast where generally larger particles are deposited.

A number of topographical features are formed due to deposition by waves and currents. Some of these topographical features are discussed here:

(i) Beach

Most of the material eroded and picked up by the waves is deposited near the coast. Due to this deposition, the sea becomes shallow and a part of the coastal area is raised above the water level. This raised portion is almost like a flat plain of a platform formed of gravel and sand. This type of depositional features along the coast is called a beach. Beaches are centres of tourist attraction. Marina Beach of Chennai and Kovalam Beach of Thiruvananthapuram are the famous beaches of India.

(ii) Sand Bar

Sometimes the deposits of sand and gravel laid down by waves and currents form embankment, separating shoreline from the sea. They thus form barriers between the sea and the mainland. Such deposits are called sand bars. They sometime pose difficulties in navigating.

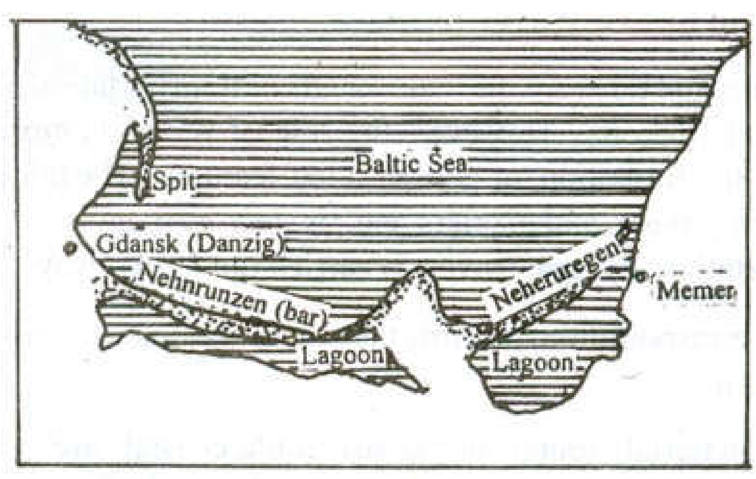


Fig 6.12 Sand Bar and Spit

(iii) Spit

When one end of a bar is attached to the coast and other extends into the sea, it is called a spit. These spits are formed by the accumulation of materials brought by waves like sand and gravel.

(iv) Lagoon

Sometimes due to deposition of waves and currents both the ends of the bar join to enclose a part of the sea water between the coast and the bar. This enclosed part of the sea forms a lake of saline water. This saline water lake is called a lagoon.

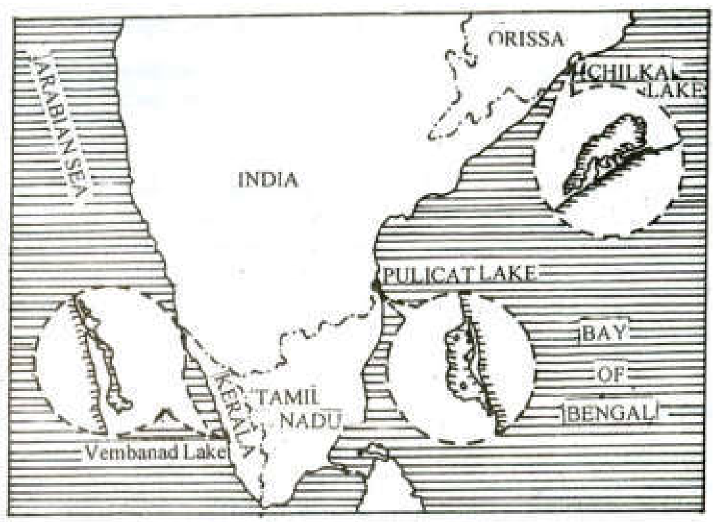


Fig. 6.13 Map showing Famous Lagoons of India

Sometimes the lagoons are formed due to wave erosion also. A lagoon is generally connected with the sea through a narrow passage. The Chilka and Pulicate lakes on the north-eastern coast and lake Vembanad on Kerala coast are examples of lagoon lakes in India.

- Topographical features like beaches, bars, spits and lagoons are formed by the action of waves.

INTEXT QUESTIONS 6.4

1. Fill in the blanks
   (a) Cutting of coastal rocks by sea waves is known as their ________work.
   (b) The four processes contributing to erosional action of sea waves are:
      (i) ___________(ii)__________(iii)__________(iv)__________

(c) Sea cliff is a result of _______________ action of sea waves.

2. Name any three relief features made through erosional action of sea waves.

   (i)_______________ (ii)______________ (iii)______________

3. Name two important factors on which the formation of the sea caves depends.

   (i) __________________(ii) __________________

4. Which action of waves is responsible for the formation of spit

   ____.

5. Classify following relief features made by erosional and depositional action of waves:

   Sea stack, Bars, Sea caves, Sea cliffs, Beaches and Arches.

Categories:

(i) Made through erosion (1) ___________(2)_________(3)_____________

(ii) Made through deposition (1) _________(2)________(3)____________

WHAT YOU HAVE LEARNT

In areas where the temperature always remains below freezing point, precipitation occurs in the form of snow. Therefore, these areas are covered with snow. Such regions are called snow-fields. Snow-fields are found always above the snowline. Snowline is that line above which the snow never melts completely. Moving ice is called a glacier. They are of two types- continental glaciers and valley glaciers. Glaciers do the work of erosion, transportation and deposition through which a number of topographical features are formed. The major topographical features of glacial erosion are the 'U' -shaped valleys and hanging valleys. The major depositional features of glacial action are the moraines. There are three types of moraines-terminal moraine, lateral moraine and medial moraine. Topographical features made by glaciers are found in areas of high altitude and high latitude.

Wind like running water, moving ice and underground water, is an important agent of gradation. Action of wind is more effective in arid and semi-arid regions. Wind erodes the rocks, transports the broken material and deposits it in different areas. These three actions of wind are known as erosion, transportation and deposition. Erosinal work of wind include abrasion, attrition and deflation. One of the major topographical features made by wind erosion is mushroom rock which resembles an umbrella in shape. The transportation work of wind is also extensive, the broken particles of rocks are transported to thousands of kilometres. Deposition of the transported material results in formation of a number of topographical features. The important ones among these are the sandunes and loess.

The most important agent shaping coastal landform is wave action. The important works of waves are the breaking up of the rocks, removal of broken material and laying down of this material in different parts of the coastal areas. These three actions of waves are called erosion, transportation and deposition. Erosion by waves is achieved through the processes of abrasion, attrition, hydraulic action and solution. Erosion by sea waves results in formation of topographical features like sea cliff, sea caves, arches and stacks. Transportation work of waves makes possible seaward movements of the material accumulated on the coast and coastward movement of the material found in the sea. Depositional work of sea waves is responsible for formation of topographical features like bars, spit, beaches and lagoons.

TERMINAL QUESTIONS

1. Answer the following questions in brief:

   (i) What is snowline?

   (iii) What is a hanging valley? How is it formed?

2. Distinguish between the following:

   (a) Continental glacier and valley glacier. (b) V-shaped valley and U-shaped valley.

3. Name the major relief features formed by glacial erosion and deposition and explain the process of formation of each with the help of diagrams.

4. In which region is the work of wind more effective? Why is it so?

5. Explain the three processes which help in the wind erosion.

6. How is a mushroom rock formed? Explain with the help of a diagram.

7. Where is the greatest deposits of loess found?

8. Which topographical features are formed through erosional action of sea waves? Explain the mode of formation of each.

10. How is a beach formed? Name two important beaches of India.

11. Differentiate between:

    (i) Erosional and depositional work of wind.

    (ii) Solution action and hydraulic action of sea-waves.

    (iii) Lagoon and beach.

ANSWERS TO INTEXT QUESTIONS

6.1

1. Glacier. 2. Snowfield. 3. Snow-line 4. (a) Continental glaciers, (b) Valley glaciers.

6.2

1. (a) U-shaped valley (b) Hanging valley (c) Cirque
2. Moraine
3. (a) Erosion, (b) Transportation, (c) Deposition

6.3

(a) Desert and semi-desert regions.

(b) (i) Erosion (ii) Transportation (iii) Deposition

(c) (i) Mushroom rock, (ii) Wind eroded basin

(d) (i) Sand dunes (ii) Barchans or Seifdunes, (iii) Loess

(e) In North China

6.4

1. (a) Erosional (b) (i) Abrasion, (ii) Attrition, (iii) Hydraulic action; (iv) Solution. (c) Erosional
2. (i) Sea cliffs (ii) Sea caves (iii) Sea arches (iv) Sea stack (any three)
3. (i) Nature of the coastline (ii) Force of waves
4. Depositional work.
5. (i) Made through erosion: Sea stacks, cliffs, caves, arches.

   (ii) Made through deposition: Bars, beaches.

HINTS TO TERMINAL QUESTIONS

1. (i) Snowline is an imaginary line above which there is Permanent snow.

   (ii) Refer to section 6.3 (a) (iii) for answer draw the diagram (Fig. 6.4) given on that page.

2. (a) (i) Continental glacier: A large area covered with ice and snow.

   (ii) Valley glacier: is formed when ice and snow start moving from high mountains into some pre-existing valleys. This moving mass of ice and snow is called a valley glacier.

(b) U-shaped Valley: Due to a steep slope in the higher mountainous regions, the flow of the rivers is very rapid. They erode the bottom of their valleys at a higher rate and this results in the formation of a V-shaped valley. (See figure in the foregoing lesson).

U-shaped valley: Glaciers do not form their valley as the river does. They flow through some old valleys. Such narrow valleys are broadened and deepened by the glaciers to form U-shaped valleys. U-shaped valleys are deep and steep-sided and they are formed through erosion on the valley floor and the valley sides. (See Fig. 6.2).

3. Major relief features formed by glacial erosion are (i) U-shaped valley, (ii) Hanging valley. Major relief features formed by glacial deposition are: (i) Lateral moraines, (ii) Terminal moraines, (iii) Ground moraines, (iv) Medial moraines.

4. In arid or desert regions

   Due to partial or total absence of vegetation cover, the wind fins the conditions ideal for blowing over vast areas uninterrupted. Besides mechanical weathering breaks the rocks into small particles which are easily blown away.

5. The three processes are abrasion, attrition and deflation. (For details Refer to Section 6.4 (A).

6. Mushroom rock is formed by wind erosion. (For details and see Section 12.6 (i).

7. Greatest expanse of loess deposits is found in North China. Where a layer over 30M is common and a maximum thickness of 1000M has been measured.

8. The major topographical features made through wave erosion are sea cliffs, sea caves, sea arches and sea stacks. (For details of their mode of formation refer to section 6.5 (A).

9. Beaches are formed through depositional work of : Sea waves. Two famous beaches of India are Marina Beach of Chennai and Kovalam Beach of Thiruvananthapuram. (For details of mode of formation see Section 6.5 (C) (i).

10. (i) Breaking lip and frictional reduction of rocks by wind is called erosion and the process of laying down of wind-borne material is called deposition. (For details refer tdsection 6.4 (A) and (C).

(ii) The term hydraulic action refers to the process of broadening of the rock joints and cracks by the pressure exerted by air entrapped in the coastal "rocks. The term solution refers to the action of water on the soluble rocks like limestone. Such rocks are dissolved by water and thus eroded. (For detail refer to Section 6.5).

(iii) Lagoon and beach are both formed through depositional action of waves. A beach is a raised portion on the sea coast made through deposition of sand and gravel. A lagoon is the enclosed part of the sea separated from the open sea by an enlarged bar. (For details refer to 6.5 (C) (i) and (iv).

7

MAJOR LANDFORMS AND THEIR ECONOMIC SIGNIFICANCE

You have learnt in the previous lesson that the landforms found on the earth's surface are the result of interplay between internal and external forces. The soft rocks are easily worn down by these forces. While the relatively harder rocks are not so easily worn down. Therefore, rocks have a great influence on the landforms developed in an area. The internal forces are perpetually elevating the earth's surface and the external forces about which you will study in the next lessons are constantly wearing down such elevations to make ,the surface level. This is how various landforms are formed by constant action of agents of gradation. These landforms are not only the physical features of the earth's surface but also the basis of human civilization. The major landforms found on the earth's surface are mountains, plateaus and plains. In this lesson, we will study the major landforms of the earth and their economic importance for us.

OBJECTIVES

After studying this lesson you will be able to :

- differentiate among the three major landforms found on the earth's surface;
- explain the process of formation of various landforms with the help of illustrations;
- classify mountains on the basis of their mode of formation;
- discuss the usefulness of mountains to man;
- list different types of plateaus and describe their economic significance;

- enumerate major types of plains and explain their influence on human life;
- locate major mountains, plateaus and plains on the outline map of the world.

7.1 MOUNTAINS

Mountain, plateau and plain are broad by present day land features of the earth's surface produced by the deformation of its crust. Among them, mountains are the most awe-inspiring landform. About 27% of the earth's surface is covered by the mountains. Generally, they are uplifted portions of the earth's surface which are much higher in contrast to the surrounding areas. But all uplifted or elevated areas are not mountains. In fact height and slope together give rise to a particular form of land which we identify as a landform. For example, the elevated portion in Tibet, which is about 4500 metres high above sea level, is called a plateau and not a mountain.

It may also be remembered that the formation of a mountain range takes millions of years. During these years, the internal forces of the earth uplifting the land are fighting against erosion wearing it down. In order to form one Mt. Everest, internal forces must push up the land faster than the external forces constantly eroding it. Therefore, mountains are those uplifted portions of the earth's surface which have steep slopes and small summit area rising more than thousand metres above the sea level. Mountains have the maximum difference of height between their high and low portions.

- The uplifted portions of the earth's surface with steep slopes and small summit area rising above 1000 metres and formed over a period of million of years are called mountains.

7.2 CLASSIFICATION OF MOUNTAINS

On the basis of their mode of formation, the mountains have been classified as:

(a) Fold Mountains
(b) Block Mountains
(c) Volcanic Mountains
(d) Residual Mountains

(a) Fold Mountains

We have studied in the last lesson how folds are formed in the rock strata by the internal earth movements. Mountain range mainly consisting of uplifted folded sedimentary rocks are called fold mountains. When these rocks are subjected to horizontal compressional forces for millions of years, they get bent into up and down folds. This leads to the formation of anticlines and synclines. Such earth movements occur from time to time and lift the folds to a considerable height which result in the formation of fold mountains.

- The mountains which have been formed by the uplift of mainly the folded sedimentary rock strata under compressional forces are called fold mountains.

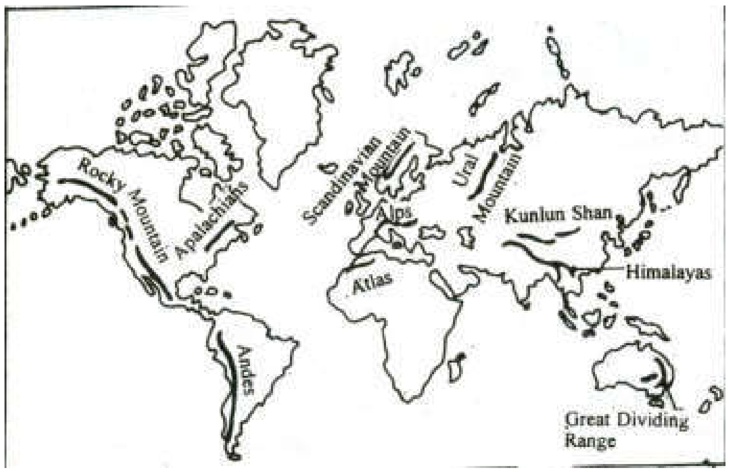


Fig. 7.1 Distribution of Important Fold Mountains of the World

The Himalayas in Asia, the Alps in Europe, the Rockies in North America and the Andes in South America are the most prominent fold mountains of the world, (See fig. 7.1). Since these mountain ranges were formed during the most recent mountain building period, they are known as young fold mountains. Some of these mountain ranges, for example, Himalayas, are still rising.

(b) Block Mountains

Block mountains are also formed by the internal earth movements. When the forces of tension act on the rocks, they create faults in them. When the land between the two almost parallel faults is raised above the adjoining areas, it forms a block mountain. It may also occur when land on the outer side of the faults slips down leaving a raised block between them. The rocks composing the fault levels may be flatlying or even folded. Block mountain is also called horst (see fig. 7.2). The Vosges in France, Black Forest Mountains in Germany and Sierra Nevada in North America are the typical examples of block mountains.

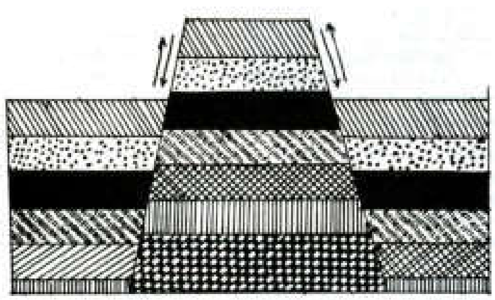


Fig. 7.2 Block Mountain or Horst

- The mountain formed by the uplift of land between faults or by the subsidence of land outside the faults is known as block mountain.

(c) Volcanic Mountains

We have learnt in the previous lesson that the interior of the earth is extremely hot. Due to high temperature deep inside the earth rocks turn into a molten magma. When this molten rock material is ejected to the earth's surface during volcanic eruption, it accumulates around the vent and may take the form of a cone. The height of the cone increases with each eruption and it takes the form of a mountain. As these mountains are formed by the accumulation of volcanic material, they are known as volcanic mountains or mountains of accumulation (see fig.7.3). Mount Mauna Loa in Hawaii Islands, Mount Popa in Myanmar, Vesuvius in Italy, Cotopaxi in Equador and Fuji Yama in Japan are examples of volcanic mountains.

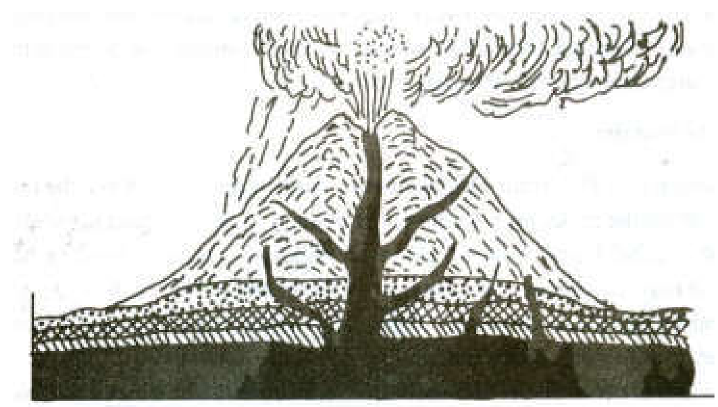


Fig. 7.3 Volcanic Mountains

- The mountains formed by the accumulation of volcanic material are called volcanic mountains or mountain of accumulation

(d) Residual Mountains

The weathering and different agents of erosion – rivers, winds, glaciers etc. are constantly acting on the earth's crust. As soon as an elevated mountain range appears on the earth's surface, the agents of gradation begin their work of leveling it down. To a large extent, the process of wearing down depends on the shape and structure of the rocks. After thousands of years, soft rocks are worn down into sand and the hard rocks are left standing up in the area that has been reduced in height. These are called residual mountains (fig.7.4). Hills like the Nilgiris, the Parasnath, the Rajmahal and the Aravalis in India are examples of residual mountains.

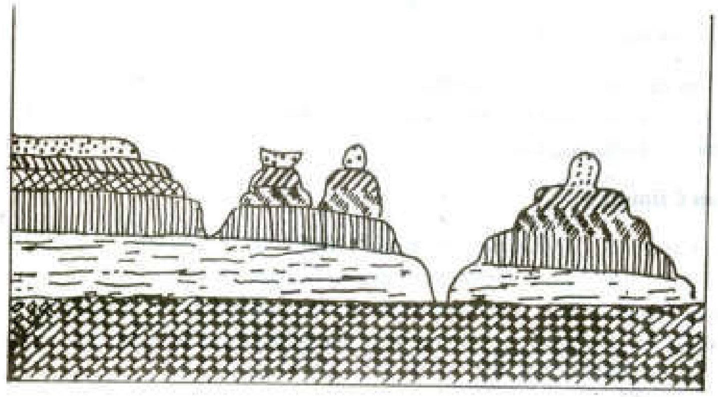


Fig. 7.4 Residual Mountains

- The elevated regions that have escaped weathering and erosion and appear in the form of mountains are called residual mountains.
- On the basis of their mode of formation, the mountains can be classified as Fold Mountains, Block Mountains, Volcanic Mountains and Residual Mountains.

7.3 THE ECONOMIC SIGNIFICANCE OF MOUNTAINS

Mountains are useful to us in the following ways :

(a) Storehouse of Resources

Mountains are the storehouse of natural resources. Large resources of minerals are found in mountains. The Appalachian range in the United States is well-known for coal and limestone deposits. We get timber, lac, medicinal herbs and wood for making pulp from the forests of the mountains. Tea and coffee plantations and some fruits orchards have been developed on mountain and hill slopes.

(b) Generation of Hydro-electricity

Hydro-electricity is generated from the waters of perennial rivers in the mountain regions. The mountainous countries like Japan, Italy and Switzerland, which suffer from the shortage of coal have developed hydro-electricity.

(c) Abundant Sources of Water

Perennial rivers rising in the snow fed or heavily rain fed mountains are the important source of water. They help in promoting the irrigation and provide water for many other uses.

(d) Formation of Fertile Plains

The rivers that originate in the high mountain region bring silt alongwith water to the lower valleys. This helps in the formation of fertile plains.

The great alluvial plain of northern India has been formed by the rivers Ganga, Sutlej and the Brahmaputra.

(e) Natural Political Frontiers

The mountain ranges do act as natural political frontiers between countries and protect them from invasions to some extent. The Himalaya have formed a political frontier between India and China.

(f) Effect on Climate

Mountainous areas have lower temperatures. They serve as climatic divide between two adjoining regions. The Himalaya for example form a barrier to the movement of cold winds from Central Asia towards the Indian subcontinent. They also force the South West Monsoons to ascend and cause rainfall on their southern slopes.

(g) Tourist Centres

The pleasant climate and the beautiful scenery of the mountains have led to their development as centres of tourist attraction. The tourist and hotel industries get an additional encouragement in such regions. Shimla, Nainital, Mussorie and Srinagar are some of the important hill stations of India which attract tourists all over the world.

INTEXT QUESTIONS 7.1

1. Name the three major landforms found on the earth's surface.

   (i)_______________ (ii)_________________ iii) ________________

2. Answer in brief

   (a) From which rock type have the fold mountains been formed?

   ____

   (b) By which forces are the fold mountains formed?

   ____

   (c) Name the four important hill stations of India.

   (i) ________________________ (ii)________________________

   (iii) _______________________ (iv) ______________________

3. Write the type of mountain in the brackets:

   (a) The Black forest ( )

   (b) The Nilgiris ( )

   (c) The Fuji Yama ( )

   (d) The Andes ( )

7.4 PLATEAUS

The plateaus cover about 18% of the earth's surface. This landform has a large elevated area on its top unlike a mountain and has nearly even surface out there. Very often rivers or streams cut out deep valleys and gorges in a plateau region. In place of its original smooth topography, it then changes into a disected plateau. A plateau, however remains much higher above the sea level of the nearby areas. Though normally 600 metres above sea level, there are plateau of Tibet and Bolivia, more than 3600 metres above sea level.

A plateau is an elevated area of more or less level land on its top. It has a large area on its top and steep slope on its side.

7.5 CLASSIFICATION OF PLATEAUS

On the basis of their geographical location and structure of rocks, the plateaus can be classified as:

(a) Intermontane Plateaus

(b) Piedmont Plateaus

(c) Continental Plateaus

(a) Intermontane Plateau

The plateau which are bordering the fold mountain range or are partly or fully enclosed within them are the intermontane plateaus (Fig 7.5). Vertical movements raise this extensive landforms of nearly horizontal rocks to thousands of metres above sea level. The extensive and over 4500 metres high plateau of Tibet is one such example. It is surrounded by folded mountains like Himalaya, Karakoram, Kunlun, Tien Shah on its two sides. The plateau of Colorado is another well known example, over one km high into which rivers have cut the Grand Canyon and a series of gorges. The plateau of Mexico, Bolivia and Iran are all other examples of this type.

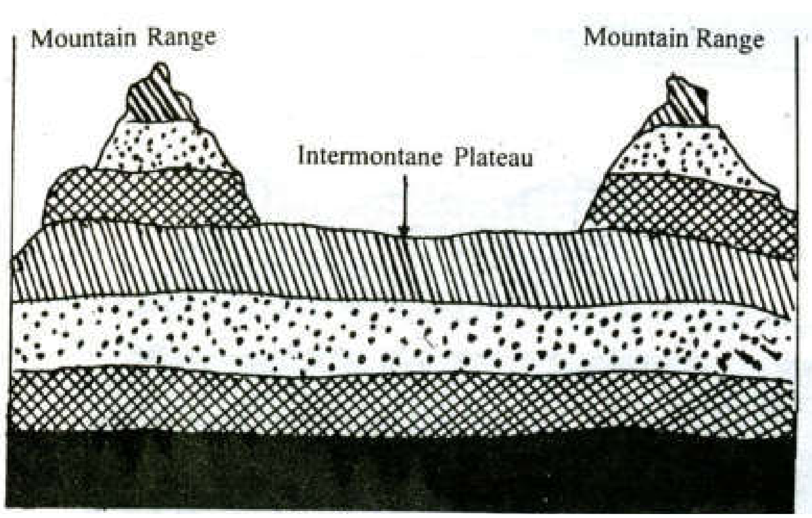


Fig. 7.5 Intermontane Plateau

(b) Piedmont Plateau

The plateaus that are situated at the foot of the mountains and are bounded on other sides by a plain or an ocean are called piedmount plateau Fig. 7.6. The plateau of Malwa in India, those of Patagonia facing the Atlantic ocean and the Appallachian situated between the Appalachian Mountain and the Atlantic Coastal Plain in U.S.A are their examples. In their case, the areas once high have now been reduced by various agents of erosion. For this reason, these are also called the plateaus of denudation.

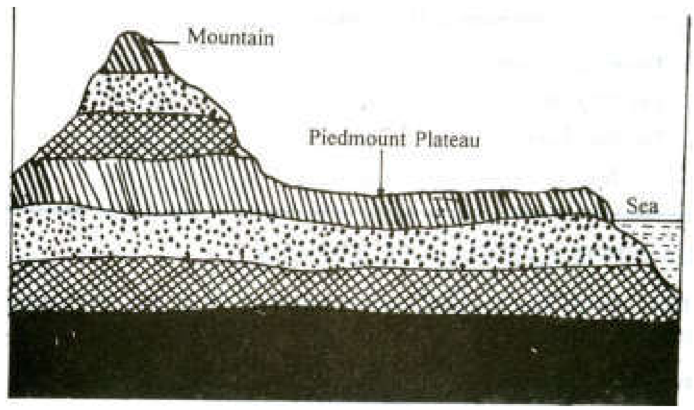


Fig. 7.6 Piedmont Plateau

(c) Continental plateau

These are formed either by an extensive continental uplift or by the spread of horizontal basic lava sheets completely covering the original topography to a great depth. The volcanic lava covered plateau of Maharashtra in India, Snake River Plateau in North West USA are the examples of this type. These are also, called the ptateau of accumulation.

All continental plateaus show an abrupt elevation in contrast to the nearby lowland or the sea (fig.7.7). As compared to other, these plateaus, cover a vast area like the Great Indian Plateau and those of Arabia, Spain, Greenland, Africa and Australia. They may be tilted on one side without any disturbance in the horizontal nature of underlying rock strata as in the case of Great Indian plateau.

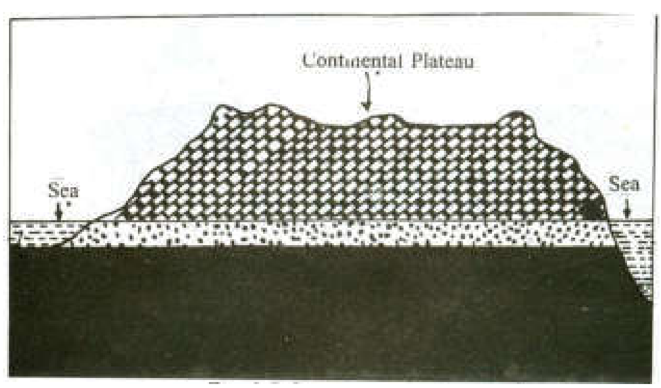


Fig. 7.7 Continental Plateau

- The plateau which are bordering or are enclosed within high mountain ranges are called intermontane plateau.
- The plateaus formed by the uplift of large areas or by the gradual spread and acumulation of basic lava sheets are called continental plateau.
- The plateaus which are situated at the foot of mountains and are bounded by a plain or an ocean on the other side are called piedmont plateaus.

[redacted]e prevalence of a patchy or the slow development of agriculture and building of roads on the plateaus. This factor also explains why the plateaus are sparsely populated. Nevertheless plateaus are extremely useful to mankind in the following ways:

(1) Storehouse of Minerals

Most of the minerals in the world are found in the plateaus. Besides, the extraction of minerals is relatively easier on plateaus. These minerals are indispensable as raw material for our industries. We get gold from the Plateau of Western Australia; copper, diamonds and gold from the Plateaus of Africa and coal, iron, manganese and mica from the Chota Nagpur Plateau in India.

(2) Generation of Hydel-power

Rivers falling down the edges of plateaus form water-falls. These water-falls provide ideal sites for generating hydel-power.

(3) Cool Climate.

The higher parts of the plateaus even in tropical and sub-tropical regions have cool climate. Hence they have attracted Europeans to settle there and develop their economy e.g. South and East Africa.

(4) Useful for Animal-rearing and Agriculture

Plateaus have large grassland areas suitable for animal-rearing specially sheep, goat and cattle. They provide a veriety of products such as wool, milk, meat and hides and skin. The lava plateaus as compared to all other plateau are richer in agriculture since their soil is very fertile.

- Plateaus are useful because of the presence and easier way of extracting minerals and favouring generation of hydro-power. Their suitable climate and sometimes fertile soils are helpful for developing animal-rearing and agriculture.

[redacted]

(a) Name the three types of plateaus.

(i) ____________ (ii) ______________ (iii) _______________

(b) Name three natural resources for which plateaus are well known

(i) _____________ (ii) _______________ (iii) ________________

(c) Write against each of the following the type of plateaus to which it belongs:

(i) The plateau of Patagonia ________________________________

(ii) The plateau of Bolivia _________________________________

(iii) The Decean plateau __________________________________

[redacted]ost important landforms found on the earth's surface. A low-lying relatively flat or slightly rolling land surface with very gentle slope and minimum local relief is called a plain. Plains occupy about 55% of the earth's surface. Most of the plains have been formed by the deposition of sediments brought down by rivers. Besides rivers, some plains have also been formed by the action of wind, moving ice and tectonic activity. Plains have an average height of less than 200 metres.

- A low-lying relatively flat or slightly rolling land surface with very gentle slope and minimum local relief is called a plain.

[redacted], plains can be classified into the following types:

(a) Structural plains,

(b) Erosional plains and

(c) Depositional plains:

(a) Structural plains

These plains are mainly formed by the uplift of a part of the sea-floor or continental shelf. These are located on the borders of almost all the major continents. The south eastern plain of the United States formed by the uplift of a part of the Gulf of Mexico is an example of this type of plain. The structural plains may also be formed by the subsidence of areas. One such plain is the central low-lands of Australia.

(b) Erosional Plains

These plains are formed by the continuous and a long time erosion of all sorts of upland. The surface of such plains is hardly smooth. These are therefore also called peneplains which means almost a plain. The Canadian shield and the West Siberian plain are examples of erosional plains.

- The plains formed by uplift or subsidence of an area are called structural plains.
- The plains formed by the continuous long term erosion of uplands are called erosional plains.

(c) Depositional plains

Fragments of soil, regolith, and bedrock that are removed from the parent rock mass are transported and deposited elsewhere to make on entirely different set of surface features–the depositional landforms. When plains are formed by river deposits, they are called riverine or alluvial plains. The Indo Gangetic plain of the Indian sub-continent, the Hwang-Ho Plain of North China, the Lombardy Plain of the Po river in Italy and the Ganga-Brahmaputra Delta Plain in Bangladesh are examples of alluvial plains.

The deposition of sediments in a lake gives rise to a lacustrine plain or a lake plain. The Valley of Kashmir and that of Manipur are examples of two most prominent lacustrine plains in India.

When plains are formed by glacial deposits they are called glacial or drift plains. Plains of Canada and North-Western Europe are examples of glacial plains.

When wind is the major agent of deposition, they are called loess plains. Loess plains of North- Western China are formed by the deposits of loess-air-borne fine dust particles.

- depositional plains are formed by the deposition of sediments brought down by rivers, glaciers and winds.
- depositional plains are sub-divided into alluvial, lacustrine, glacial and loess plains.

[redacted]wing ways:

(1) Fertile Soil

The plains generally have deep and fertile soil. Since the plains have a flat surface, the means of irrigation are easily developed. Both these factors have made the plains agriculturally so important that they are often called 'food baskets of the world'.

(2) Growth of Industries

The rich agricultural resources especially of alluvial plains have helped in the growth of agrobased industries. This has given employment to millions of people and has registered a marked increase in the national production and per capita income. Since the plains are thickly populated, plenty of labour is available for the intensive cultivation and for supplying work force for industries.

(3) Expansion of Means of Transport

Since the plains have an even surface it favours the building of roads, airports and laying down of railway lines.

(4) Centres of civilization

The plains have been the centres of many modern and ancient civilizations. The major river valley civilizations of the world have flourished in the plains only. Hencs, they are aptly referred to as the cradles of civilization. For example, there are the civilization of the Indus and the Nile Valley.

(5) Setting-up of Cities and Towns

Easy means of transport on land, the growth of agriculture and industries in plains have resulted in the setting-up and expansion of cities and towns. The most developed trade-centres and ports of the world are found in the plains only. Rome, Tokyo, Calcutta, Yangoon (Rangoon), Varanasi, Paris and other famous cities are situated in the plains. As much as 80% of the world's population lives in the plains.

- Plains are useful to man due to their fertile soils, growth of industries, development of transport, setting up of cities & towns and making them attractive as craddles of human civilisation.

[redacted]

(a) Name the three major types of plains.

(i) ______________ (ii) ______________ (iii) ______________

(b) To which category do the following plains belong?

(i) Lombardy Plain of Italy _________________

(ii) The Plain of North-Western China _______________

(iii) The Plain of Northern Canada _________________

2. Name two civilizations that flourished in the river valleys.

(i) __________________________(ii) _______________________.

3. Give two examples of lacustrine plains?

(i) ________________________(ii)____________________________

[redacted]s surface are the mountains, the plateaus and the plains. Besides the structure of rocks, the external and internal forces acting on the earth's surface also play a significant role in the development of these landforms. The landforms on the earth's surface have influenced human life in different ways. Fertile plains have been formed by the rivers originating in the mountains. These rivers are our perennial source of water for irrigation and other purposes. The plateaus are often described as the storehouse of minerals. Many of our major industries are dependent on the constant supply of these minerals. Besides this, the density of population is also influenced by the landforms. The plains including some of the valleys located in the mountain are teeming with people. Compared to the plains, the mountains and the plateaus have an uneven surface that is why they are generally sparsely populated.

[redacted]f mountains found in the world and describe the formation of each type.

2. Describe how plateaus are useful to man.

3. Why are the plains called 'cradles of civilization'?

4. Describe the significance of mountains.

5. Distinguish between the following:

(i) The intermontane plateau and the continental plateau.

(ii) The block mountain and the volcanic mountain.

(iii) The structural plain and the depositional plain.

6. Locate and label the following on the outline map of the world.

   (a) Rockies and Alps mountain ranges;

   (b) Patagonia and Tibetan plateaus;

   (c) Central low land of Australia and Hwang-Ho plains.

[redacted]

1. (a) Mountain (b) Plateau (c) Plain

2. (a) Sedimentary rocks (b) Horizontal compressional force (c) (i) Shimla (ii) Nainital (iii) Mussorie (iv) Sri nagar.

3. (a) Block mountain (b) Residual mountain (c) Volcanic mountain (d) Fold mountain .

7.2

(a) (i) Intermontane plateau (ii) Piedmont plateau (iii) Continental plateau

(b) (i) Mineral resources, (ii) water & soils, (iii) grassland

(c) (i) Piedmont plateau (ii) Intermontane plateau (iii) continental plateau.

7.3

1. (a) (i) Structural, (ii) Erosional and (iii) Depositional

   (b) (i) Alluvial plain, (ii) Loess plain and (iii) Erosional plain

2. (i) The Indus valley civilization (ii) The Nile valley

3. (i) Valley of Kashmir (ii) Manipur plain

HINTS TO TERMINAL QUESTIONS

1. See para 7.2 - classification of Mountains. Give examples of each type of mountain and illustrate your answer with diagram.

2. See para 7.6

3. Expand on the following points-availability of fertile soil, development of means of transport, growth of industries, development of trading centre. Give examples of different civilization which flourished on plains.

4. See para 7.3.

5. (i) See para 7.5 (a) and (c)

   (ii) See para 7.2 (b) and (c)

   (iii) See para 7.8 (a) and (c)

6. See Maps.

8

OCEANS: SUBMARINE RELIEF AND WATER CIRCULATION

Water is important for life on the earth. It is required for all life processes, such as, cell growth, protein formation, photosynthesis and, absorption of material by plants and animals. There are some living organisms, which can survive without air but none can survive without water. All the water present on the earth makes up the hydrosphere. The water in its liquid state as in rivers, lakes, wells, springs, seas and oceans; in its solid state, in the form of ice and snow, though in its gaseous state the water vapour is a constituent of atmosphere yet it also forms a part of the hydrosphere. Oceans are the largest water bodies in the hydrosphere. In this lesson we will study about ocean basins, their relief, causes and effects of circulation of ocean waters and importance of oceans for man.

OBJECTIVES

After studying this lesson, you will be able to :

- identify various oceans and continents on the world map;
- differentiate the various submarine relief features;
- analyze the important factors determining the distribution of temperature both horizontally and vertically in oceans;
- locate the areas of high and low salinity on the world map and give reasons for the variation in the distribution of salinity in ocean waters;
- state the three types of ocean movements - waves, tides and currents;
- explain the formation of waves;

- give various factors responsible for the occurrence of tides;
- establish relationship between the planetary winds and circulation of ocean currents;
- explain with suitable examples the importance of oceans to mankind with special reference to the significance of continental shelves for human beings .

8.1 OCEAN BASINS

Our earth is the only planet in the solar system which has water in abundance, hence, it is often called a 'watery Planet'. About 71 % of the earth's surface is covered by water.

Oceans form a single, large, continuous body of water encircling all the landmass of the earth. They account for four- fifth of the Southern Hemisphere and three fifth of the Northern Hemisphere. They contain 97.2 percent of the world's total water.

There are four principal oceans in the world which are separated largely on the basis of their geographical locations. These are the Pacific Ocean, the Indian ocean, the Atlantic Ocean and the Arctic Ocean. All the other seas, inland seas or the arms of the oceans, are counted within these four main oceans.

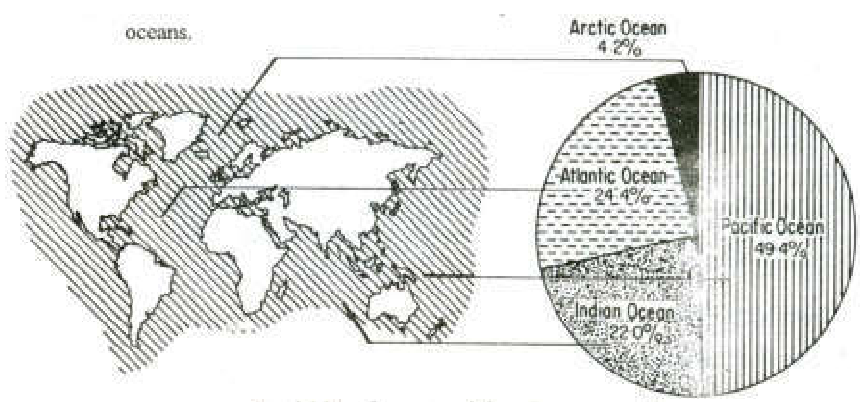


Fig 8.1 The Oceans and their Percentage Share of the Planet's total Ocean Area.

8.2 THE RELIEF OF THE OCEAN BASINS

The ocean water conceals a considerable variety of landscape very similar to its counterpart on the continents. There are mountains, basins, plateaus, ridges, canyons and trenches beneath the ocean water too. These relief features found on the ocean floor are called submarine relief. The Ocean basins are broadly divided into four major sub-divisions. They are:

(a) Continental shelf;

(b) Continental slope;

(c) Abyssal plains and

(d) The ocean deeps.

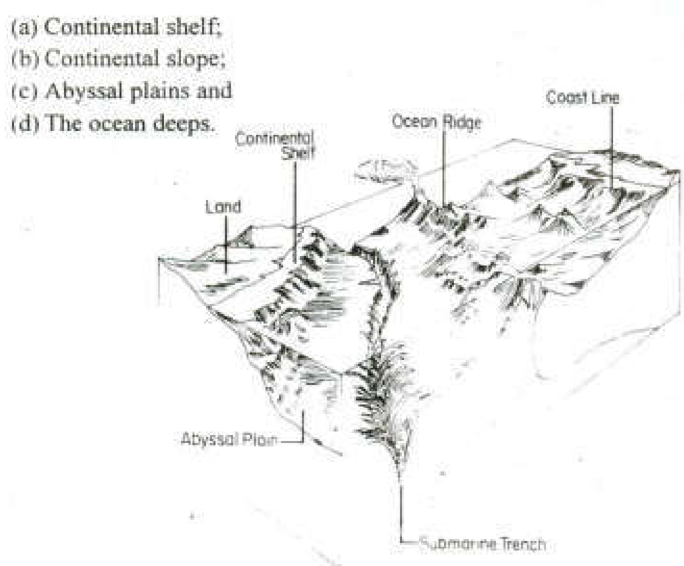


Fig 8.2 The Relief of the Ocean Basins

(a) Continental Shelf

There is no clear or well-defined line separating oceans from continents. Infact, continents do not end abruptly at shoreline. They slope seaward from the coast to a point where the slope becomes very steep. The shallow submerged extension of continent is called the continental shelf. The depth of this shallow sea water over the continental shelf ranges between 120 to 370 metres. The width of the continental shelf varies greatly ranging between a few kilometres to more than 100 kilometres. This variation can be seen even in the context of Indian peninsula. The continental shelf off the eastern coast of India is much wider than that of the western coast. Similar variations are seen all over the world. Off the coast of West Europe, it extends to 320 kilometres from the Cape of Land's End. Off the coast of Florida the shelf is 240 kilometres wide. They are much narrower or absent in some continents, particularly where fold mountains run parallel or close to the coast as along the eastern Pacific Ocean.

Most of the continental shelves represent land which has been inundated by a rise in sea level. Many regard their formation due to the erosional work of waves or due to the extension of land by the deposition of river borne material on the off-shore terraces. Off the coast regions which were once covered by ice sheets, they may have developed due to glacial deposits.

The continental shelves are of great importance to man. The shallow water over the shelf enables sunlight to penetrate through the water to the bottom and encourages growth of microscopic plants and animals called planktons. These planktons are the food for fishes. Continental shelves are the source of fishes, mineral including sand and gravel. A large quantity of the world's petroleum and natural gas is obtained from these shelves. The Bombay High and the recent discovery of petroleum in the Godavari basin are examples of on shore drilling on the continental shelf. Coral reefs and lipoclastic materials are also common on continental shelves.

One of the striking features of the continental shelf is the presence of submarine canyons which extend to the continental slope. These canyons are 'steepsided valleys' cut into the floor of the seas. They are very similar to the gorges found on the continents. Godavari Canyon in front of the Godavari river mouth is 502 metres deep.

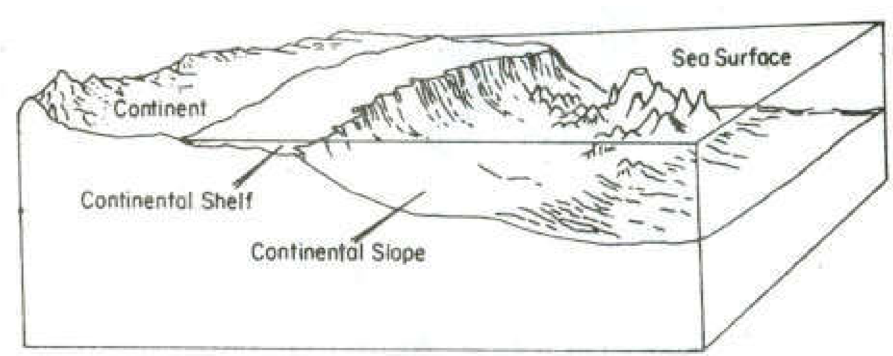


Fig 8.3 Submarine Canyon

One of the reasons for the formation of submarine canyon is underwater landslide. The sediments collected on the continental shelves get dislodged by a storm or a earthquake. The force of these moving sediments erode the slopes as they come down and as a result submarine canyons are carved out. The continental shelf is generally considered to be territorial water extent of the nations to which it adjoins.

- Continental shelf is the submerged portion of the continent which gradually slope seawards from the shore line.
- Submarine canyon is a deep valley cut into a continental shelf and extends to continental slope.

(b) Continental Slope

The continuously sloping portion of the continental margin, seaward of the continental shelf and extending down to the deep sea floor of the abyssal plain, is known as continental slope. It is charactersied by gradients of 2.5 degrees. It extends between the depth of 180 to 3600 metres. In some places, for example, off the shore of Philippines, the continental slope extends to a great depth.

Continental slopes, mainly due to their steepness and increasing distance from the land have very little deposits of sediments on them. Sea life is also far less here than on the shelf.

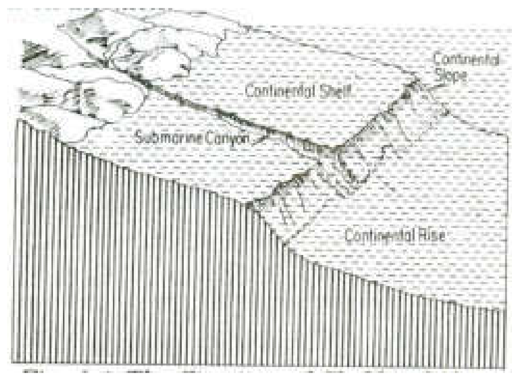


Fig 8.4 The Continental Shelf and Slope

Along the base of the continental slope is a deposit of sediments. This belt of sedimentary deposits form the continental rise. In some regions the rise is very narrow but in others it may extend up to 600 km in width.

- Continental slope is the steeply sloping part of the sea floor which marks the boundary between the sea floor and the continental shelf.
- The belt of sediments deposited along the base of the continental slope is called continental rise.

(c) Abyssal Plain

Abyssal plains are extremely flat and featureless plains of the deep-ocean floor. In fact, the abyssal plains are likely the most level areas on the earth. Abyssal plains covering a major portion of ocean floor between the depth of 3000m to 6000m. They were once regarded as featureless plains but modem devices have shown that they are as irregular as the continental plain or surface. They have extensive submarine plateaus, hills, guyots and seamounts.

The floor of the abyssal plain is covered by sediments. The plains close to the continents are covered mostly by sediments brought down from the land. But those seas which favour, an abundant growth of organisms have a thick layer of sediments, formed from the remains of living things.

These sediments are called oozes. Some of the open seas do not support enough life to produce ooze on the floor. They are covered with a type of sediment called red clay which is of volcanic origin or made up of tiny particles brought by wind and rivers.

(i) Submarine Ridges

The lofty mountain systems which exist on the continents is also represented beneath the ocean waters. These oceanic mountains are known as submarine ridges. They are linear belts occurring near the middle of the oceans and are also called mid-oceanic ridges. All the mid oceanic ridges constitute a world-wide system which is interconnected from ocean to ocean. These ridges are intersected by faults. The oceanic ridge is the site of frequent earthquakes. Volcanism is common in ocean ridges and it produces many relief features.

The Mid-Atlantic Ridge is the largest continuous submerged mountain ridge which runs from north to south in the Atlantic-Ocean. It is in the shape of S. At some places, the peaks, rise above the surface of water in the form of islands. Many of the islands are volcanic in origin. The East Pacific Ridge and Carlsberg Ridge are some of the important submarine ridges. (see fig 8.5)

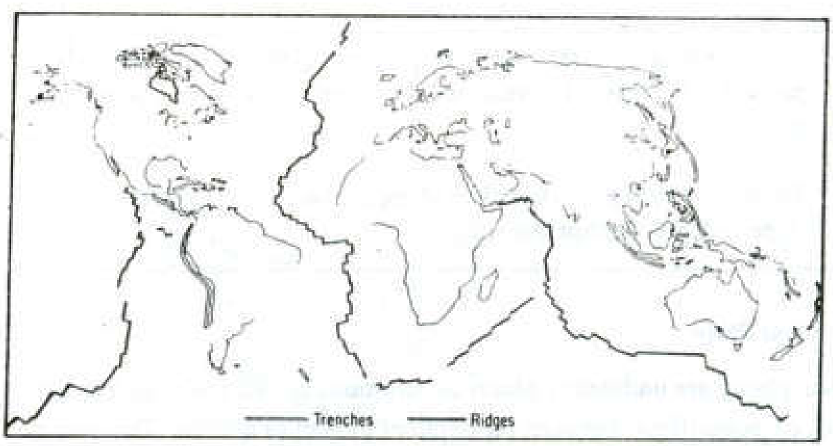


Fig 8.5 The World wide System of Submarine Ridges and Trenches

(ii) Seamounts and Guyots

Scattered over the entire sea floor are thousands of submerged volcanoes with sharp tops called seamounts. Sometimes they rise above the sea as isolated Islands. Hawaii and Tahiti Islands are the exposed tops of volcanoes. Volcano rising above the ocean floor whose top has been flattened by erosion and is covered by water is called guyot.   .

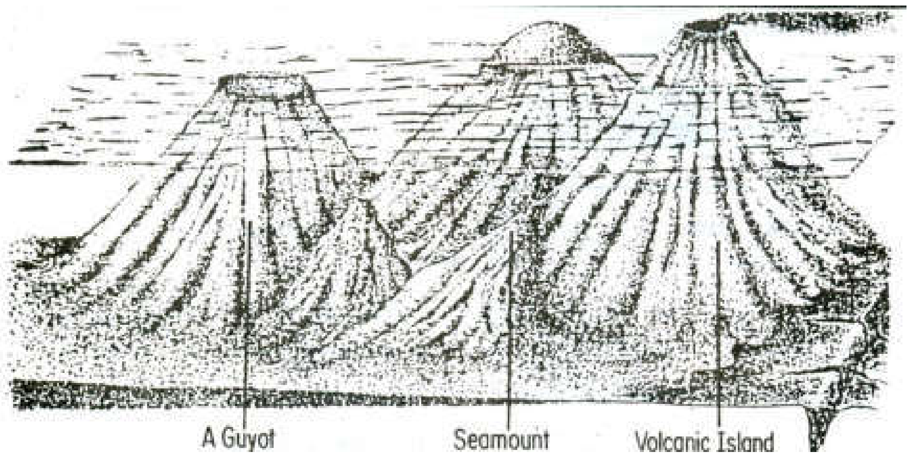


Fig 8.6 Seamounts and Guyots

(d) The Ocean Deeps

The ocean deeps are the deepest part of the ocean. They are long, narrow, steep sided and flat-floored depressions on the ocean floor. They are generally called submarine trenches. These trenches are not always located in the middle of the ocean basins, as may be generally expected but are situated very close or parallel to the continents bordered by fold mountains. They are usually found adjacent to the areas of volcanic and earthquake activity. Great earthquakes and tsunamis are born in them. They occur in all the major oceans. The Pacific Ocean has the largest number of trenches. The Mariana Trench in 'the Pacific Ocean is the deepest known part of the oceans. This trench is so deep that if we place the highest mountain of the world - the Mt. Everest in it, even this shall have a few kilometers of water above its summit.

- Abyssal plains are undulating plains of enormous extent which have many irregularities such as submarine plateaus, hills. guyots and seamounts.
- Long, narrow steep sided and flat floored depressions in the oceans are known as ocean deeps.

INTEXT QUESTIONS 8.1

1. Fill in the blanks:

   (i) The four oceans are

   (a)________(b)________(c)__________(d)____________

   (ii) The four major subdivisions of ocean basin are

   (a)________(b)________(c)__________(d)____________

(iii) The submerged portion of the continent is called

____

(iv) The two main types of sediments deposited in the abyssal plains are (a) ____________ (b) ______________

(v) A long narrow, steep-sided depression on the ocean floor is called __________________________

(vi) A submerged volcano with sharp top is called____________.

(vii) __________ trench in the Pacific Ocean is the deepest known part of the ocean.

2. Tick (√) the correct ending.

(i) The boundary between the continental shelf and ocean floor is always marked by

(a) continental slope (b) abyssal plain (c) trench (d) seamount.

(ii) The best fishing ground in the world are located in

(a) continental shelves (b) abyssal plain (c) submarine trenches (d) ocean deeps.

3. Write True against the correct statements and False against the Wrong.

(i) A submerged volcano with a flat top is called seamount

(ii) Oozes are formed by non-living things.

(iii) Submarine ridge is continuous -chain of mountains.

8.3 PROPERTIES OF OCEAN WATERS

The temperature and salinity are two important aspects of the ocean waters which affect their movements. Therefore, the temperature, salinity and density of the ocean water have special significance in the study of circulation of ocean waters.

(i) TEMPERATURE OF OCEAN WATERS

The temperature of the surface water of the oceans varies in much the same way as that of the land surface. This is because insolation is responsible for the varying quantities of heat which are received at different latitudes and in different seasons. Generally, the temperature is higher near the equator and gradually decreases towards the poles. . The mean annual temperatures of about 27°C or higher, are common in tropical seas but there is a general decrease towards the poles where the mean temperature of around 1.8°C are found. However, the decrease of temperature of surface water towards the poles or increase towards the equator is not uniform because drifting warm water from the tropical seas may move into higher latitudes or vice versa and gives a local increase or decrease of temperature. Upwellings of deep, cold water also reduce locally the surface temperature of tropical and subtropical sea waters.

The high temperatures of waters are found in enclosed seas in the tropics e.g. the Red Sea. The Arctic and Antartic waters are so cold that their surface remains permanently frozen down to a depth of several metres. In the summer months, parts of the ice break off as icebergs which dilute the water and lower the surface temperature of surrounding ice free seas.

There is also variation in the vertical distribution of temperature. Temperature decreases with increase in depth. This is because the surface of the sea water receives the largest amount of insolation. As the rays penetrate the water, their intensity is reduced by scattering, reflection and diffusion. However, the rate of decrease in the temperature is not equal at all depth. Upto a depth of about 100 metres, the temperature of water is about the same as that of the surface, while it falls from 15°C to about 2°C between the surface and a depth of 1,800 metres. The decrease between 1,800 and 4,000 metres is from 2°C to about 1.6°C.

The main process of heating the ocean waters are

(1) by absorption of heat from the sun

(2) by convection of heat through the ocean bottom from the interior of the earth.

The cooling processes are:

(1) by loss of heat to the atmosphere,

(2) by evaporation

(ii) SALINITY OF THE OCEAN WATERS

One of the most striking characteristics of the ocean water is its salinity or saltiness. When we speak of salinity we have in mind not only common salt or sodium chloride but a great variety of other salts as well. The dominant salts among these are sodium chloride & Magnesuim Chloride with 77.7% & 10.9% respectively. Due to the free movement of ocean water, the proportion of different salts remain remarkably constant in all oceans and even to great depth. But the degree of concentration of the salt solution in oceans does vary appreciably in different seas.

The salinity of the ocean water is produced by a large number of dissolved chemical compounds. Salinity is defined as the weight in grammes of solid material left after the evaporation of 1000 grammes of sea water. If the weight of solid material is 35 grammes (and it is usually very near this figure), the salinity would be shown $35^0/_{00}$ (35 per thousands). Salinity is expressed in this way rather than as percentage.

In the Baltic Sea, fresh water enters it from the surrounding land and reduce the salinity to $7^0/_{00}$ and it may fall in this sea as low as $2^0/_{00}$. But great evaporation combined with a very dry climate in the Red Sea region gives the water of this sea a high salinity of $41^0/_{00}$ to $42^0/_{00}$. In enclose sea, which are areas of inland drainage such as the Caspian Sea, the salinity is very high, $18^0/_{00}$ in the Dead Sea of Jordan. The salinity may by as high as $25^0/_{00}$. The variation of salinity in different seas and oceans is affected by

(i) The rate of evaporation,

(ii) The amount of fresh water added by streams and icebergs,

(iii) Mixing of the ocean waters.

INTEXT QUESTIONS 8.2

(1) Define the term salinity

____

(2) When 1000gm of water from the Great Salt Lake is evaporated, 250gm of salt remains. What is the salinity of the Great Salt Lake?

____

(3) Fill in the blanks.

(a) Solar radiation is __________ in equatorial region on in the polar region.

(b) The average salinity of sea water is ________________

(c) Enclosed seas are the areas of ____________ salinity.

8.4 MOVEMENTS OF OCEAN WATERS

The waters of oceans are never still. The oceans actually exhibit three major types of movements - waves, tides and currents.

(I) WAVES

Waves are oscillatory movements that result in the rise and fall of water surface. Infact, the movement of each water particle in a wave is circular. The movement of the waves is just like the wind blowing across a wheat field and causing wave like ripples to roll across its surface. The wheat stalk returns to its original position after the passage of each wave of wind. Similarly water also returns to its original position after transmitting a wave.

A wave has two major parts. The raised part is called the *crest.* Between the two crests are low areas called *troughs.* The vertical distance between trough and crest is called wave height. The horizontal distance between two crests or two troughs is called wave length. The time it takes for two crests to pass a given point is called wave period. Fast moving waves have short period while slow moving waves have long period (see fig 8.7)

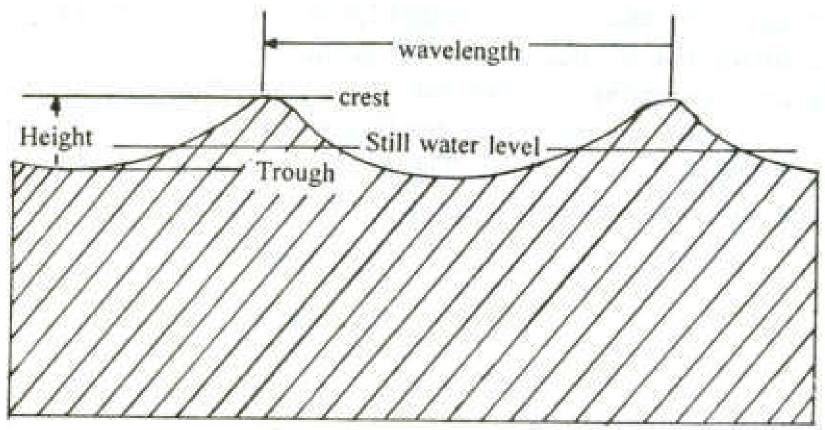


Fig. 8.7 Part of a Wave

The size and force of a sea wave depends on three factors

(i) Velocity of the wind,

(ii) The length of time the wind blows and

(iii) Distance that the wind has travelled across the open sea. This is called a fetch.

Waves are an important agent of erosion. When waves are associated with storms or volcanic eruption, they are very violent and cause damage on coastal areas. They are also a source of energy and efforts are being made to harness their energy.

- Waves are the to and for movements of ocean water in which water particles move roughly in a circular path. They rise up in a crest, advance, descend and retreat in the trough as the wave passes.

(II) TIDES

Along a coast all over the world, we observe the sea water moving both upwards and downwards at rates varying from place to place. Such a variation in sea level occurs from hour to hour and from day to day. At the time of a rising sea level, the incoming tide towards the land is spoken of as a flow tide or a flood tide. At the time of a falling sea level after a few hours, we speak of the tide water going out or withdrawn, is an ebb tide (low tide). The flood tide is a high tide and the ebb tide is a low tide. Tides are really the largest waves keeping the ocean water restless. Twice a day regularly at constant intervals, a tide flows in and twice a day it ebbs away. Twice a month, flow tides are higher and the ebb tides are lower than the average. Also twice a month flow tides are lower and the ebb tides are higher than the average.

However the regular interval between two high tides or between two low tides is 12 hours and 25 minutes and not exactly 12 hours. Each day (in 24 hours) the high tide arrives about 51 minutes later than on the previous day. It is so because each day the rising and setting of the moon also falls behind by 51 minutes. It takes 24 hours and 50 minutes for the rotating earth to bring the same meridian vertically below the moon every day. The timings of the tides at a place on a coast will be clear to you from the following examples.

High Tide	06.00 AM
Low Tide	12.13 PM
High Tide	06.25 PM
Low Tide	12.38 AM
High Tide	06.51 AM next day

The factors responsible for bringing about such a variation in the regulation and the size of tides are:

1. The location of the sun, the moon and the earth in relation to each other which is rarely in a straight line.
2. The distances of the sun and the moon from the earth are not constant.
3. Our globe is not entirely covered with water.
4. The outline or shape of the coast may help or hinder the tides.

Still the tides follow each other with a great punctuality at any given coast. What are the forces that generate the tides? The earth attracts and is also attracted by the sun, the moon and by other planetary bodies. It is called the gravitational force and it operates between the sun, moon and the earth. It sets the ocean waters in motion producing a tidal current. Tides are the proof of such a gravitational pull.

The moon and the sun both exert their gravitational force on the earth. The Oceans, Submarine Relief And Circulation sun which is bigger in mass than the moon is also at a greater distance from the earth than the moon. Therefore, the gravitational attraction of the moon is more effective on the earth than the gravitational attraction of the sun. Since the water is liquid and mobile, its bulging in the direction facing the moon is easily noticed, yet a lower tidal bulge also develops on the other side of the earth farther from the moon because of moon's least attraction. (see fig 8.8)

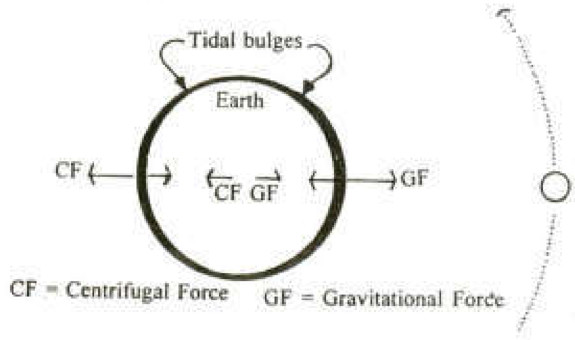


Fig 8.8 Formation of Tides

- The rise and fall of the ocean water at a particular place are called tides.
- Interval between two high tides or low tides is exactly 12 hours 25 minutes.
- Tides are produced as a result of gravitational pull of the moon and the Sun on the earth.

(a) SPRING AND NEAP TIDES

The moon, as it is closer to the earth, exerts twice the gravitational pull of the sun on the earth. When the sun and the moon are in a line as on a new moon *(Amavasya)* or a full moon day *(Purnima)* both of them pull together at the same time in the same direction. This combined pull produces an extra large tide. It is called a *spring tide* see fig 6.9(1). In its first quarter *(Asthmi Shukla Paksha)* and the third quarters *(Asthmi-Krishna Paksha)* the gravitational force of the two heavenly bodies is at right angle. At this time, the two pulls are opposing each other and are not acting in the same direction. In other words they cancel or neutralize each other's effect. It produces a weak tide which is called a *neap tide* see fig.8.9(2).

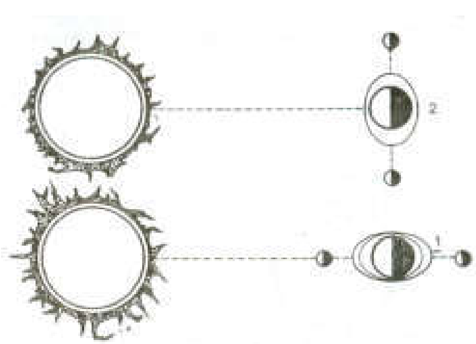


Fig 8.9 Spring(1) and Neap(2) Tides

(b) EFFECT OF TIDES

The phenomenon of tides, which is so universal has been of immense value to man for ages. Tides act as link between the port and the open sea. Some of the major ports of the world, such as London port on the river Thames and Kolkata port on river Hugli are located on the rivers away from the sea coast. The tidal current clear away the river sediments and slows down the growth of delta. It increases the depth of water which help ships to move safely to the ports. It also acts as a source for producing electricity.

- Tides make the rivers navigable for ocean going ships, clear sediments, retard formation of delta and are a source of producing electricity.

INTEXT QUESTIONS 8.3

1. Choose the correct alternative for the following statements:

   (i) The source of most waves on the sea surface is________________.

   (a) winds (b) tides (c) earthquakes (d) density difference

   (ii) The length of time for one crest of a wave to follow another crest past is called the wave ________________

   (a) height (b) length (c) period (d) frequencey

   (iii) The time between a high tide and a low tide is about __________

   (a) 6 hours 13 minutes (b) 12 hours (c) 24 hours (d) 24 hours, 50 min

2. Define tide?

   ____

3. Define wave length?

   ____

4. If the first high tide occurred at 9.00 a.m on one day, when will the first high tide most likely to occur the next day?

   ____

(III) CURRENTS

The ocean current are horizontal flow of a mass of waters in a fairly defined direction over great distances. They are like stream of water flowing through the main body of the ocean in a regular pattern. The average speed of current is between 3.2 km to 10 kms per hour. Ocean currents with higher speed are called stream and currents with lower speed are called drift.

Ocean currents can be broadly divided into two :-

(1) Those currents which flow from equatorial regions towards poles have a higher surface temperature and are called warm current.

(2) Those currents which flow from polar regions towards equator have a lower surface temperature and are called cold currents.

The origin. and the nature of circulation of the ocean currents depend on the following factors:

(i) Differences in Density

The sea water's density varies from place to place according to its temperature and proportion of salinity. The higher the temperature of water, the lesser will be the density. Hence the less dense water of the equator moves towards the poles while the cold and dense waters of the poles move towards the equator. Thus cold currents always move from the poles to the equator while the warm currents move from equator towards the poles

Currents are also produced by changes in the salinity of ocean waters. If the salinity of the water is more, the density of the water increases, and the water sinks. Hence water with Lower salinity flows on the surface of the high salinity water while an under current of high salinity flows towards the less dense water. The currents caused by difference in salinity are found between the Atlantic ocean with lower salinity and the Mediterranean Sea with higher salinity.

- The higher the temperature of water, lower is its density.
- The higher the salinity of water, higher is its density.

(ii) The Earth's Rotation

We have studied in an earlier lesson that the earth's rotation deflects air to its right in the northern hemisphere and to its left in the southern hemisphere. Similarly, ocean water is also affected by Coriolis force and follows the Ferrel's Law. So all the ocean currents follow clockwise direction in the northern hemisphere and anticlockwise direction in the southern hemisphere.

(iii) The Planetary Winds

The planetary winds like the trade winds and westerlies, drive the ocean water in a steady flow in front of them. If we compare the world map of planetary wind system, with that of the ocean currents it will be clear that currents follow the main direction of the planetary wind system. In low latitudes or in the region of the trade winds the ocean currents change their direction according to the change in the direction of summer and winter monsoon winds.

8.5 CURRENTS OF THE ATLANTIC OCEAN

To the north and south of equator there are two westward moving currents i.e., the north and south equatorial currents. Between these two equatorial currents is the Counter Equatorial Current which flows from west to east. (Locate it in the fig 8.10). This counter current replaces the water removed from the eastern side of the oceans by North and South Equatorial Currents.

The South Equatorial Current bifurcates into two branches near the Cape De Sao Roque in Brazil. Its northern branch joins the North Equatorial Current. This combined current enters the Caribbean Sea and the Gulf of Mexico, while the remaining current passes along the eastern side of the West Indies as the Antilles Current. The part of the current which enters the Gulf of Mexico, comes out from the Florida strait and joins the Antilles Current. This combined current moves along the south eastern coast of U.S.A.. It is known as Florida Current upto cape of Hatteras. Beyond the Cape Hatteras, upto the Grand Banks, off New Foundland, it is called the Gulf Stream. From the Grand Banks, the Gulf Stream is deflected eastwards under the combined influence of the westerlies and the rotation of the earth. It crosses the Atlantic Ocean as North Atlantic Drift.

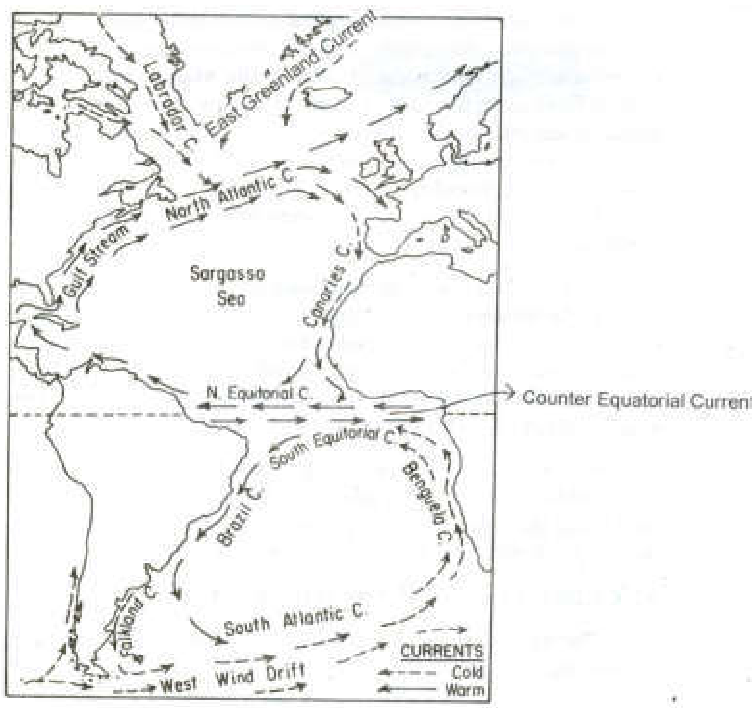


Fig 8.10 Currents of the Atlantic Ocean

The North Atlantic Drift bifurcates into two branches on reaching the eastern part of the ocean. The northern branch continues as North Atlantic Drift; reaches the British Isles from where it flows along the coast of Norway as the Norwegian Current and enters the Arctic Ocean. The southern branch flows between Spain and Azores Island as the cold Canaries Current. The Canaries Current finally joins the North Equatorial Current and completes the circuit in the North Atlantic Ocean. Within this circuit lies the Sargasso Sea which is full of large quantities of seaweeds called sargassum, a brown algae.

Apart from the clockwise circulation of the currents in the North Atlantic Ocean, there are also two cold currents - the East Greenland Current and the Labrador Current which flow from the Arctic Ocean into the Atlantic Ocean. The Labrador Current flows along the eastern coast of Canada and meets the warm Gulf Stream. (locate it on the fig 8.10) The confluence of these two currents, one cold and the other hot, produces fog around Newfoundland and makes it the most important fishing ground of the world. East Greenland current flows between Iceland and Greenland and cools the North Atlantic Drift at the point of their confluence.

We have seen earlier that South Equatorial Current splits into two branches near Cape De Sao Roque (Brazil). The northern branch joins the North Equatorial Current, whereas the southern branch turns south and flows along the eastern coast of South America as Brazil Current. At about 35° south latitude the influence of the westerlies and the rotation of the earth propel the current eastward to merge with the West Wind Drift.

Near the Cape of Good Hope, the South Atlantic Current is diverted northward as the cold Benguela Current. It finally joins the South Equatorial Currents thus completing the circuit. Another cold current, known as the Falkland Current, flows along the South eastern coast of south America from south to north.

8.6 CURRENTS OF THE PACIFIC OCEAN

It may be observed that the same broad circulatory systems, clockwise in the Northern Hemisphere and anti-clockwise in the Southern Hemisphere, are present in the Pacific ocean also.

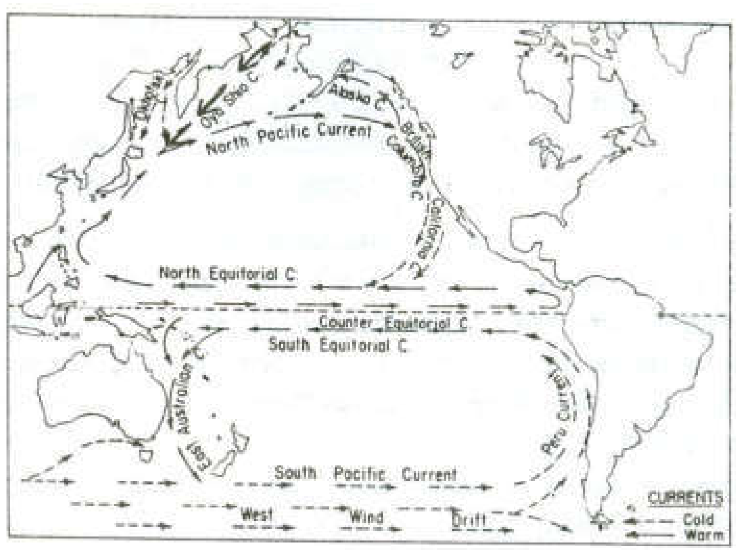


Fig 8.11 The Currents of the Pacific Ocean

In the Equatorial belt of the Pacific Ocean, two streams of equatorial currents flow across the ocean from the Central American Coast. Between these two - the North Equatorial Current and the South Equatorial Current flows a Counter Equational current moves west to east. The North Equatorial Current turns northwards and flows along the Philippines Islands, Taiwan and Japan to form the warm Kuro Shio or Kuro Siwo current. From the southeast coast of Japan, the current comes under the influence of westerlies and flows right across the ocean as North Pacific Current (see fig 8.ll). After reaching the west coast of North America, it bifurcates into two branches. The northern branch flows anti clockwise along the coast of British Columbia and Alaska and is known as the Alaska Current. The warm waters of this current help to keep the Alaska coast ice free in winter. The other branch of the North Pacific Current moves southward along the coast of California as the Cold Californian Current. It eventually joins the North Equatorial Current to complete its circuit. In the northern part of the Pacific Ocean two cold currents also flow. These are the Oya Siwo Current and Okhotsk Current. The cold Oya Siwo Current flows along the coast of the Kamchatka Peninsula. Another cold current, Okhotsk Current flows past Sakhalin to merge with the Oya Siwo Current near Hokkaido Island. It later merges with Kuro Siwo Current and sinks beneath the warm waters of the North Pacific Currents. (locate it in figure 8.11).

In the South Pacific Ocean, the South Equatorial Current flows towards west and turns southwards as the East Australian Current. It then meets near Tasmania the cold South Pacific Current which flows from west to east. On reaching the South Western Coasts of South America, it turns north wards as the cold Peru Current. It then meets the South Equatorial Current and completes the circuit. The cold waters of the Peru Current are partly responsible for making the coast of northern Chile and western Peru with very scanty rainfall.

8.7 CURRENTS OF THE INDIAN OCEAN

The pattern of circulation of currents in the Indian Ocean differs from the general pattern of circulation in the Atlantic Ocean and the Pacific Ocean. This is because Indian Ocean is blocked by the continental masses in the north. The general pattern of circulation in the southern section of the Indian Ocean is anti clockwise as that of other oceans. But in the northern section there is a clear reversal of currents in winter and summer. These are completely under the influence of the seasonal changes of the monsoon winds. So there is a clear reversal of currents in the winter and summer season i.e/south-westwards during the north-east Monsoon, north-eastwards during the south-west Monsoon and variable during transition season.

During winters Srilanka divides the currents of the Arahian sea from those of the Bay of Bengal. The North Equatorial Current flows westward just south of Srilanka with distinct counter equatorial current flows between it and the South Equatorial Current. (See fig. 8.12) At this time in the northern section, the whole of Bay of Bengal and Arabian sea is under the influence of North East Monsoon. The North East Monsoon drives the water of Bay of Bengal and Arabian Sea west wards to circulate in an anti clockwise direction. This current is known as North East Monsoon Drift.

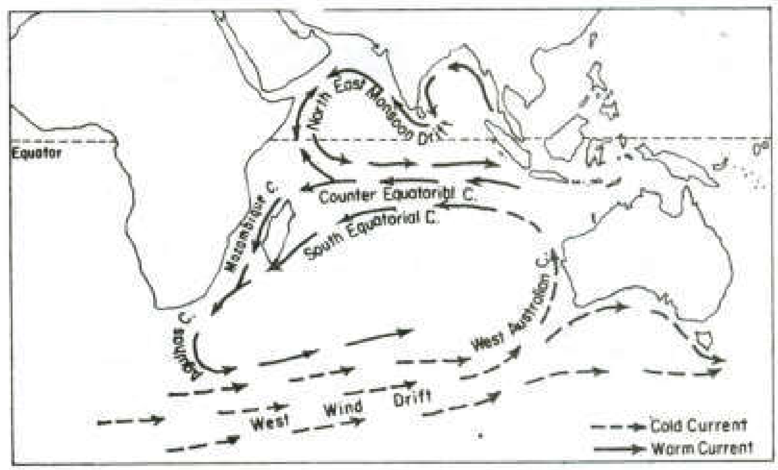


Fig 8.12 The Currents of the Indian Ocean (Winter)

In summers, the northern section comes under the influences of South West Monsoon. There is an easterly movement of water in the Bay of Bengal and Arabian Sea and produces a clockwise circulation. This current is known as South West Monsoon Drift (see fig.8.13). In general the summers currents are more regular than those of winter.

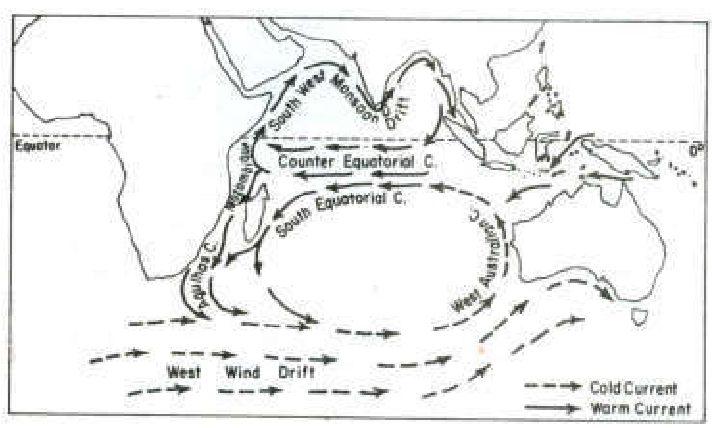


Fig 8.13 The Currents of the Indian Ocean (Summer)

In the southern Indian Ocean, the South Equatorial Current, strengthened by its corresponding current of the Pacific Ocean, flows from east to west. It turns south-wards along the Coast of Mozambique in Africa. A part of this current which flows between the mainland and the Madagascar Island is known as warm Mozambique Current. After the confluence of these two currents, it is called Aghulas Current. It then turn eastwards and merges with the West Wind Drift.

The West Wind Drift flows across the ocean in west east direction in the higher latitudes to reach the southern tip of Australia. A branch of this stream turns north to flow along the western coast of Australia as cold West Australian Current. West Australian Current later joins the South Equatorial Current to complete the circuit.

8.8 EFFECTS OF OCEAN CURRENTS

(a) Influence on climate

Oceans currents closely influence the distribution of temperature, pressure, winds and precipitation, which directly or indirectly influence the economy and society of the people, especially those living in the coastal regions. Some of the important effects of oceans currents are as follows:

Currents move from warm temperature areas to colder temperature areas and vice versa. As they move from one place to another they partly attempt to modify the temperature. The temperature of a mass of water affects the temperature of the air above it. Therefore, the ocean current that moves from the equatorial region to the colder latitudes raises the temperature of the air in the areas into which it moves. For example, warm North Atlantic Drift which flows northwards to West European coast helps to keep the coast of Great Britain and Norway free of ice in winter too. The effect of the ocean current becomes more clear if you compare the winter conditions of the British Isles with that of the North East Coast of Canada situated on the same latitudes. Since the North East Coast of Canada comes under the influence of cold Labrador current, it remains ice bound during the winter time.

When cold and warm currents meet they produce mist and fog. For example, near New Foundland warm Gulf Stream meets Labrador Current and produces fog. They also create conditions for storms. Hurricanes in New Found land and Typhoons in Japan are perhaps the result of the meeting of warm and cold currents.

(b) Influence on marine Life

Temperature has a great influence on marine life. It determines the type of flora and fauna. The areas where warm and cold currents meet are among the most important fishing grounds of the world. The oceanic movement in the form of currents helps in the dispersal of marine life.

(c) Influence on Trade

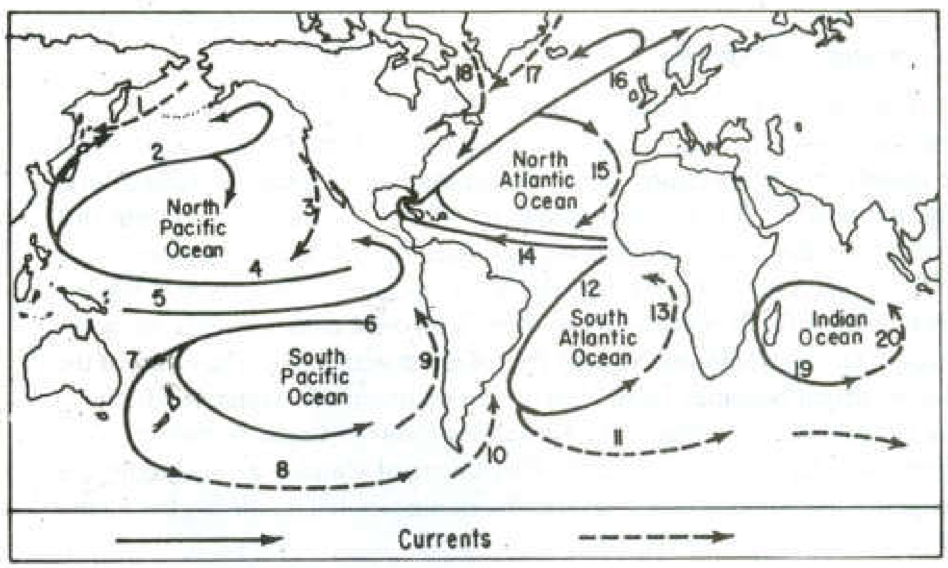
Ocean currents influence the trade. The ports and harbours of higher latitudes which are affected by warm currents are ice free and open for trade all the

Notes

year round. For example, the ports of North Western Europe remain open throughout the year while port of Quebec in Canada gets frozen in winters.

INTEXT QUESTIONS 8.4

1. Study the map given below. Each current in the map is shown by a number. Write the name of the corresponding ocean current against the number given below. Also complete the key of the map by writing appropriate words.



1 ________________	11 ________________
2 ________________	12 ________________
3 ________________	13 ________________
4 ________________	14 ________________
5 ________________	15 ________________
6 ________________	16 ________________
7 ________________	17 ________________
8 ________________	18 ________________
9 ________________	19 ________________
10 ________________	20 ________________

2. The warm current which flows off the east coast of South East Africa is called the

(i) Benguela Current

(ii) Mozambique Current

(iii) Canaries Current

(iv) West Wind Drift.

3. Which one of the following statement is not true?

   (i) Ocean currents sometimes cause fog.

   (ii) The distribution of fishes is often influenced by ocean currents.

   (iii) Ocean current can influence coastal temperature.

   (iv) Warm water wells up along a coast from which an ocean current moves.

8.9 IMPORTANCE OF OCEAN FOR HUMANS

We are well aware that oceans cover about 71 % the earth's surface. They form a major part of our environment and have an overwhelming influence on humans and his activities. In this section we will be studying the importance of oceans in different spheres of human life.

(a) Ocean as modifiers of climate

The most important part played by the oceans is as modifiers of climate.

(i) The ocean stores a large quantity of heat, hence it is often called "the saving bank for the solar energy, receiving deposits in season of excessive insolation and paying them back in seasons of want". The extensive deep waters of oceans gain as well as loose heat more slowly than the land when both are subjected to the same amount of insolation. The contrast in the temperature of the ocean and land explains the difference in the temperature of coastal and interior region.

(ii) The oceans supply water vapour to the atmosphere and thus are the basic source of all precipitation on earth. They are also the vital source of fresh water on earth.

(iii) Ocean currents are important regulators of temperature on the earth's surface. They help in exchange of heat between low and high latitudes and are essential in sustaining the global energy balance. On the local scale, the warm ocean currents bring a moderating influence to coasts in higher latitudes; cool currents reduce the heat of tropical deserts along narrow coastal belts.

(iv) The influence of oceans on climate becomes more clear if we consider the distribution of pressure and prevailing wind system over the sea surface. The oceans surface has six or more permanent centres of high pressure. These high pressure areas give birth to the planetary wind system over the earth. These planetary winds determine the amount of rainfall and its distribution over the earth's surface. The westerlies give rainfall on the West European Coast after collecting moisture from the warm North Atlantic Drift.

(b) Oceans and Resources

The oceans have always been a great source of food and other products of value to man. The animals and plants of the sea constitute a vast resource from which man can derive food, fertilizers for agriculture and raw material for industry. Fish and other marine animals form a rich source of food and nutrition for man. With the progress of human society and the increasing population, man's dependence on sea for other products has increased. Fishes now make up more than 10 per cent of the total animal protein that human consume.

(c) Oceans and Mineral Resources

Oceans are the store house of a large number of useful metallic and non-metallic minerals. Foremost among the minerals are the petroleum deposits of the continental shelves. In the energy hungry world, they are the most sought after resources. Vast deposits of petroleum have been found in many places such as in the North Sea, off the coast of South California and Texas, in the Mediterranean Sea, Persian Gulf, Bombay High in the Arabian Sea.

The common salt or sodium chloride is extracted from sea water. Apart from salt, magnesium and bromine have long been extracted from sea water. The mineral wealth of the seas also include metals. All the metallic elements are present in the seawaters in some degree. However waters and sediments of ocean are heavily saturated with such metals as zinc, copper, lead, silver and gold, especially in the volcanic region of the oceanic ridge. The technology to exploit these minerals has not yet developed.

The most significant are mineral nodules found on the deep sea floor. The important ones are phosphorites and manganese nodules.

(d) Ocean and Energy

The energy resources of the oceans are of various types - tidal power, geothermal energy and energy from the ocean temperature.

Tidal energy was in use even in the 12th Century. Water wheels driven by the tides were used for grinding grain. Today, efforts are being made to harness the energy to run electric generators. There are difficulties in the. use of tidal power because of the irregularities of tides, However, a few tidal power stations are working in Russia, France and China.

(e) Ocean Transportation and Trade

Ocean were originally considered as barriers but today they act as natural link among continents and nations of the world. They provide natural highways at low cost for international trade. They facilitate movement of bulky goods. The water is buoyant and needs less motive power. Oceans are a great boon to international trade.

INTEXT QUESTIONS 8.5

1. Which one of the following statements is not true?
   - (a) Oceans control the distribution of pressure in the upper atmosphere.
   - (b) Oceans receive large amount of solar energy in seasons of excessive insulation and pay them back in season of short supply.
   - (c) Oceans currents help to redistribute heat over thousands of kilometres.
   - (d) Oceans provide natural highways but are a big hindrance to international trade.
   - (e) energy due to the rise and fall of the sea water is called geothermal energy.

WHAT YOU HAVE LEARNT

All living organisms on the earth depend on water. About 71 % of the earth's surface is covered by water. The earth is the only known planet in the solar system with abundant water. The oceans are the single largest continuous body of water encircling land. The oceans contain 97.2% of the world's water. There are four oceans - the Pacific oceans, the Atlantic oceans, the Indian ocean and the Arctic ocean. The ocean floor which once was considered to be flat has variety of features such as continental shelf; continental slope, abyssal plains and the deeps.

Pacific ocean is the largest ocean. It comprises of thousands of islands. The greater part of the ocean comprises of the deep seas. Mariana trench in the Pacific Ocean is the deepest known part of the ocean with a depth of 11022 metres. The Atlantic Ocean is almost half the size of the Pacific Ocean. The world's widest shelves like Dogger Bank and Grand Bank are found here. The largest continuous Mid Atlantic Ridge is the important feature of the Atlantic ocean. Indian ocean is smaller than the other two ocean.

The temperature of the surface water of the oceans varies from one part of the ocean to the other. It is generally high near the equator and low near the poles. There is variation in the vertical distribution of temperature too

Temperature decreases with the increase in depth. Salinity is defined as the weight in grammes of solid material left after the evaporation of 1000 grammes of sea water. The salinity of the ocean water is caused by a large number of dissolved chemical compounds. The salinity is not uniform everywhere in the ocean. Equatorial and Polar water are less saline than the tropical seas. Ocean waters are in constant motion. There are three type of movements in the oceans waters - waves, tides and currents. Waves are 'caused by winds. They move roughly in circular path. Tides are the periodic change in the elevation of the oceans surface at a particular place. They are produced as a result of gravitational attraction of the moon and the centrifugal force produced due to rotation of earth. Currents are distinct and generally horizontal flow of a mass of water in a fairly defined' direction. Currents are formed due to the density of water rotation of the earth and planetary winds. These currents form a clockwise pattern in the northern hemisphere and move in anti clockwise pattern in the southern hemisphere. The currents of the Indian ocean are influenced by Monsoon winds.

Oceans are of great importance to man. They influence the climate of the earth's surface 'and provide rich source of marine food and minerals. They are also helpful in international trade by providing free highways.

TERMINAL QUESTIONS

1. Describe the important relief features of the ocean floor with the help of a diagram.
2. Distinguish between the following terms:
   (a) Continental shelf and continental slope.
   (b) Submarine trench and submarin Ridge.
3. Describe the difference between a seamount and a guyot.
4. Explain the importance of continental shelf to humans.
5. Write short notes on:
   (a) Submarine canyons
   (b) Continental rise
6. Define the term salinity and how is it expressed?
7. Why does temperature of ocean decrease with depth?

8. What are tides? How are they caused?
9. Distinguish between spring tide and neap tide with the help of a diagram.
10. Give reasons to account for the following.
    (a) Spring tides occur on new moon and full moon.
    (b) In the lower latitudes the eastern sides of the land masses are warmer than the western sides.
    (c) In the higher latitudes the eastern sides of the landmasses are cooler than the western side.
11. Describe the circulation of ocean currents In the Atlantic Ocean with the help of a diagram. Compare it with that of the currents of the Pacific Ocean.

12 Write a short essay to show the importance of oceans for man.

ANSWERS TO INTEXT QUESTIONS

8.1

1. (i) (a) The Pacific Ocean (b) The Atlantic Ocean (c) The Indian Ocean (d)The Arctic Ocean.
   (ii) (a) The continental shelf(b) The continental slope (c) Abyssal plains (d) and the deeps.
   (iii) The continental shelf
   (iv) (a) oozes (b) red clay (v) submarine trench
   (vi) seamount
   (vii) The Mariana
2. (i) (a) continental slope
   (ii) (b) continental shelves
3. (i) False (ii) False (iii) True

8.2

1. Salinity is the weight in grammes of solid material left after the evaporation of 1000 grammes of sea water.
2. $250^{0}/_{00}$
3. (a) maximum, minimum (b) 35%/(c) high.

8.3

1. (a) winds, (ii) period, (iii) 6 hours 13 minutes
2. Periodic charge in the elevation of the ocean surface at a particular place.
3. The horizontal distance between two crests or two troughs.
4. 9.51 A.M

8.4

Warm currents	Cold currents
1. Okhotsk Current	2. North Pacific Current
3. California Current	4. North Equational Current
5. Counter Equatorial Current	6. South Equatorial Current
7. East Australian Current	8. West Wind Drift
9. Peru Current	10. Falk and Current
11. West Wind Drift	12. Brazil Current
13. Benguela Current	14. North Equatorial Current
15. Canaries Current	16. Norwegian Current
17. East Greenland Current	18. Labrador Current
19. Agulhas Current	20. West Australian Current
2. Mozambique Current	3. (iv)

8.5

1. (a), (d), (e)

HINTS TO TERMINAL QUESTIONS

1. Refer to section to 8.2
2. Refer to section 8.2(a) and (b)

   Refer to section 8.2(d) and (c) (i)
3. Refer to section 8.2(c) (ii)
4. Refer to 8.2(a)
5. See under continental shelf and continental slope.
6. See para 8.3 (ii)
7. See para 8.3 (ii)

8. See para 8.4 II

9. See para 8.4 II(a)

10. (a) See para 8.4 II(a)

    (b) In the equatorial region the warm ocean currents flow from east to west direction carrying with them warm water, in the process warming the coastal regions. Whereas the western coast are affected by cold currents. Give examples with your explanation.

    (c) In the higher latitudes the eastern sides are generally washed by cold current and western coast by warm current. Give examples with your explanation.

11. Refer to section 8.5 and 8.6

12. Refer to section 8.9

9

ATMOSPHERE COMPOSITION AND STRUCTURE

Earth is a unique planet because the life is found only on this planet. The air has a special place among the conditions necessary for life. The air is a mixture of several gases. The air encompasses the earth from all sides. The air surrounding the Earth is called the atmosphere. The atmosphere is an integral part of our Earth. It is connected with the earth due to the gravitational force of the earth. It helps in stopping the ultra violet rays harmful for the life and maintain the suitable temperature necessary for life.

The air is essential for the survival of all forms of life on the earth. You cannot imagine any kind of life in the absence of it. The atmosphere is like a large protective cover. Besides many gases, water vapour and dust particles are also found in the atmosphere. Due to these all kinds of changes take place in the atmosphere you will study in this lesson. The composition and structure of the atmosphere and the cyclic process of main gases.

OBJECTIVES

After studying this lesson, you will be able to :-

- explain the composition of atmosphere.
- tell the characteristics of different layers of the atmosphere.
- explain the importance of atmosphere.
- explain the cyclic process of main gases of the atmosphere – nitrogen, oxygen and Carbon dioxide.
- describe the importance of cyclic process of important gases of the atmosphere such as nitrogen, oxygen and carbon dioxide.

9.1 COMPOSITION OF ATMOSPHERE

The atmosphere is made up of different types of gases, water rapour and dust particles. The composition of the atmosphere is not static. It changes according to the time and place.

(A) Gases of the atmosphere:

The atmosphere is the mixture of different types of gases, including water vapour and dust particles. Nitrogen and Oxygen are the two main gases of the atmosphere. 99 percent part of it is made up of these two gases. Other gases like organ, carbon dioxide, hydrogen, nion, helium etc. form the remaining part of atmosphere. The details of different gases of the atmosphere are given in the table No. 9.1 and Fig. No. 9.1

Table 9.1 : Amount of gases in the dry and air of the atmosphere.

Serial No.	*Gas*	*Amount (in percentage)*	
A.	**Main**		
1.	Nitrogen	78.1	99%
2.	Oxygen	20.9	
B.	**Secondary**		
1.	Organ	0.9	0.99%
2.	Carbon Dioxide	0.03	
3.	Hydrogen	0.01	
4.	Nion	0.0018	
5.	Helium	0.0005	
6.	Ozone	0.00006	
7.	Others		

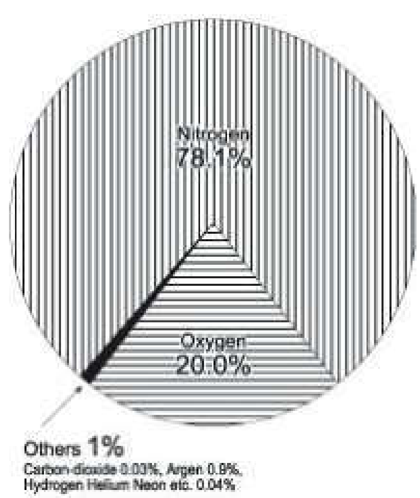


Fig. 9.1 Composition of Atmosphere

Ozone Gas

The amount of ozone gas in the atmosphere is very little. It is limited to the ozone layer but it is very important. It protects the living beings by absorbing the ultra-violet rays of the sun. If there was no ozone gas in the atmosphere, there would not have been existence of living beings and plants on the earth surface.

(B) Water vapour

Gaseous form of water persent in the atmosphere is called water vapour. Water vapour present in the atmosphere has made life possible on the earth Water vapour is the source of all kinds of precipitation. Its maximum amount in the atmosphere could be upto 4 percent. Maximum amount of water vapour is found in hot-wet regions and its least amount is found in the dry regions. Generally, the amount of water vapour goes on decreasing from low latitudes to high latitudes.

In the same way, its amount goes on decreasing with increasing altitude. Water vapour reaches in the atmosphere through evaporation and transpiration. Evaporation takes place in the oceans, seas, rivers, ponds and lakes while transpiration takes lace from the plants, trees and living beings.

(c) Dust Particles

Dust particles are generally found in the lower layers of the atmosphere. These particles are found in the form of sand, smoke and oceanic salt. Sand particle have important place in the atmosphere. These dust particles help in the condensation of water vapour. During condensation water vapour gets condensed in the form of droplets around these dust particles. Due to this process the clouds are formed and precipitation is made possible.

Importance of the Atmosphere:

(i) Oxygen is very important for the living beings.

(ii) Carbon dioxide is very useful for the plants.

(iii) Dust particles present in the atmosphere create suitable conditions for the precipitation.

(iv) The amount of water vapour in the atmosphere goes on changing and directly affects the plants and living beings.

(v) Ozone protects all kinds of life on the earth from the harmful ultra violet rays of the sun.

INTEXT QUESTIONS 9.1

(i) Which are the two main gases of the atmosphere?

(a) ______________________ (b) ___________________________

(ii) In which region the maximum amount of water vapour is found?

____

(iii) What is the main function of ozone gas?

____

9.2 STRUCTURE OF THE ATMOSPHERE

The atmosphere is an integral part of the earth. It surrounds the earth from all sides. Generally it extends upto about 1600 kilometres from the earths surface. 97 percent of the total amount of weight of the atmosphere is limited upto the height of about 30 kilometres. The atmosphere can be divided into five layers according to the diversity of temperature and density.

(a) Troposphere
(b) Stratosphere
(c) Mesosphere
(d) Ionosphere
(e) Exosphere

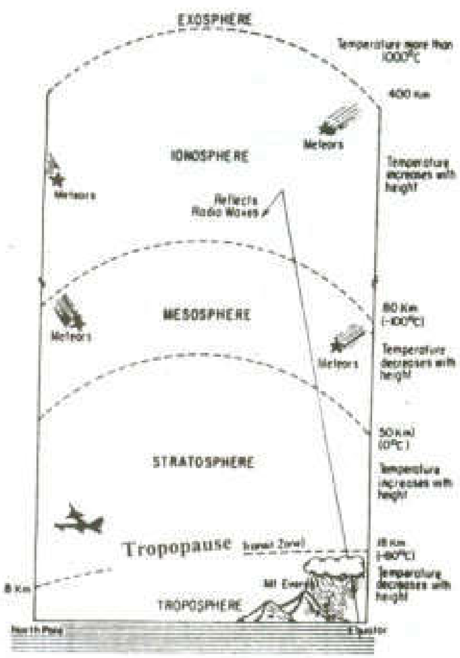


Fig. 9.2 Structure of the atmosphere

(a) TROPOPHERE :-

(i) This is the lowest layer of the atmosphere.

(ii) The height of this layer is about 18 kms on the equator and 8 kms on the poles. The main reason of higher height at the equator is due to presence of hot convection currents that push the gases upward.

(iii) This is the most important layer of the atmosphere because all kinds of weather changes take place only in this layer. Due to these changes development of living world take place on the earth. The air never remains static in this layer. Therefore this layer is called changing sphere or troposphere.

(iv) The environmental temperature decreases with increasing height of atmosphere. It decreases at the rate of 1^0C at the height of 165 metre. This is called Normal lapse rate.

(v) The upper limit of the troposphere is called tropopause. This is a transitional zone. In this zone characteristics of both the troposphere and ionosphere are found.

(b) STRATOSPHERE

(i) This layer is above the troposphere.

(ii) This layer is spread upto the height of 50 kms from the Earth's surface. Its average extent 40 kms.

(iii) The temperature remains almost the same in the lower part of this layer upto the height of 20 kms. After this the temperature increases slowly with the increase in the height. The temperature increases due to the presence of ozone gas in the upper part of this layer.

(iv) Weather related incidents do not take place in this layer. The air blows horizontally here. Therefore this layer is considered ideal for flying of aircrafts.

(c) MESOSPHERE

(i) It is the third layer of the atmosphere spreading over stratosphere.

(ii) It spreads upto the height of 80 kms. from the surface of the earth. It's extent is 30 kms.

(iii) Temperature goes on decreasing and drops upto – 100^0C.

(iv) 'Meteors' or falling stars occur in this layer.

(d) IONOSPHERE

(i) This is the fourth layer of the atmosphere. It is located above the mesosphere.

(ii) This layer spreads upto the height of 400 kms. from the surface of the earth. The width of this layer is about 300 kms.

(iii) The temperature starts increasing again with increasing height in this layer.

(iv) Electrically charged currents flows in the air in this sphere. Radio waves are reflected back on the earth from this sphere and due to this radio broadcasting has become possible.

(e) EXOSPHERE

(i) This is the last layer of the atmosphere located above ionosphere and extends to beyond 400 km above the earth.

(ii) Gases are very sparse in this sphere due to the lack of gravitational force. Therefore, the density of air is very less here.

- Change of weather take place only in troposphere.
- Change of weather conditions donot take polace in stratosphere. This is an ideal layer for flying aeroplanes.
- Ions are found in abundance in ionosphere. Ionosphere reflects back the radio waves to the earth and make possible the communication system.
- Density of air is the least in the exosphere.

INTEXT QUESTIONS 9.2

1. Define tropopause.

   ____

2. Why is there a difference in the height of troposphere?

   ____

3. In which two spheres the temperature increases with the height?

   ____

4. From which sphere are the radio waves reflected?

   ____

5. In which layer of the atmosphere, the density of the air is the least?

   ____

6. In which layer of the atmosphere is the ozone gas found?

   ____

9.3 CYCLIC PROCESS OF THE ATMOSPHERIC GASES

The cycle of main gases found in the atmosphere is given below:-

(a) Carbon cycle

(b) Oxygen cycle

(c) Carbon dioxide cycle

(a) CARBON CYCLE

1. The element of carbon is present in the atmosphere in the form of carbon dioxide. The source of carbon for all living beings is atmosphere.
2. Green plants receive carbon dioxide from the atmosphere which is used for making food with the help of the sun light. This is called photosynthesis. By this process the plants create 'carbohydrates' in the form of food. Carbohydrates thus, produced by plants are used as a food by all Living beings.

3. Carbon dioxide gets dissolved in the water bodies and gets collected in the form of lime on the earth. After dissolution of lime stone, carbon dioxide again reaches in the atmosphere. This process is called carbonization. In this way carbon dioxide goes on moving between the atmosphere and water-bodies of the earth.

4. Carbon dioxide produced by breathing of plants and animals, disintegration of plants and animals and by burning fossil fuels like coal, petroleum and natural gas again returns back to the atmosphere.

In this way, the process of receiving of carbon-dioxide from the atmosphere and going back to it from the surface of the earth keeps on going continuously. It keeps the balance between the carbon and biosphere.

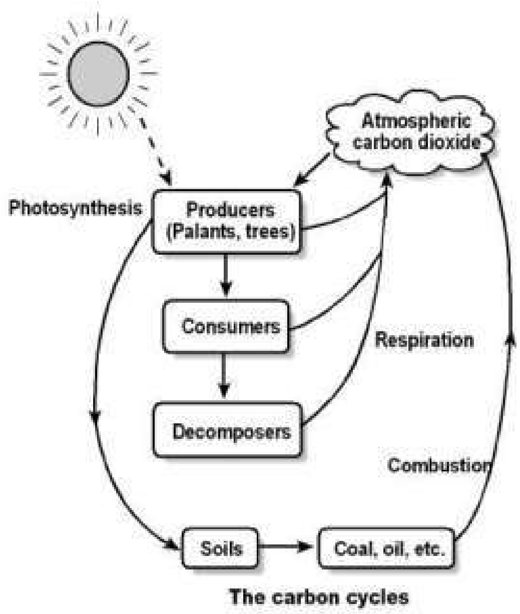


Fig. 9.3 : Carbon cycle

(b) OXYGEN CYCLE

1. The amount of oxygen in the atmosphere is about 21% and all living beings use oxygen present in the atmosphere for breathing.

2. For the burning of fuels like wood, coal, gas etc. oxygen is essential and carbon dioxide gas is produced by their burning.

3. The main sources of oxygen in the atmosphere are plants and trees. Higher the number of trees and plants, the availability of oxygen will be more.

4. Oxygen produced through photosynthesis by the green plants goes back to the atmosphere. In this way the process of oxygen cycle goes on continuously.

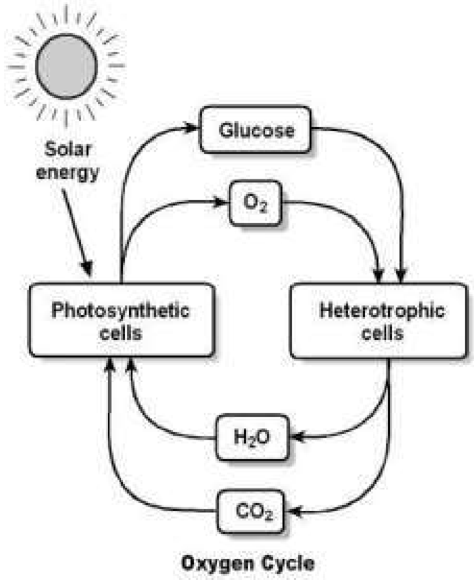


Fig. 9.4 Oxygen cycle

(c) NITROGEN CYCLE

Nitrogen is an important element for life. The amount of nitrogen gas in the atmosphere is 78%. The main source of nitrogen are nitrates present in the soil. From the atmosphere, nitrogen enters into bio components through the biological and industrial processes. Nitrogen compounds from the plants are transferred to the animals through food chain. The process of transformation of nitrogen gas of the atmosphere into nitrogen components is called nitrogen Fixation. Bacteria's decompose dried plants and dead animals. It produces nitrogen gas which goes back into the atmosphere. In this way the cycle of nitrogen gas is completed.

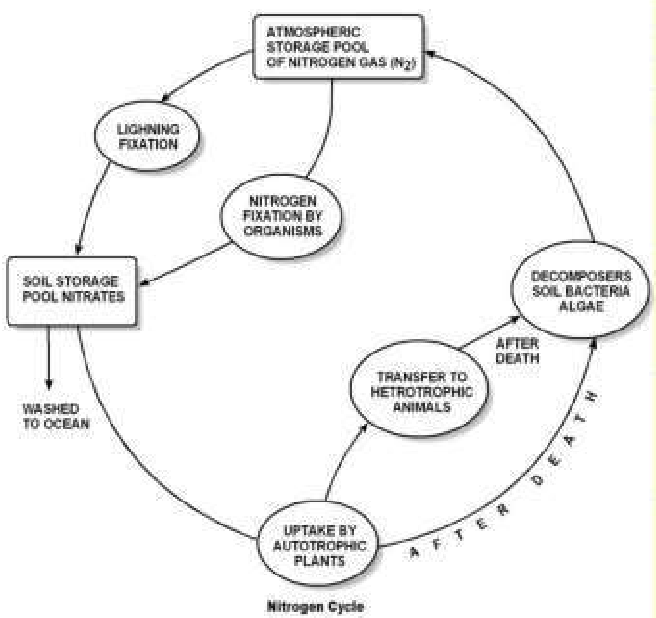


Fig. 9.5 Nitrogen cycle

- The main source of carbon is carbon dio-oxide gas found in the atmosphere.
- The main source of oxygen in the atmosphere are plants and trees.
- Oxygen is used for breathing and for burning fuels.
- Nitrogen is very essential for life on the earth. The main source of nitrogen in the plants are nitrates present in this soil.

INTEXT QUESTIONS 9.3

(i) What is the main source of carbon?

____

(ii) What is the main source of oxygen?

____

(iii) What is the percentage of nitrogen in the atmosphere?

____

WHAT YOU HAVE LEARNT

The atmosphere is made up of different kinds of gases which surrounds the earth. Two important gases nitrogen and oxygen together are found on the 99% part of the atmosphere. The atmosphere is composed of troposphere, stratosphere, mesosphere, ionosphere and exosphere. All weather related incidents take place in the troposphere whereas stratosphere is considered to be ideal for flying of aeroplanes. Radio waves are reflected back on the earth from the ionosphere. This has made possible the radio broadcast.

The element of carbon in the atmosphere is found in the form of carbon dio-oxide gas. The main sources of carbon are petroleum, wood, coal and gases. The main sources of oxygen in the atmosphere are plants and trees. Oxygen is very important for breathing and for the burning of fuels. The main source of nitrogen for the plants is nitrate present in the soil. Nitrogen gas is produced by decomposition of plants and animals and goes back to the atmosphere.

TERMINAL QUESTIONS

(1) Which is called atmosphere?
(2) Distinguish between troposphere and stratosphere.
(3) State the importance of ozone gas.
(4) Explain the cycle process of nitrogen gas.
(5) Explain the oxygen cycle with the help of a diagram.

(6) Describe the structure of the atmosphere with the help of a diagram.

(7) Write notes on the following.
- (i) Carbon cycle.
- (ii) Importance of atmospheric is gases.
- (iii) Water vapour.
- (iv) Dust particles.

ANSWERS TO INTEXT QUESTIONS

9.1

(i) Nitrogen and Oxygen

(ii) Hot-wet region

(iii) Absorption of harmful ultra-violet rays of the sun.

9.2

(i) See para 9.1(a)

(ii) See para 9.2(a)

(iii) See para 9.3(c)

(iv) Ionosphere

(v) Exosphere

(vi) Stratosphere

9.3

(i) Fossil fuels – Coal, petroleum and natural gas

(ii) Plants and trees

(iii) 78 percent

HINTS TO TERMINAL QUESTIONS

1. See 9.1
2. See 9.2 (a and b)
3. See ozone gas under 9.1(A)
4. See 9.3(c)
5. See 9.3(b)
6. See 9.2
7. (i) See 9.3(a)
   (ii) See 9.1
   (iii) See 9.1(b)
   (iv) See 9.1(c)

10

INSOLATION AND TEMPERATURE

In the previous lesson we have studied that the air surrounding the earth is called the atmosphere. The atmosphere is made up of different types of gasses, water vapour and dust particles. Atmosphere is essential for survival of plant and animal life. They also require optimum temperature to keep themselves warm and grow. Have you ever thought what is the source of heat and energy received on the surface of the earth? Why does earth's surface get warm during the day and cool down during the night? Let us find answer to all these and other related questions in this lesson.

OBJECTIVES

After studying this lesson, you will be able to :

- explain the importance of insolation and establish relationship between angle of incidence of sun's rays and the intensity of heat received from them at a place;
- explain the different processes involved in heating and cooling of the atmosphere (conduction, convection, radiation and advection);
- explain the heat budget with the help of a diagram;
- differentiate between solar radiation and terrestrial radiation;
- explain the causes of global warming and its effects ;
- explain the various factors affecting the horizontal distribution of temperature;
- explain with the help of map, the main characteristics of temperature distribution in the world in the month of January and July;
- explain the conditions in which inversion of temperature occurs.

10.1 INSOLATION (Solar Radiation)

The sun is the primary source of energy on the earth. This energy is radiated in all directions into space through short waves. This is known as solar radiation.

Only two billionths or (two units of energy out of 1,00,00,00,000 units of energy radiated by the sun) of the total solar radiation reaches the earth's surface. This small proportion of solar radiation is of great importance, as it is the only major source of energy on the earth for most of the physical and biological phenomena.

Incoming solar radiation through short waves is termed as insolation. The amount of insolation received on the earth's surface is far less than that is radiated from the sun because of the small size of the earth and its distance from the sun. Moreover water vapour, dust particles, ozone and other gases present in the atmosphere absorb a small amount of insolation.

- Sun is the primary source of energy on earth.
- Insolation is the incoming solar radiation.

(a) Factors influencing Insolation

The amount of insolation received on the earth's surface is not uniform everywhere. It varies from place to place and from time to time. The tropical zone receive the maximum annual insolation. It gradually decreases towards the poles. Insolation is more in summers and less in winters.

The following factors influence the amount of insolation received.

(i) The angle of incidence.

(ii) Duration of the day. (daily sunlight period)

(iii) Transparency of the atmosphere.

(i) The Angle of Incidence : Since the earth is round, the sun's rays strike the surface at different angles at different places. The angle formed by the sun's ray with the tangent of the earth's circle at a point is called angle of incidence. It influences the insolation in two ways. First, when the sun is almost overhead, the rays of the sun are vertical. The angle of incidence is large hence, they are concentrated in a smaller area, giving more amount of insolation at that place. If the sun's rays are oblique, angle of incidence is small and sun's rays have to heat up a greater area, resulting in less amount of insolation received there. Secondly, the sun's rays with small angle, traverse more of the atmosphere, than rays striking at a large angle. Longer the path of sun's rays, greater is the amount of reflection and absorption of heat by atmosphere. As a result the intensity of insolation at a place is less. (see fig. 10.1)

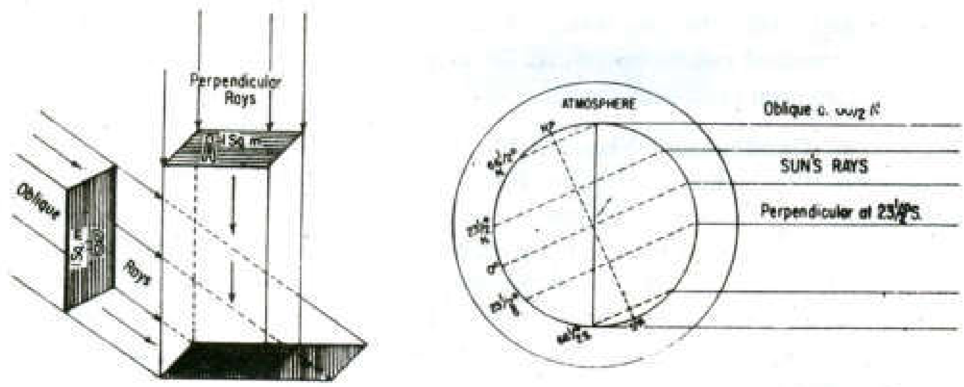


Fig. 10.1 : Effect of Angle of Incidence on Insolation

(ii) Duration of the day : Duration of the day varies from place to place and season to season. It decides the amount of insolation received on earth's surface. The longer the duration of the day, the greater is the amount of insolation received. Conversely shorter the duration of the day leads to receipt of less insolation.

(iii) Transparency of the atmosphere: Transparency of the atmosphere also determines the amount of insolation reaching the earth's surface. The transparency depends upon cloud cover, its thickness, dust particles and water vapour, as they reflect, absorb or transmit insolation. Thick clouds hinder the insolation to reach the earth while clear sky helps it to reach the surface. Water vapour absorb insolation, resulting in less amount of insolation reaching the surface.

- Amount of insolation at a place depends upon angle of incidence, duration of the day and transparency of the atmosphere.

(b) Heating and cooling of the Atmosphere

Sun is the ultimate source of atmospheric heat and energy, but its effect is not direct. For example, as we climb a mountain or ascend in the atmosphere, temperature become steadily lower, rather than higher, as we might expect. This is because the mechanism of heating the atmosphere in not simple. There are four heating processes directly responsible for heating the atmosphere. They are : (i) Radiation (ii) Conduction (iii) Convection and (iv) Advection.

(i) Radiation : Radiation is the process by which solar energy reaches the earth and the earth loses energy to outer space. When the source of heat transmits heat directly to an object through heat waves, it is known as radiation process. In this process, heat travels through the empty space. The vast amount of heat energy coming to and leaving the earth is in the form of radiation. The following facts about radiation are worth noting.

(i) All objects whether hot or cold emit radiant energy continuously.

(ii) Hotter objects radiate more energy per unit area than colder objects.

(iii) Temperature of an object determines the waves length of radiation. Temperature and wave length are inversely related. Hotter the object shorter is the length of the wave.

(iv) Insolation reaches the earth's surface in short waves and heat is radiated from the earth in long waves.

You will be amused to know that atmosphere is transparent to short waves and opaque to long waves. Hence energy leaving the earth's surface i.e. terrestrial radiation heats up the atmosphere more than the incoming solar radiation i.e. insolation.

(ii) Conduction: When two objects of unequal temperature come in contact with each other, heat energy flow from the warmer object to the cooler object and this process of heat transfer is known as conduction. The flow continues till temperature of both the objects becomes equal or the contact is broken. The conduction in the atmosphere occurs at zone of contact between the atmosphere and the earth's surface. However, this is a minor method of heat transfer in terms of warming the atmosphere since it only affects the air close to the earth's surface.

(iii) Convection: Transfer of heat by movement of a mass or substance from one place to another, generally vertical, is called convection. The air of the lower layers of the atmosphere get heated either by the earth's radiation or by conduction. The heating of the air leads to its expansion. Its density decreases and it moves upwards. Continuous ascent of heated air creates vacuum in the lower layers of the atmosphere. As a consequence, cooler air comes down to fill the vacuum, leading to convection. The cyclic movement associated with the convectional process in the atmosphere transfer heat from the lower layer to the upper layer and heats up the atmosphere.

(iv) Advection: Winds carry the temperature of one place to another. The temperature of a place will rise if it lies on the path of winds coming from warmer regions. The temperature will fall if the place lies on the path of the winds blowing from cold regions. This process of horizontal transport of heat by winds is known as advection.

INTEXT QUESTION 10.1

1. Answer the following questions in one or two words:

   (a) By which process heat energy travels from the sun to the earth?

____

(b) What part of solar radiation is received by the earth's surface?

____

(c) Name the process in which heat is transferred by winds.

____

(d) Name the three factors influencing the amount of insolation received at a place.

____

(i)__________ (ii)__________ (iii)__________

2. Select correct alternative for each of the following and mark (√) on it.

(a) Insolation comes to the earth's surface in

(i) short waves, (ii) long waves, (iii) both of them, (iv) none of them

(b) Atmosphere is heated by

(i) insolation, (ii) heat radiation from the earth, (iii) both of them, (iv) none of them.

(c) Even after the sunset the air near the earth's surface continues to receive heat by-

(i) insolation, (ii) terrestrial radiation, (iii) conduction, (iv) convection

10.2 HEAT BUDGET

The insolation is made up of energy transmitted directly through the atmosphere and scattered energy. Insolation is the amount of solar radiation that reaches the earth's surface through shortwaves. The earth also radiates heat energy like all other hot object. This is known as terrestrial radiation. The annual mean temperature on the surface of the earth is always constant. It has been possible because of the balance between insolation and terrestrial radiation. This balance is termed as a heat budget of the earth.

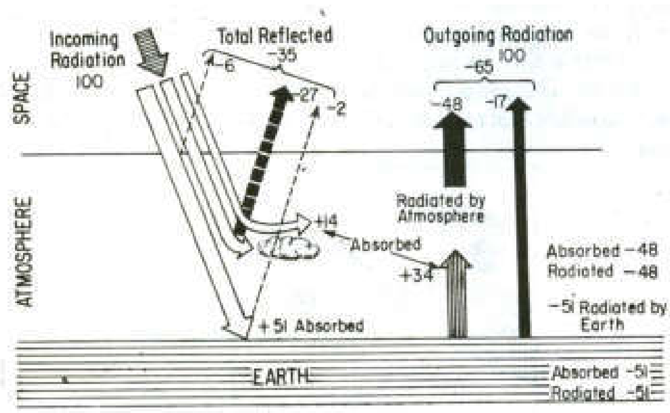


Fig. 10.2 : Heat Budget (balance between insolation and terrestrial radiation)

Let us suppose that the total heat (incoming solar radiation) received at the top of the atmosphere is 100 units (see fig. 10.2) Roughly 35 units of it are reflected back into space even before reaching the surface of the earth. Out of these 35 units, 6 units are reflected back to space from the top of the atmosphere, 27 units reflected by clouds and 2 units from the snow and ice covered surfaces.

Out of the remaining 65 units (100-35), only 51 units reach the earth's surface and 14 units are absorbed by the various gases, dust particles and water vapour of the atmosphere.

The earth in turn radiates back 51 units in the form of terrestrial radiation. Out of these 51 units of terrestrial radiation, 34 units are absorbed by the atmosphere and the remaining 17 units directly go to space. The atmosphere also radiates 48 units (14 units of incoming radiation and 34 units of outgoing radiation absorbed by it) back to space. Thus 65 units of solar radiation entering the atmosphere are reflected back into the space. This account of incoming and outgoing radiation always maintains the balance of heat on the surface of the earth.

- Heat budget is the balance between insolation (incoming solar radiation) and terrestrial radiation.

Although the earth as a whole, maintains balance between incoming solar radiation and outgoing terrestrial radiation. But this is not true what we observe at different latitudes. As previously discussed, the amount of insolation received is directly related to latitudes. In the tropical region the amount of insolation is higher than the amount of terrestrial radiation. Hence it is a region of surplus heat. In the polar regions the heat gain is less than the heat loss. Hence it is a region of deficit heat. Thus the insolation creates an imbalance of heat at different latitudes (see Fig. 10.3 This is being nullified to some extent by winds and ocean currents, which transfer heat from surplus heat regions to deficit heat regions. This is commonly known as latitudinal heat balance.

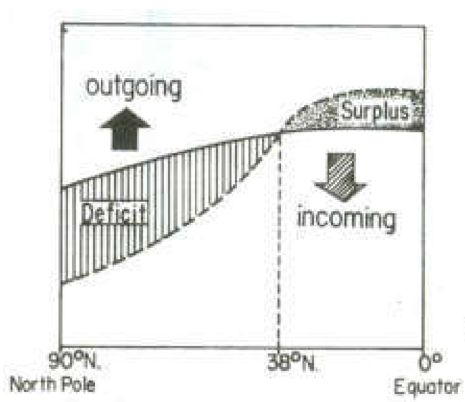


Fig. 10.3 Latitudinal Heat Balance

10.3 GLOBAL WARMING

Global warming is one of the major environmental problem our earth is facing. Scientist see its close association with depletion of Stratospheric ozone layer and increase in atmospheric carbon dioxide.

As you know that the upper portion of the stratosphere contains a layer of ozone gas. Ozone is capable of absorbing a large amount of sun's ultraviolet radiation thus preventing it from reaching the earth's surface. Scientist have realised that the thickness of the ozone layer is reducing. This is disturbing the balance of gases in the atmosphere and increasing the amount of ultraviolet radiation reaching the earth. Ultraviolet radiation is responsible for increasing the global temperature of the earth's surface besides it can severely burn human being's skin, increase the incidence of skin cancer, destroy certain microscopic forms of life and damage plants. There is a gradual increase in the carbon dioxide content of the atmosphere. It is estimated that the carbon dioxide content of the atmosphere has increased 25 per cent in the last hundred years. Carbon dioxide allows insolation to pass through but absorbs terrestrial radiation. Increase of carbon dioxide in the atmosphere has the effect of raising the atmospheric temperature. It is estimated that the temperature of atmosphere has increased by about 0.5^0C in the last 1000 years. Large scale deforestation, fossil fuel burning, burning of garbages, combustion processes in factories and volcanic eruptions are some of the factors responsible for the increase of carbon dioxide in the atmosphere.

If the depletion of ozone layer and the increase in the carbon dioxide content continue, the time would come when the temperature of the atmosphere will rise to the extent that it would melt polar ice caps, increasing the sea level and causing submergence of coastal regions and islands. The phenomenon of world wide increase of atmospheric temperature due to depletion of ozone layer and the increase of carbon dioxide content is known as global warming.

- Latitudinal heat balance is the transfer of heat from lower to higher latitudes by winds and ocean currents to counter the imbalance created by insolation at different latitudes.
- Global warming is the world - wide increase of atmospheric temperature due to depletion of ozone layer and in the increase of carbon dioxide content.

INTEXT QUESTIONS 10.2

1. Define the following terms:

   (a) Heat Budget:

   ____

   (b) Latitudinal Heat Balance:

(c) Global Warming

2. Answer the following questions very briefly:

   (a) What percentage of insolation is received by the earth?

   (b) What part of the incoming solar radiation is reflected back to space from the top of the atmosphere?

   (c) Name the regions of surplus heat

   (d) Which is the region of deficit heat?

10.4 TEMPERATURE AND ITS DISTRIBUTION

Temperature indicates the relative degree of heat of a substance. Heat is the energy which make things or objects hot, while temperature measures the intensity of heat. Although quite distinct from each other, yet heat and temperature are closely related because gain or loss of heat is necessary to raise or lower the temperature. The celsius scale, named after the swedish astronomer. Anders Celsius, is accepted internationally by Scientists for reporting air temperature. The historical temperature records of several English-speaking countries include values on the Fahrenheit scale, Fahrenheit temperatures may be converted to their celsius equivalents by the formula $C = \frac{5}{9}(F - 32)$. Moreover, difference in temperature determines the direction of flow of heat. This we can understand by studying temperature distribution.

Distribution of temperature varies both horizontally and vertically. Let us study it under:

(a) The horizontal distribution of temperature

(b) The vertical distribution of temperature

(a) Horizontal Distribution of Temperature

Distribution of temperature across the latitudes over the surface of the earth is called its horizontal distribution. On maps, the horizontal distribution of temperature is commonly shown by "Isotherms", lines connecting points that have equal temperatures. An isotherm is made of two words 'iso' and 'therm', 'Iso' means equal and 'therm' means" temperature. If you study an isotherm map you will find that the distribution of temperature is uneven.

The factors responsible for the uneven distribution of temperature are as follows:

(i) Latitude
(ii) Land and Sea Contrast
(iii) Relief and Altitude
(iv) Ocean Currents
(v) Winds
(vi) Vegetation Cover
(vii) Nature of the soil
(viii) Slope and Aspect

(i) Latitude : You have already studied under'insolation' that the angle of incidence goes on decreasing from equator towards poles (fig. 10.1). Higher the angle of incidence, higher is the temperature. Lower angle of incidence leads to the lowering of temperature. It is because of this that higher temperatures are found in tropical regions and they generally decrease at a considerable rate towards the poles. Temperature is below freezing point near the poles almost throughout the year.

(ii) Land and Sea Contrast: Land and sea contrast affects temperature to a great extent. Land gets heated more rapidly and to a greater degree than water during sunshine. It also cools down more rapidly than water during night. Hence, temperature is relatively higher on land during day time and it is higher in water during night. In the same way there are seasonal contrasts in temperature. During summer the air above land has higher temperature than the oceans. But the air above oceans gets higher temperature than landmasses in winter.

Not withstanding the great contrast between land and water surfaces, there are differences in the rate of heating of different land surfaces. A snow covered land as in polar areas warms very slowly because of the large amount of reflection of solar energy. A vegetation covered land does not get excessively heated because a great amount of insolation is used in evaporating water from the plants.

(iii) Relief and Altitude: Relief features such as mountains, plateaus and plains control the temperature by way of modifying its distribution.

Mountains act as barriers against the movement of winds. The Himalayan ranges prevent cold winds of Central Asia from entering India, during winter. Because of this Kolkata is not as cold as Guangzhou (Canton) in winter though both are situated almost on the same latitude. (fig. 10.4).

As we move upwards from sea level, we experience gradual decrease in temperature. Temperature decreases at an average rate of 6^0C per 1000 m. altitude. It is known as normal lapse rate. The air at lower elevations is warmer than that of higher elevations because it is closest to the heated surface of the earth. As a result mountains are cooler than the plains even during summers (see fig.10.4). It is worth remembering that the rate of decrease of temperature with altitude varies with time of day, season and location.

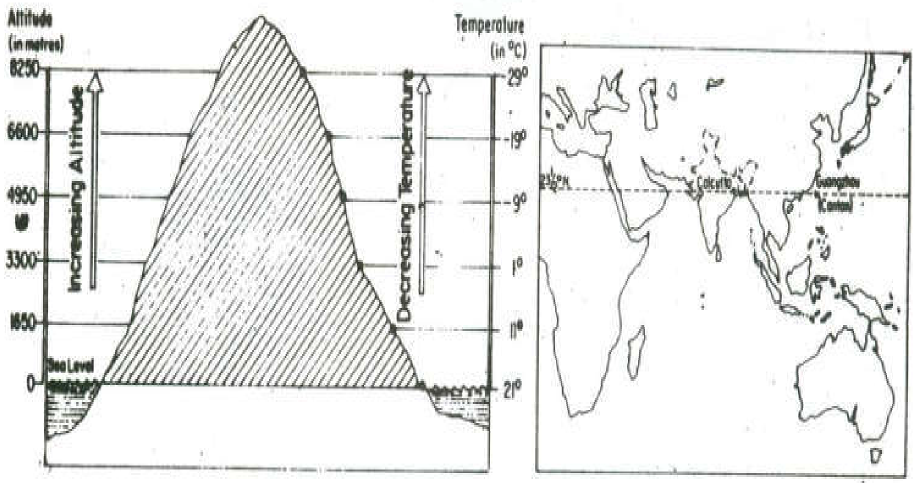


Fig. 10.4 Effect of Altitude on Temperature

Quito and Guayaquil are two cities of Ecuador (South America) situated near the equator and relatively close to each other. Quito is at 2800 metres. high from mean sea level while Guayaquil is just at 12 metres altitude. However because of difference in altitude. Quito experiences annual mean temperature of 13.3°C while in Guayaquil it is 25.5°C.

(iv) Ocean Currents: Ocean currents are of two types - warm and cold. Warm currents make the coasts along which they flow warmer, while cold currents reduce the tempeeture of the coasts along which they flow. The North-Western European.Coasts do not freeze in winter due to the effect of North Atlantic Drift (a warm current), while the Quebec on the coast of Canada is frozen due to the Cold Labrador Current flowing along it, though the Quebec is situated in lower latitudes than the North-West European Coast (see fig.10.5).

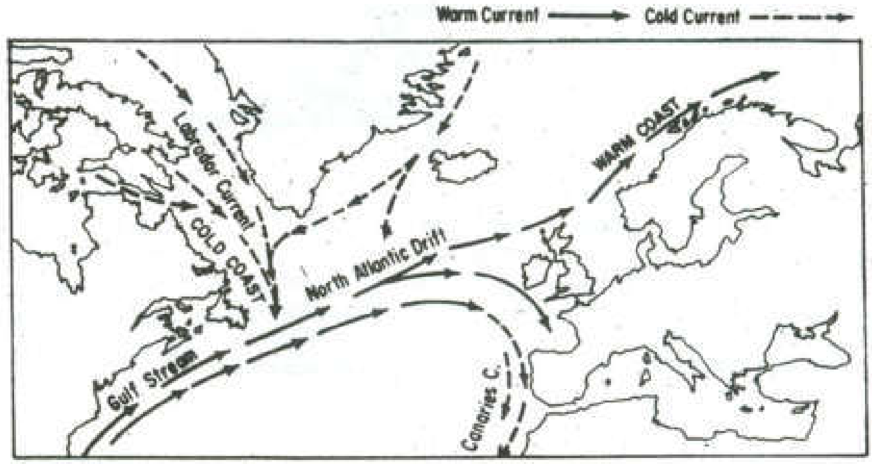


Fig. 10.5 Effect of Warm and Cold Ocean Current

(iii) Winds : Winds also affect temperature because they transport heat from one region to the other, about which you have already studied under advection.

(vi) Vegetation Cover: Soil devoid of vegetation cover receives heat more rapidly than the soil under vegetation cover. Because vegetation cover absorbs much of sun's heat and then prevents quick radiation from the earth whereas the former radiates it more rapidly. Hence the temperature variations in dense forested areas are lower than those in desert areas. For example annual range of temperature in equatorial regions is about 5°C while in hot deserts, it is as high as 38°C.

(vii) Nature of the Soil: Colour, texture and structure of soils modify temperature to a great degree. Black, yellow and clayey soils absorb more heat than sandy soils. Likewise heat radiates more rapidly from sandy soils than from black, yellow and clayey soils. Hence temperature contrasts are relatively less in black soil areas than those of sandy soils.

(viii) Slope and Aspect : Angle of the. slope and its direction control the receipt of insolation. The angle of incidence of sun's rays is greater along a gentler slope and smaller along a steeper slope. The ray in both the cases carry an equal amount of solar energy. Greater concentration of solar energy per unit area along gentler slope raises the temperature while its lesser concentration along steeper slopes lowers the temperature. For such reasons, the southern slopes of the Himalaya are warmer than the northern ones. At the same time the slopes, in terms of aspect, exposed to the sun receive more insolation and are warmer than those which are away from the direct rays of the sun. The northern slopes of the Himalaya for example, not facing the sun are exposed to cold northernly winds are obviously colder. On the other hand the southern slopes of the Himalaya are sun-facing and are also shelter from the northernly cold winds are warmer. Hence we observe settlements and cultivation largely on the southern slopes of the Himalaya while the northern slopes are more under forest area.

- Latitude, land and sea contrast, relief and altitude, oceans currents, winds, vegetation cover, nature of soil, slope and aspect control the distribution of temperature in the world.

The horizontal distribution of temperature over the globe can be studied easily from the maps of January and July months, since the seasonal extremes of high and low temperature are most obvious in both northern and southern hemispheres during these months.

(I) Horizontal Distribution of Temperature in January

In January, the sun shines vertically overhead near the Tropic of Capricorn. Hence it is summer in southern hemisphere and winter in northern hemisphere. High temperature is found over the landmasses mainly in three regions of the southern hemisphere. These regions are North-west Argentina, East, Central Africa, and, Central Australia. Isotherm of 30°C closes them. In northern hemisphere landmass arc cooler than oceans. During this time North-east Asia experiences lowest temperatures. (see fig. 10.6)

As the air is warmer over oceans than over landmasses in the northern hemisphere, the Isotherms bend towards poles when they cross the oceans. In southern hemisphere, the position of the isotherms is just reverse. They bend towards poles when they cross the landmasses and towards equator when they cross oceans.

Large expanse of water exists in southern hemisphere. Hence, isotherms are regular and widely spaced in the southern hemisphere. While they are irregular and closely spaced in northern hemisphere due to large expanse of landmasses. For these reasons no extreme seasonal contrasts between land and water are found in middle and higher latitudes in the southern hemisphere as they exist north of equator.

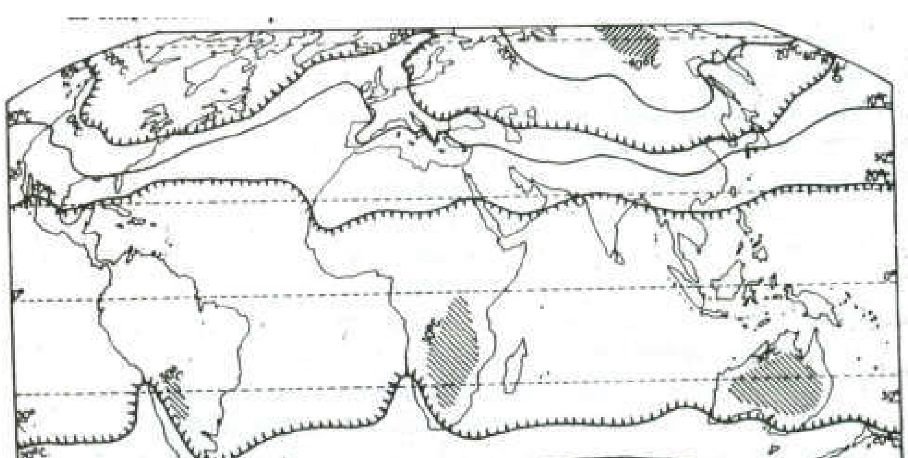


Fig. 10.6 Horizontal Distribution of Temperature (January)

(II) Horizontal Distribution of Temperature in July

During this period the sun shines vertically overhead near the Tropic of Cancer. Hence, high temperatures are found in the entire northern hemisphere. Isotherm of 30°C passes between 10° N and 40° N latitudes. The regions having this temperature include South Western USA, the Sahara, the Arabia, Iraq, Iran, Afghanistan, desert region of India and China. However, lowest temperature of 0°C is also noticed in the Northern Hemisphere during summer in the central part of Greenland (see fig. 10.7)

During summer in the northern hemisphere, isotherms bend equatorward while crossing oceans and polewards while crossing landmasses. In southern Hemisphere the position of isotherms is just opposite.

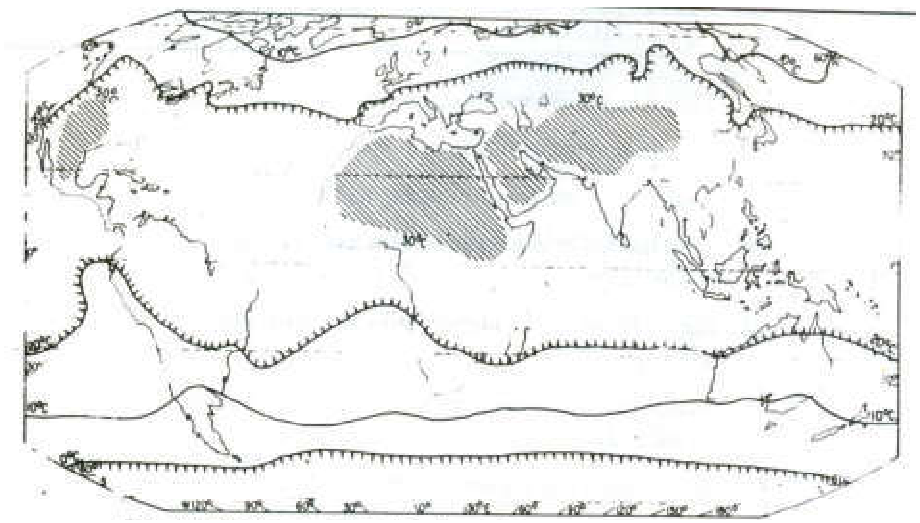


Fig. 10.7 Horizontal Distribution of Temperature (July)

lsotherms are wide spaced over oceans while they are closely spaced over landmasses.

A comparison between the January and July isotherm maps reveals the following important characteristics.

The latitudinal shifting of highest temperature as a result of migration of the vertical rays of the sun.

The occurance of highest values in the low latitudes and the lowest value in the high latitudes is due to the decreasing insolation from equator to the poles.

In northern hemisphere the isotherms on leaving the land usually bend rather sharply towards poles in winter and towards the equator in the summer. This behaviour of the isotherms is due to the differential heating and cooling of landmasses. The continents are hotter in the summer and colder in the winter than the oceans.

Difference between the average temperatures of warmest and the coldest months is known as annual range of temperature. Annual range of temperature is larger in the interior parts of the continents in middle and high latitudes of the northern hemisphere. Verkhoyansk in Siberia records 66°C the highest annual range of temperature in the world. Its lowest average winter temperature is-50°C. Hence it is aptly called 'cold pole' of the earth.

- The difference between average temperature of the warmest and the coolest months is known as annual range of temperature.

INTEXT QUESTIONS 10.3

1. Select the correct alternative and mark tick (√) on it:

   (a) Terrestrial radiation is the amount of heat radiated by the

   (i) earth, (ii) sun, (iii) atmosphere, (iv) hydrosphere

   (b) Quito has lower temperature than that of Guayanquil because Quito is situated at

   (i) higher latitude, (ii) higher altitude, (iii) lower latitude, (iv) lower altitude.

   (c) Verkhoyansk has very high annual range of temperature because it is located

   (i) in the equatorial region, (ii) on the sea coast, (iii) in the interior parts of Asia (iv) on mountain

2. Give a geographical term for each of the following statements:

   (a) The process of horizontal transport of heat by winds.

   ____

   (b) Imaginery lines on a map joining the places of equal temperature, reduced to sea level.

   ____

   (c) Difference between the mean temperatures of the hottest and that of the coldest month.

   ____

(b) Vertical Distribution of Temperature

The permanent snow on high mountains, even in the tropics, indicate the decrease of temperature with altitute. Observations reveals that there is a fairly regular decrease in temperature with an increase in altitude. The average rate of temperature decrease upward in the troposphere is about 6^0C per km, extending to the tropopause. This vertical gradient of temperature is commonly referred to as the standard atmosphere or normal lapse rate, but is varies with height, season, latitude and other factors. Indeed the actual lapse rate of temperature does not always show a decrease with altitude.

(c) Inversion of Temperature

Long winter night, clear sky, dry air and absence of winds leads to quick radiation of heat from the earth's surface, as well as from the lower layers of the atmosphere. This results in the cooling of the air near the earth's surface. The upper layers which lose their heat not so quickly are comparatively warm. Hence the normal condition in which temperature decreases with increasing height, is reversed. The cooler air is nearer the earth and the warmer air is aloft. In other words, temperature increases with increasing height temporarily or locally. This phenomena is termed as inversion of temperature. Sometimes the cold and dense air remains near the surface for number of days. So the phenomenon of inversion of temperature is also seen for days together.

The phenomenon of inversion of temperature is especially observed in intermontane valleys. During winters the mountain slopes cool very rapidly due to the quick radiation of heat. The air resting above them also becomes cold and its density increases. Hence, it moves down the slopes and settles down in the valleys. This air pushes the comparatively warmer air of valleys upwards and leads to the phenomenon of inversion of temperature. Sometimes the temperature falls below freezing point in the valleys leading even to the occurance of frost. In contrast, the higher slopes remain comparatively warmer. That is why mulberry planters of the Suwa Basin of Japan and the apple growers of Himachal Pardesh avoid the lower slopes of the mountains to escape winters frost. If you have been to any hill station you would have seen that most of the holiday resorts and the houses of affluent persons are built on the upper slopes.

- Temperature usually decreases with increasing altitude.
- The normal lapse rate is 6^0C per 1000m metres ascend.
- The phenomenon in which temperature increases with increasing altitude temporarily and locally under certain conditions is known as inversion of temperature.

INTEXT QUESTIONS 10.4

1. Select the correct alternative for each of the following and mark tick ( ) on it:

(a) Temperatures decrease with increase in -

(i) altitude, (ii) depth, (iii) pressure, (iv) both altitude and depth

(b) The normal lapse rate is 6^0C per

(i) 561 metres, (ii) 1000 m, (iii) 651 metres (iv) 156 metres

(c) The phenomenon in which temperature increases with increasing altitude is known as

(i) temperature anomaly, (ii) inversion of temperature, (iii) lapse rate, (iv) insolation

2. Tick (√) the true statements and cross (x) on the false ones

(a) Cold air is light.

(b) Cold air is dense.

(c) Clear sky dry air and absence of winds causes rapid radiation leading to the phenomenon of inversion of temperature.

(d) Inversion of temperature occurs very frequently in plain

(e) Apple growers of the Himachal Pradesh avoid lower slopes

(f) The cool and dense air sliding down the mountain slopes pushes the comparatively warm and light air of valleys of words.

(g) Inversion of temperature occurs locally and temporarily.

WHAT YOU HAVE LEARNT

Sun is the primary source of energy on earth. Sun's energy reaching the earth in short waves is called insolation. The amount of insolation depends upon angle of incidence, duration of the day and transparency of the atmosphere. The processes involved in the heating and cooling of the atmosphere are radiation, conduction, convection and advection. Radiation predominates other three processes. Terrestrial radiation is the amount of heat radiated back from the earth. There is a balance between the receipt of insolation and the. terrestrial radiation on earth' s surface. It is known as heat budget. Global warming is the world wide increase of atmospheric temperature due to depletion of ozone layer and increase in carbon dioxide

Temperature measures the intensity of heat. Distribution of temperature varies both horizontally and vertically. Certain factors control its distribution. They are latitude, land and water contrast, winds, ocean currents, altitude and aspect of slope. Horizontal distribution of temperature is shown on a map with the help of isotherms, the imaginery lines joining places of equal temperature.

Temperature also decreases with increasing altitude. The rate at which it decreases in normal conditions is known as normal lapse of temperature. It is 6^0C per 1000m of height. The phenomenon of inversion of temperature occurs when temperature increases with increase in height: It is generally local and temporary in character.

TERMINAL QUESTIONS

1. Answer the following questions at the most in one sentence:
   (a) What is meant by normal lapse rate?
   (b) What is insolation?
   (c) Define terrestrial radiation.
   (d) At which rate does temperature decrease with increase in altitude?
2. Write in about 50 words on each of the following
   (a) Distribution of temperature in the world in January
   (b) Heat Budget
   (c) Comparison between. January & July isotherms.
   (d) Latitudinal heat balance.
3. Describe the factors that influence the horizontal distribution of temperature.
4. Mark and label the following on an outline map of world.
   (a) 30°C isotherm in July
   (b) Verkhoyansk
   (c) The Sahara
   (d) Borneo island
5. Why do different parallel of latitude receive different amount of insolation?
6. Draw a diagram to explain the heat budget of the earth.

ANSWER TO INTEXT QUESTIONS

10.1

1. (a) Radiation (b) Two billionths part (c) Advection (d) (i) Angle of incidence, (ii) Duration of the day and (iii) Transparency of the atmosphere

2. (a) short waves (b) heat radiation from the earth (c) terrestrial radiation

10.2

1. (a) see 10.2 (b) see 10.2 (c) see 10.3
2. (a) 51% (b) 6% (c) Tropical Region (d) Polar region

10.3

1. (a) earth (b) higher altitude (c) in the interior parts of Asia
3. (a) Advection (b) Isotherms (c) Annual range of temperature

10.4

1. (a) altitude (b) 1000 metres (c) inversion of temperature
2. (a) False, (b) True, (c) True, (d) False', (e) True, (f) True, (g) True

HINTS TO TERMINAL QUESTIONS

1. (a) The normal rate at which temperature decreases with increase in altitude.
   (b) The portion of solar radiation that reaches the surface of the earth.
   (c) Heat radiated from the earth's surface.
   (d) 6°C at every 1000 metres altitude.
2. (a) Please refer to para to 10.4 (a) (I)
   (b) Please refer to para 10.2
   (c) Please refer to para 10.4 (a) (II)
   (d) Please refer to para 10.2 (a)
3. Please refer to para 10.4 (a)
4. Please see maps of this lesson
5. Please see para 10.1 (i)
6. Please see Fig. 10.2

11

PRESSURE AND WINDS

We do not ordinarily think of air as having too much weight. But air has weight and it exerts pressure. Let us take an empty bicycle tube and weight it. Now fill tube with air and weight it again. You will find that the weight of the air filled tube is more than when it was empty. If you go on filling air in the tube a situation comes when the tube bursts. The bursting of the tube occurs due to increase in air pressure in the tube. Similarly, the air around us exerts pressure. But we do not feel the weight of the atmosphere because we have air inside us which exerts an equal outward pressure that balances the inward pressure of the atmosphere. Atmospheric pressure is important to us because it is related to winds and it helps to determined, weather conditions of a place. In this lesson you will study air pressure, its distribution, winds and their types.

OBJECTIVES

After studying this lesson, you will be able to :

- give reasons for the decrease of air pressure with increase in altitude;
- describe with examples the effect of low air pressure at high altitude on the daily life of man;
- explain the relationship between the spacing of isobar and pressure gradient;
- establish relationship between the temperature and the existence of equatorial low pressure and the polar high pressure;
- give reason for the existence of sub-tropical high pressure and sub-polar low pressure belts;
- explain the distribution of atmospheric pressure with the help of isobar maps of the world for the months of January and July;

- establish the relationship between pressure gradient and speed of winds
- explain the influence of coriollis effect on the direction of winds of both the hemispheres;
- draw diagram showing pressure belts and planetary winds;
- distinguish between (a) planetary and monsoon winds (b) land and sea breezes (c) valley and mountain breezes and (d) cyclones and anti-cyclones:
- describe the characteristics of Important local winds

11.1 MEASUREMENT OF AIR PRESSURE

The atmosphere is held on the earth by the gravitational pull of the earth. A column of air exerts weight in terms of pressure on the surface of the earth. The weight of the column of air at a given place and time is called air pressure or atmospheric pressure. Atmospheric pressure is measured by an instrument called barometer. Now a days Fortin's barometer and Aneroid barometer I are commonly used for measuring air pressure.

Atmospheric pressure is measured as force per unit area. The unit used for measuring pressure is called millibar. Its abbreviation is 'mb'. One millibar is equal to the force of one gram per square centimetre approximately. A pressure of 1000 millibars is equal to the weight of 1.053 kilograms per square centimetre at sea level. It is equal to the weight of a column of mercury which is 76 centimetre high. The international standard pressure unit is the "pascal", a force of one Newton per square meter. In practice atmospheric pressure is expressed in kilopascals, (one kpa equals 1000 Pa).

- The weight of a column of air at a given place and time is called air pressure.
- Barometer is the instrument which measures air or atmospheric pressure.
- The unit of measurement of atmospheric pressure is millibar (kilopascals).
- One millibar is equal to the force of nearly one gram per square centimetre.

The mean atmospheric pressure at sea level is 1013.25 millibars. However the actual pressure at a given place and at a given time fluctuates and it generally ranges between 950 and 1050 millibars

11.2 DISTRIBUTION OF AIR PRESSURE

Distribution of atmospheric pressure on the surface of the earth is not uniform. It varies both vertically and horizontally.

(a) Vertical Distribution

Air is a mixture of various gases. It is highly compressible. As it compresses, its density increases. The higher the density of air, the greater is the air pressure and vice versa. The mass of air above in the column of air compresses the air under it hence its lower layers are more dense than the upper layers; As a result, the lower layers of the atmosphere have higher density, hence, exert more pressure. Conversely, the higher layers are less compressed and, hence, they have low density and low pressure. The columnar distribution of atmospheric pressure is known as vertical distribution of pressure. Air pressure decreases with increase in altitude but it does not always decrease at the same rate. Dense components of atmosphere are found in its lowest parts near the mean sea level. Temperature of the air, amount of water vapour present in the air and gravitational pull of the earth determine the air pressure of a given place and at a given time. Since these factors are variable with change in height, there is a variation in the rate of decrease in air pressure with increase in altitude. The normal rate of decrease in air pressure is 34 millibars per every 300 metres increase in altitude; (see figure 11.1). The effects of low pressure are more clearly experienced by the people living in the hilly areas as compared to those who live in plains. In high mountainous areas rice takes more time to cook because low pressure reduces the boiling point of water. Breathing problem such as faintness and nose bleedings are also faced by many trekkers from outside in such areas because of low pressure conditions in which the air is thin and it has low amount of oxygen content.

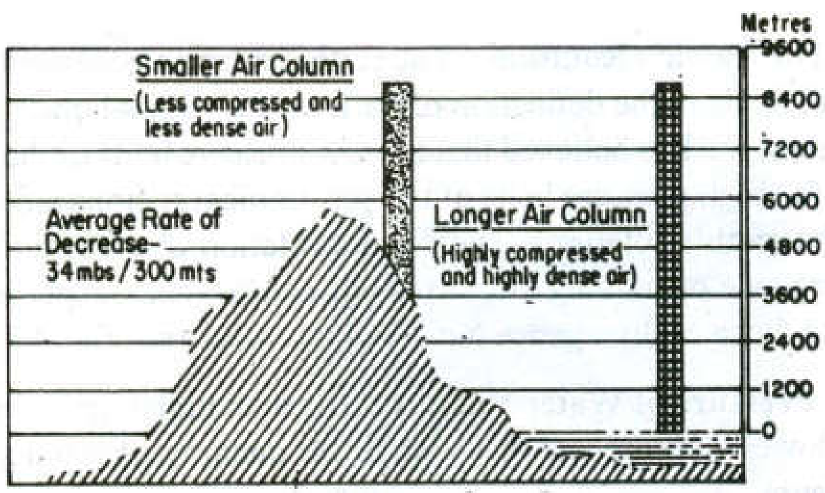


Fig 11.1 Vertical Distribution of Air Pressure

(b) Horizontal Distribution

The distribution of atmospheric pressure over the globe is known as horizontal distribution of pressure. It is shown on maps with the help of isobars. An isobar is a line connecting points that have equal values of pressure. Isobars are analogous to the contour lines on a relief map. The spacing of isobars expresses the rate and direction of change in air pressure. This charge in air pressure is referred to pressure gradient. Pressure gradient is the ratio between pressure difference and the actual horizontal distance between two points. Close spacing of isobars expresses steep pressure gradient while wide spacing indicates gentle pressure gradient (see fig. 11.5)

The horizontal distribution of atmospheric pressure is not uniform in the world. It varies from time to time at a given place; it varies from place to place over short distances. The factors responsible for variation in the horizontal distribution of pressure are as follows:

(i) Air temperature

(ii) The earth's rotation

(iii) Presence of water vapour

(i) Air Temperature: In the previous lesson, we have studied that the earth is not heated uniformly because of unequal distribution of insolation, differential heating and cooling of land and water surfaces. Generally there is an inverse relationship between air temperature and air pressure. The higher the air temperature, the lower is the air pressure. The fundamental rule about gases is that when they are heated, they become less dense and expand in volume and rise. Hence, air pressure is low in equatorial regions and it is higher in polar regions. Along the equator lies a belt of low pressure known as the "equatorial low or doldrums". Low air pressure in equatorial regions is due to the fact that hot air ascends there with gradual decrease in temperatur causing thinness of air on the surface. In polar region, cold air is very dense hence it descends and pressure increases. From this we might expect, a gradual increase in average temperature thords equator. However, actual readings taken on the earth's surface at different places indicate that pressure does not increase latitudinally in a regular fashion from equator to the poles. Instead, there are regions of high pressure in subtropics and regions of low pressure in the subpolar areas.

(ii) The Earth's Rotation: The earth's rotation generates centrifugal force. This results in the deflection of air from its original place, causing decrease of pressure. It is believed that the low pressure belts of the sub polar regions and the high pressure belts of the sub-tropical regions are created as a result of the earth's rotation. The earth's rotation also causes convergence and divergence of moving air. Areas of convergence experience low pressure while those of divergence have high pressure (see fig. 11.7).

(iii) Pressure of Water Vapour : Air with higher quantity of water vapour has lower pressure and that with lower quantity of water vapour has higher pressure. In winter the continents are relatively cool and tend to develop high pressure centres; in summer they stay warmer than the oceans and tend to be dominated by low pressure, conversely, the oceans are associated with low pressure in winter and high pressure in summer.

- An isobar is a line connecting points that have equal values of pressure.
- Pressure gradient is the ratio between pressure difference and horizontal distance between two points.
- On an average air pressure decreases by 34 millibars per 300 metres increase in height.

INTEXT QUESTIONS 11.1

1. Name the three factors which influence horizontal distribution of air pressure:

   (a)__________________(b)______________(c)________________

2. Name the two instruments used to measure air pressure:

   (a)_______________________(b)____________________________

3. What is the mean atmospheric pressure at sea level?

   ____

4. Select the best alternative for each and mark tick (√) on it :

   (a) A pressure of 1000 millibars is equal to the weight of a column of mercury having height of

   (i) 65 cm; (ii) 70 cm; (iii) 76 cm; (iv) 80cm

   (b) Areas where moving air converge have

   (i) high pressure. (ii) low pressure; (iii) both high and low pressure (iv) no pressure at all

   (c) Air with lower quantity of water vapour has (i) higher pressure (ii) lower pressure; (iii) no pressure (iv) none of the above

11.3 PRESSURE BELT

The horizontal distribution of air pressure across the latitudes is characteriesd by high or low pressure belts. This is however, a theoretical model because pressure belts .are not always found as such on the earth. We will see it later how the real condition departs from the idealized model. and examine why these differences occur.

These pressure belts are: (i) The Equatorial Low Pressure Belt;. (ii) The Sub tropic High Pressure Belts; (iii) The Sub-polar Low Pressure Betts; (iv) The Polar High Pressure Belts (see fig. 11.2)

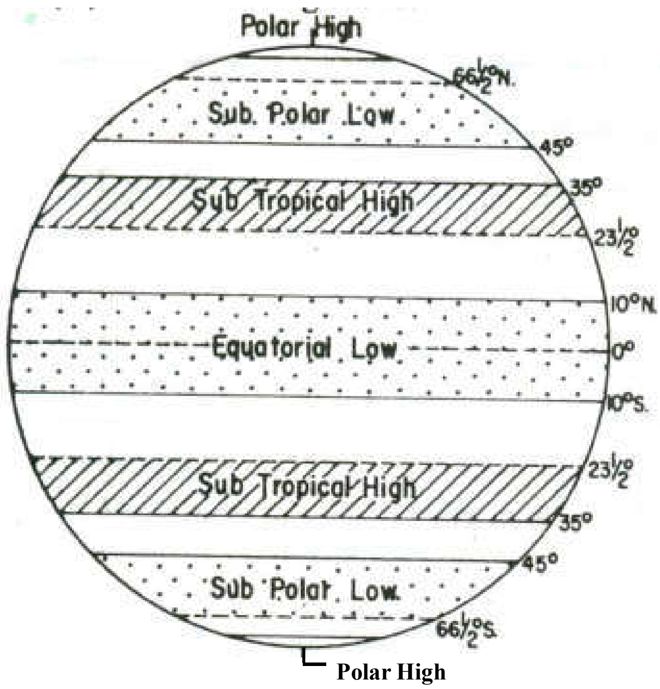


Fig. 11.2 Pressure Belts

(i) The Equatorial Low Pressure Belt

The sun shines almost vertically on the equator throughout the year. As a result the air gets warm and rises over the equatorial region and produce equatorial low pressure. This belt extends from equator to 10^0N and 10^0S latitudes. Due to excessive heating horizontal movement of air is absent here and only conventional currents are there. Therefore this belt is called doldrums (the zone of calm) due to virtual absence of surface winds. These are the regions of convergence because the winds flowing from sub tropical high pressure belts converge here. This belt is also known as-Inter Tropical Convergence Zone (ITCZ).

(ii) The Sub-tropical High Pressure Belts

The sub-tropical high pressure belts extend from the tropics to about 35^0 latitudes in both the Hemispheres. In the northern hemisphere it is called as the North sub-tropical high pressure belt and in the southern hemisphere it is known as the South sub-tropical high pressure belt. The existence of these pressure belts is due to the fact that the up rising air of the equatorial region is deflected towards poles due to the earth's rotation. After becoming cold and heavy, it descends in these regions and get piled up. This results in high pressure. Calm conditions with feeble and variable winds are found here. In olden days vessels with cargo of horses passing through these belts found difficulty in sailing under these calm conditions. They used to throw the horses in the sea in order to make the vessels lighter. Henceforth these belts

Notes

or latitudes are also called 'horse latitudes'. These are the regions of divergence because winds from these areas blow towards equatorial and sub-polar low pressure belts.

(iii) The Sub-polar low Pressure Belts

The sub-polar low pressure belts extend between 45^0N and the Arctic Circle in the northern hemisphere and between 45°S and the Antarctic Circle in the southern hemisphere. They are known as the North sub-polar low and the South sub-polar low pressure belts respectively. Winds coming from the sub-tropical and the polar high belts converge here to produce cyclonic storms or low pressure conditions. This zone of convergence is also known as polar front.

(iv) The Polar High Pressure Belts

In polar regions, sun never shines vertically. Sun rays are always slanting here resulting in low temperatures. Because of low temperature, air compresses and its density increases. Hence, high pressure is found here. In northern hemisphere the belt is called the North polar high pressure belt while it is known as the South polar high pressure belt in the southern hemisphere. Winds from these belts blow towards sub-polar low pressure belts.

This system of pressure belts that we have just studied is a generalised picture. In reality, the location of these pressure belts is not permanent. They shift northward in July and southward in January, following the changing position of the sun's direct rays as they migrate between the Tropics of Cancer and Capricorn. The thermal equator (commonly known as the belt of highest temperature) also shifts northwards and southwards of the equator. With the shifting of thermal equator northwards in summer and southwards in winter, there is also a slight shift in pressure belts towards north and south of their annual average location.

- Sub-tropical high pressure belts are also called horse latitudes.
- Subsidence and piling of air in sub-tropical belts cause high pressure.
- Convergence of subtropical and polar winds result in the formation of cyclones in the sub-polar regions.
- High pressure belts are dry while low pressure belts are humid.
- With the movement of sun northwards and southwards thermal equator also shifts northwards and southwards.
- Pressure belts also shift northwards and southwards with the shift of thermal equator.

11.4 SEASIONAL DISTRIBUTION OF PRESSURE

The variation of pressure from place to place and from season to season over the earth plays an important role in affecting the weather and climate. Therefore we study pressure distribution through isobar maps. While drawing isobar maps, the pressures of all places are reduced to sea level to avoid the effect of altitude on air pressure.

(i) January Conditions

In January, with the south-ward apparent movement of the Sun, the equatorial low pressure belt shifts a little south of the mean equatorial position (see fig. 11.3). Areas of lowest pressure occurs in South America, Southern Africa and Australia. This is because the land tends to get hotter rapidly than water. Sub-tropical high pressure cells are centered over the ocean in the southern hemisphere. The belt of high pressure is interrupted by the continental land masses where the temperature is much higher. They are well developed in eastern part of the ocean where cold ocean currents dominate.

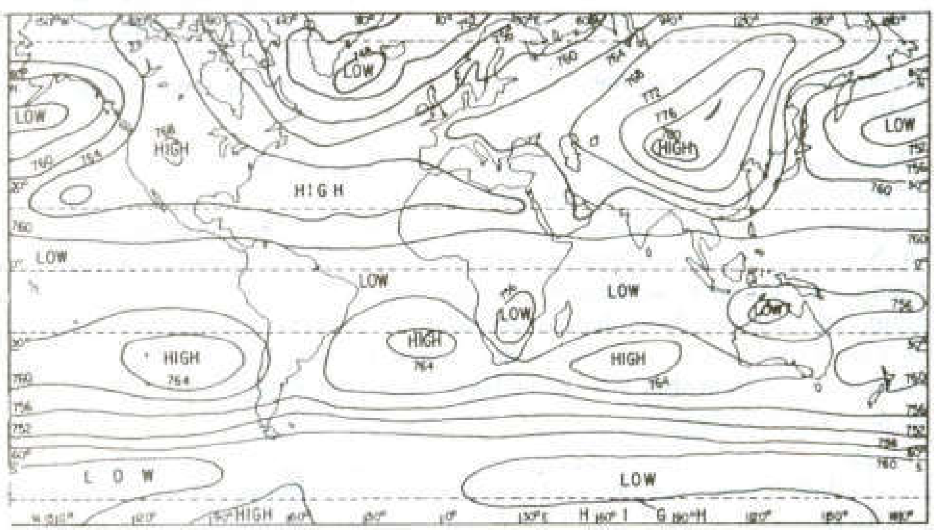


Fig. 11.3 Distribution of Air Pressure (January)

In the northern hemisphere, ridges of high pressure occur in the sub-tropical latitudes over the continent. A well developed high pressure cell occurs in the interior parts of Eurasia. This is due to the fact that land cools more rapidly than oceans. Its temperatures are lower in winter than the surrounding seas. In the southern hemisphere, the sub-polar low pressure belt circles the earth as a real belt of low pressure and is not divided into cells, because there is virtually no landmass. In northern hemisphere two cells of low pressure namely Iceland low and Aleutian low develop over the North Atlantic and the North Pacific oceans respectively.

(ii) July Conditions

In July, the equatorial low pressure belt shifts a little north of the mean equatorial position because of the northward apparent movement of the Sun. All the pressure belts shift northwards in July. (see fig. 11.4)

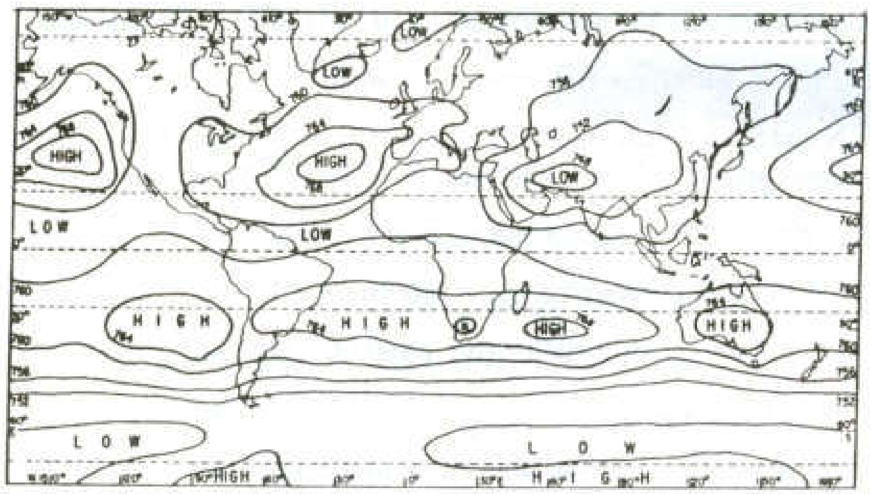


Fig. 11.4 Distribution of Air Pressure (July)

The Aleutian and Icelandic lows disappear from the oceans while the landmasses, which developed high pressure during winter months, have extensive low pressure cells now. In Asia, a low pressure develops. The sub-tropical hights of the northern hemisphere are more developed over the oceans - Pacific and Atlantic. In the southern hemisphere, the sub-tropical high pressure belt is continuous. Sub-polar low forms a continuous belt in the southern hemisphere while in northern hemisphere, there is only a faint oceanic low.

INTEXT QUESTION 11.2

1. Complete each of the following with suitable endings:

   (a) The belt of highest temperature is known as____________

   (b) In drawing isobar maps the factor eliminated is that of___________

   (c) Higher the density of air, higher is its ________________

   (d) Higher the temperature of air, lower is its________________

2. Select the best alternatives for each of the following:

   (a) Earth's rotation causes:

   (i) deflection of air from its original direction.(ii) convergence of air. (iii) both deflection and convergence of air. (iv) none of the above.

(b) Equatorial Low Pressure Belt extends between:

(i) 45° N and S Arctic and Antarctic Circles. (ii) 10° N and 10° S latitudes. (iii) tropics and 35° N and S latitudes. (iv) none of them.

(c) 'Horse latitudes' are those latitudes which lie within:

(i) equatorial low pressure belt. (ii) sub- tropical high pressure belts. (iii) sub-polar low pressure belts. (iv) polar high pressure regions.

(d) Belts of high pressure are:

(i) unstable and dry. (ii) unstable and humid. (iii) both of the above. (iv) none of the above.

11.5 WINDS

We have just studied that air pressure is unevenly distributed. Air attempts to balance the uneven distribution of pressure. Hence, it moves from high pressure areas to low pressure areas. Horizontal movement of air in response to difference in pressure is termed as wind while vertical or nearly vertical moving air is called air current. Both winds and air currents form the system of circulation in the atmosphere.

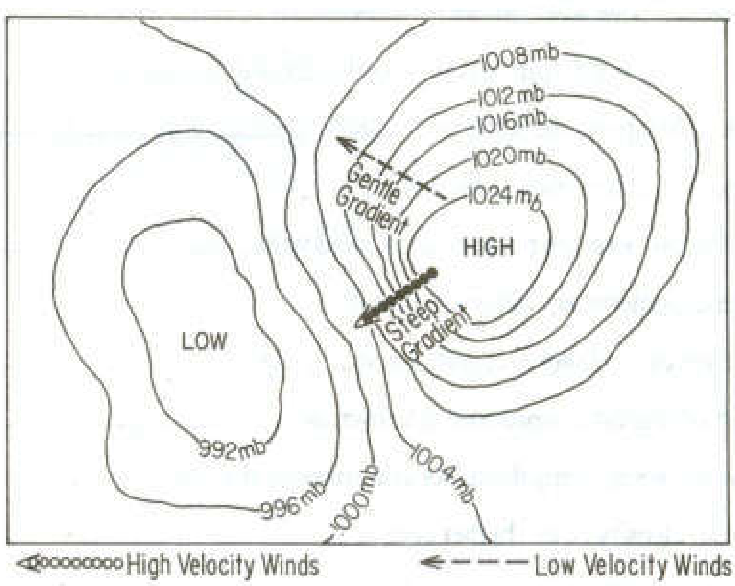


Fig. 11.5 Relationship between Pressure Gradient and Winds

(i) Pressure Gradient and Winds

There is a close relationship between the pressure and the wind speed. The greater the difference in air pressure between the two points, the steeper is the pressure gradient and greater is the speed of the wind. The gentler the pressure gradient slower is the speed of the wind. (see fig. 11.5).

(ii) The Coriolis Effect and Wind

Winds do not cross the isobars at right angles as the pressure gradient directs them. They get deflected from their original paths. One of the most potent influences on wind direction is the deflection caused by the earth's rotation on its axis. Demonstrated by Gaspaved de Coriolis in 1844 and known as the Coriolis effect or coriolis force. Coriolis force tend to deflect the winds from there original direction. In northern hemisphere winds are deflected towards their right, and in the southern hemisphere towards their left (see fig. 11.6) This is known as Farrel's law. The Coriolis force is absent along the equator but increases progressively towards the poles.

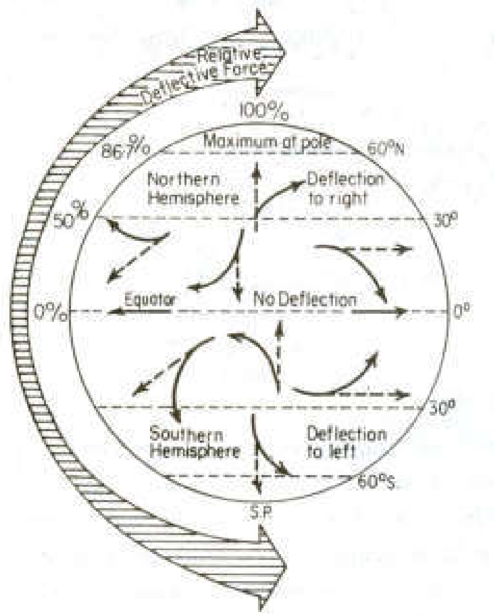


Fig. 11.6 Deflection of Winds by Coriolis Force

11.6 TYPE OF WINDS

For ages man has observed that in some areas of the earth the winds blow predominantly from one direction throughout the year; in other areas the wind direction changes with the season and in still others the winds are so variable that no pattern is discernible. Despite these difference, the winds are generalized under three categories.

(a) planetary winds or permanent winds

(b) periodic winds and

(c) local winds

(a) Planetary Winds

Planetary or permanent winds blow from high pressure belts to low pressure belts in the same direction throughout the year. They blow over vast area of continents and oceans. They are easterly and westerlies and polar easterlies. (see fig. 11.7)

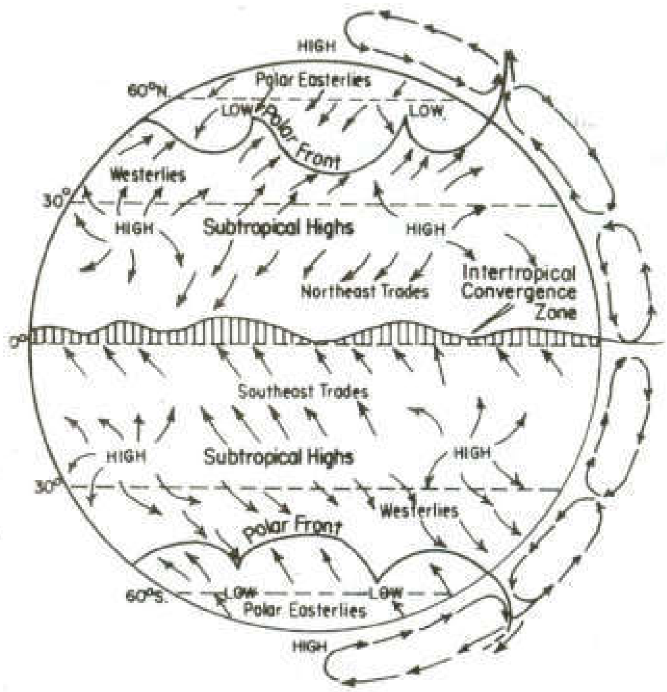


Fig 11.7 : Planetary Winds

(i) The Easterlies

The winds that blow from sub-tropical high pressure areas towards equatorial low pressure areas called trade or easterly winds: The word trade has been derived from the German word 'trade' which means track. To blow trade means 'to blow steadily and constantly in the same direction'. Because of the Coriolis effect the northern trade winds move away from the sub-tropical high in north-east direction. In southern hemisphere the trade winds diverge out of the sub-tropical high towards the equatorial low from the south-east direction As the trade winds tend to blow mainly from the east, they are also known as the Tropical easterlies. (see fig. 11.7)

(ii) The Westerlies

The winds that move poleward from the sub-tropical high pressure in the northern hemisphere are detected to the right and thus blow from the south west. These in the southern hemisphere are deflected to the left and blow from the north-west. Thus, these winds are called westerlise (see fig. 11.7)

(iii) Polar Easterlies

Polar easterlies blow from polar regions towards sub-polar low pressure regions. Their direction in the northern hemisphere is from north-east to south-west and from south-east to north-west in the southern hemisphere.

- In northern hemisphere winds, are deflected towards their right and in the southern hemisphere towards their left. This is known as Ferrel's law.

INTEXT QUESTIONS 11.3

1. Name Planetary winds:

   (a) ______________(b)________________(c)_________________

2. What is Ferrel's law?

   ____

3. Choose the correct alternative for each of the following:

   (a) Winds blow from high pressure to

   (i) low pressure, (ii) high pressure, (iii) both low and high pressures (iv) none of them.

   (b) Winds are deflected from their original path due to

   (i) Coriolis effect, (ii) pressure gradient, (iii) their speed, (iv) high pressure

   (c) Winds are caused primarily by

   (i) Coriolis effect, (ii) pressure difference (iii) rotation of the earth, (iv) humidity difference.

   (d) The Coriolis force at the equator is

   (i) maximum, (ii) medium, (iii) nil, (iv) none of the above.

(b) Periodic Winds

The direction of these winds changes with the change of seasons. Monsoon winds are the most important periodic winds.

Monsoon Winds

The word 'Monsoon' has been derived from the Arabic word 'Mausim' meaning season. The winds that reverse their direction with the change of seasons are called monsoon winds. During summer the monsoon winds blow from sea towards land and during winter from land towards seas. Traditionally these winds were explained as land and sea breezes on a large scale. But this explanation does not hold good now. Now a days the monsoon is generally accepted as seasonal modification of the general planetary wind system. The Asiatic monsoon is the result of interaction of both planetary wind system and regional factors, both at the surface and in the upper troposphere (see fig. 11.8)

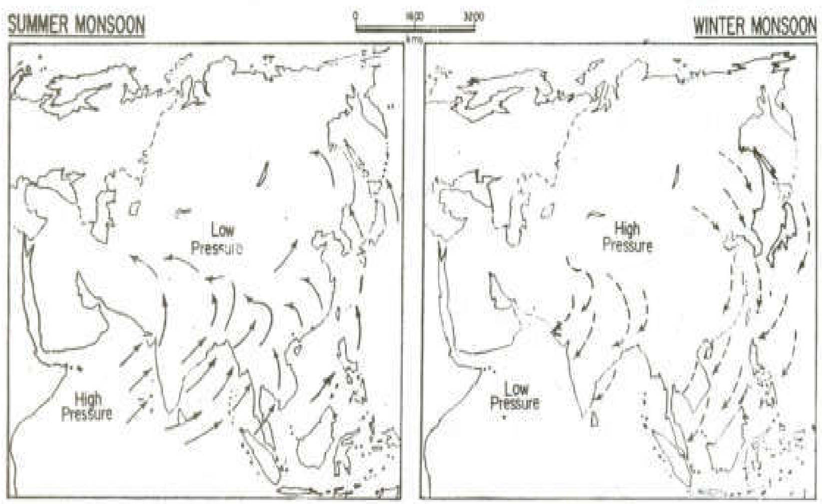


Fig. 11.8 The Monsoon Winds

India, Pakistan, Bangladesh, Myanmar(Burma), Sri Lanka, the Arabian Sea, the Bay of Bengal, South-east Asia, North Australia, China and Japan are important regions where monsoon winds are prevalent.

- Winds which reverse their direction with the change of seasons are called monsoons.

(c) Local Winds

Till now we were discussing the major winds of the earth's surface, which are vital for understanding the climatic regions. But we are all aware that there are winds that affect local weather. Local winds usually affect small areas and are confined to the lower levels of the troposphere. Some of the local winds are given below :

(i) Land and Sea Breezes

Land and sea breezes are prevalent on the narrow strips along the coasts or a lake. It is a diurnal (daily) cycle, in which the differential heating of land and water produces low and high pressures. During the day when landmass gets heated more quickly than the adjoining sea or large lake; air expands and rises. This process produces a local low pressure area on land. Sea breeze then develops, blowing from the water (high pressure) towards the land (low pressure). The sea breeze begins to develop shortly before noon and generally reaches its greatest intensity during mid-day to late afternoon. These cool winds have a significant moderating influence in coastal area.

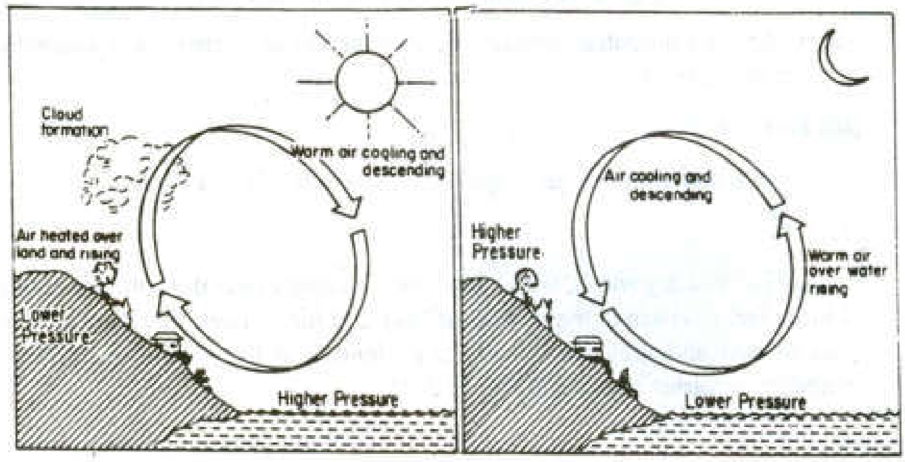


Fig 11.9 Sea and Land Breezes

At night, the land and the air above it cools more quickly than the nearby water body. As a result, land has high pressure while the sea has comparatively a low pressure area. Gentle wind begins to blow from land (high pressure) towards sea (low pressure). This is known as land breeze (see fig. 11.9)

(ii) The Mountain and Valley Breezes

Another combination of local winds that undergoes a daily reversal consists of the mountain and valley breezes. On a warm sunny day the mountain slopes are heated more than the valley floor.

Hence, the pressure is low over the slopes while it is comparatively high in the valleys below. As a result gentle wind begins to blow from valley towards slopes and it assumes the name of valley breeze (see fig. 11.10).

After sunset, the rapid radiation takes place on the mountain slopes. Here, high pressure develops more rapidly than on the valley floor. Cold arid heavy air of mountain slopes starts moving down towards the valley floor. This is known as the mountain breeze (see fig. 11.10).

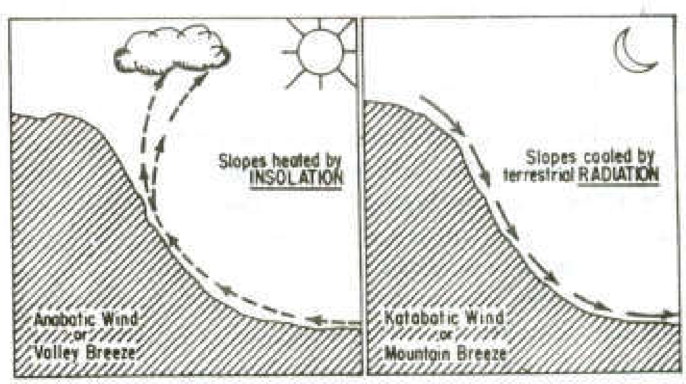


Fig. 11.10 : Mountain and Valley Breezes

The valley and mountain breezes are also named as anabatic and katabatic breezes respectively.

(iii) Hot Winds

Loo, Foehn and Chinook are important hot winds of local category.

(1) Loo

Loo are hot and dry winds, which blow very strongly over the northern plains of India and Pakistan in the months of May and June. Their direction is from west to east and they are usually experienced in the afternoons. Their temperature varies between 45°C to 50°C.

(2) Foehn

Foehn is strong, dusty, dry and warm local wind which develops on the leeward side of the Alps mountain ranges. Regional pressure gradient forces the air to ascend and cross the barrier. Ascending air sometimes causes precipitation on the windward side of the mountains. After crossing the mountain crest, the Foehn winds starts descending on the leeward side or northern slopes of the mountain as warm and dry wind. The temperature of the winds vary from 15°C to 20°C which help in melting snow. Thus making pasture land ready for animal grazing and help the grapes to ripe early.

(3) Chinook

Chinook is the name of hot and dry local wind which moves down the eastern slopes of the Rockies in U.S.A. and Canada. The literal meaning of chinook is 'snow eater' as they help in melting the snow earlier. They keep the grasslands clear of snow. Hence they are very helpful to ranchers.

(iv) Cold Winds

The local cold winds originate in the snow-capped mountains during winter and move down the slopes towards the valleys. They are known by different names in different areas.

(1) Mistral

Mistrals are most common local cold winds. They originate on the Alps and move over France towards the Mediterranean Sea through the Rhone valley. They are very cold, dry and high velocity winds. They bring down temperature below freezing point in areas of their influence. People in these areas protect their orchards and gardens by growing thick hedges and build their houses facing the Mediterranean sea.

INTEXT QUESTIONS 11.4

1. Choose the correct alternative for each of the following:
   (a) Foehn winds are
   (i) wet and dry (ii) cold, (iii) both wet and cold, (iv) none of them.
   (b) Chinooks are similar to
   (i) Foehn, (ii) Mistral, (iii) both of them, (iv) none of them.
2. Where from the Foehn wind originates.

   ____
3. Name the local wind which originate on the snow capped rockies and move down the eastern slopes.
4. Write hot or cold against each of the following
   (a) Loo ______________
   (b) Mistral ______________
   (c) Chinok _____________

11.7 TROPICAL AND TEMPERATE CYCLONES

(1) Air Mass

An air mass is an extensive portion of the atmosphere having uniform characteristics of temperature, pressure and moisture which are relatively homogeneous horizontally.

An air mass develops when the air over a vast and relatively uniform land or ocean surface remains stationary for long time to acquire the temperature or moisture from the surface. The major source regions of the air masses are the high latitude polar or low latitude tropical regions having such homogeneous conditions. Air masses, therefore, are of two kinds-polar and tropical air masses. Polar air mass is cold and tropical air mass is warm. When cold air mass and warm air mass blow against each other, the boundary line of convergence separating the two air masses is termed as front. When the warm air mass, moves upward over the cold air mass the front formed in such a situation is called warm front. On the contrary, when the cold air mass advances faster and undercuts the warm air mass and forces the warm air upwards, the front so formed is called cold front. The frontal surface of cold front is steeper than that of a warm front (see fig 12.5). A prevailing air mass in any region - polar, tropical, maritime or continental largely controls the regions general weather.

(2) Cyclones

Typical cyclones are elliptical arrangement of isobars having low pressure at the centre with a convergence of winds within them. The wind direction in the cyclones is anti clockwise in the northern hemisphere and clockwise in the southern hemisphere. Cyclones are of two types - the temperate or mid latitude cyclones and the tropical or low latitude cyclones (see fig. 11.11)

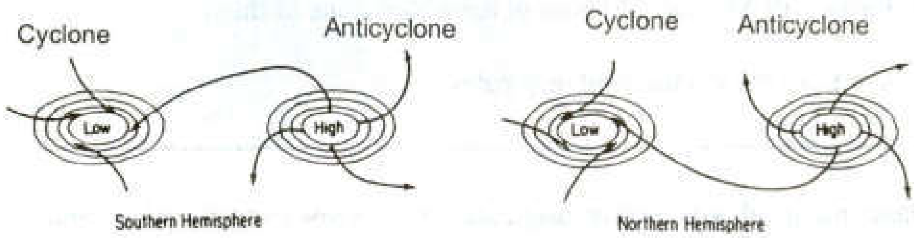


Fig. 11.11 : Movement of Wind associated with Cyclones and Anticyclone in Northern and Southern Hemisphere

(a) Temperate Cyclones

Temperate cyclones are formed along a front in mid-latitudes between 35° and 65° N and S. They blow from west to east and are more pronounced in winter season.

Atlantic Ocean and North West Europe are major regions of temperate cyclones. They are generally extensive having a thickness of 9 to11 kilometers and with 1040-1920 km short and long diametres respectively. Each such cyclone alternates with a high pressure anticyclone. The weather associated with the cyclone is drizzling rain and of cloudy nature for number of days. The anticyclone weather is sunny, calm and of cold waves.

(b) Tropical Cyclones

Tropical cyclones are formed along the zone of confluence of north-east and south-east trade winds. This zone is known as the Inter Tropical Convergence Zone (ITCZ). Cyclones generally occur in Mexico, South-Western and North Pacific Ocean, North Indian Ocean and South Pacific Ocean. These cyclones differ from temperate cyclones in many ways. There are no clear warm and cold fronts as temperature seldom differs in Inter Tropical Convergence Zone. They do not have well-defined pattern of winds and are energised by convectional currents within them. Generally, these are shallow depressions and the velocity of winds is weak. These are not accompanied by anticyclones. The arrangement of isobars is almost circular. These are not extensive and have the diametres of 160-640km. However, a few of them become very violent and cause destruction in the regions of their influence. They are called hurricanes in the Carribean Sea, typhoons in the China, Japan and phillipines, cyclones in the Indian Ocean and willy-willies in Northern Australia (see fig. 11.12)

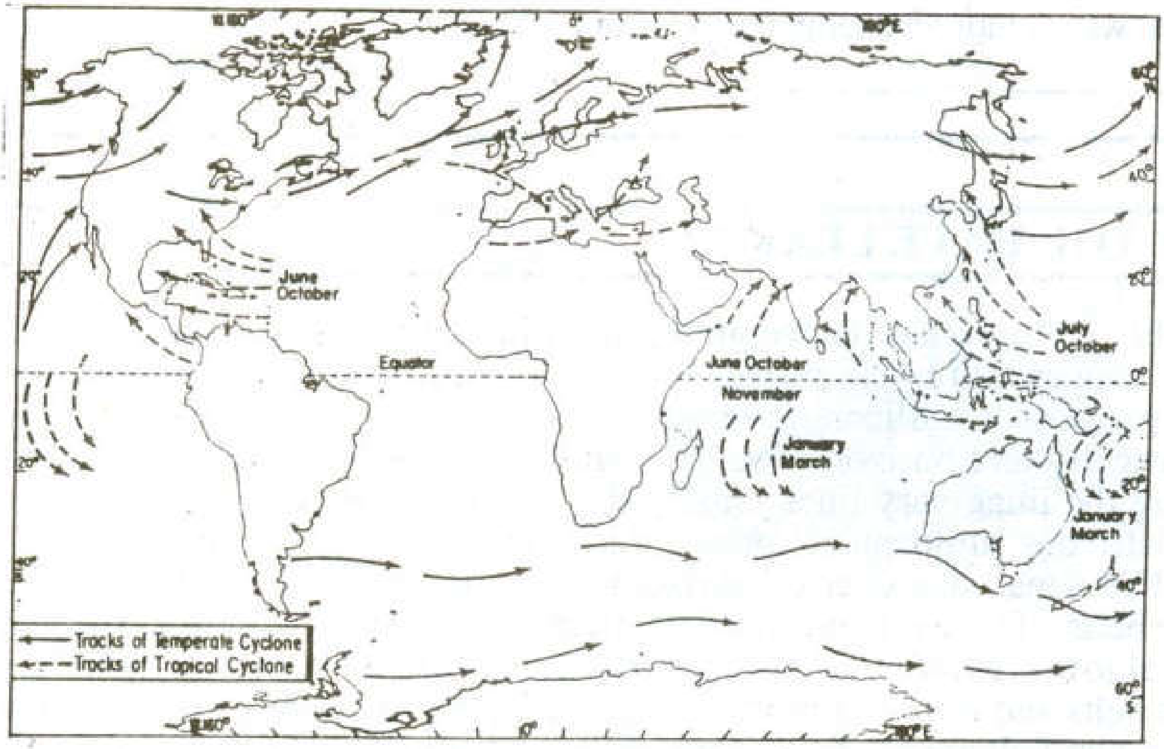


Fig. 11.12 : Tracks of Temperate and Tropical Cyclones

Tropical cyclones often cause destruction on the coasts. You would have heard cyclones striking Indian coasts in summer and autumn months. They cause heavy loss of life and property in these regions. The steeper pressure gradient causing strong high velocity winds and torrential rainfall bursting upon a restricted area combine to create distructive storms. However about 8 to 48 km. area around their centre called the eye of these stormy cyclones remains calm and rainless. If this eye is detected, it is possible for the modern science to stop further development of these strong cyclones and thus protecting us from them.

- An air mass is a large body of air having uniform temperature and moisture contents.
- The boundary line separating two air masses is termed as front.
- Temperate cyclones are prevalent in mid-latitudes while tropical cyclones develop in tropical regions.

INTEXT QUESTIONS 11.5

1. What is air mass?

2. Which type of cyclones cause heavy loss to life and property?

3. In which latitudes temperate cyclones develop?

WHAT YOU HAVE LEARNT

Atmospheric pressure is the weight of the column of air at a given place and time. It is measured by an instrument called barometer. Unit of measurement of pressure is millibar. The distribution of atmospheric pressure varies both vertically and horizontally. It is shown on the maps through isobars which are the imaginary lines joining the places having equal air pressure. In high latitudes, atmospheric pressure is more than the pressure at low latitudes. The zonal character of horizontal pressure is commonly known as pressure belts. There are four pressure belts spread over the earth. They are equatorial low pressure belt, sub-tropical high pressure belts, sub-polar low pressure belts and the polar highs. Thermal factor causes difference in pressure. Pressure belts are not fixed, they shift northwards in summer and south wards in winter with the apparent movement of the sun. Pressure gradient is the difference in horizontal pressure between regions of high pressure and region of low pressure. The difference in air pressure causes movement of air called wind. There are wind systems that blow regularly on a daily pattern. Examples include the land and sea breezes, the mountain and valley breezes and winds warmed as a result of compression. There is a close relationship between pressure gradient and wind speed. Due to Coriolis force, winds deflect from their original course. In Northern Hemisphere they deflect towards their right and in Southern Hemisphere towards their left. This is known as the Ferrel's law. Winds are grouped under planetary, Periodic and local winds. Planetary winds blow in the same direction throughout the year, while the other types of winds get modified due to certain reasons. Monsoon are seasonal winds while local winds below generally on diurnal basis. Air masses are horizontal large bodies of air which have uniform temperatures and moisture contents. The boundary line between two different air masses is called a front. Air masses and front cause temperate cyclones in mid-latitudes. Another type of cyclones are tropical cyclones which originate on tropical oceans and influence the coastal areas. Sometimes they turn violent and cause heavy loss to life and property.

TERMINAL QUESTIONS

1. Answer the following questions in about 30 words each.

(a) What is an atmospheric pressure?

(b) How is atmospheric pressure measured?

(c) What are the following?

(i) Millibars

(ii) Isobars.

(d) What is the effect of altitude on air pressure?

2. Distinguish between the following in 50 words each:

(a) Air current and wind.

(b) Planetary winds and periodic winds.

(c) Foehn and Mistral.

(d) Katabatic and Anabatic Breezes.

3. Give reasons for the following in 100 words:

(a) Low pressure is prevalent in sub-polar regions

(b) Sea breezes blow during day time.

(c) Winds change their direction in both the hemisphere.

4. Define the following:

(a) Air mass (b) front

5. What are temperate cyclones? How do they differ from tropical cyclones?

6. What is the role of coriolis force in the deflection of winds?

7. Explain the following terms:

(a) Horse latitudes (b) Doldrums

8. On an outline map of the world mark and label the following.

(a) Prominent areas of low pressure in January.

(b) Prominent areas of high pressure in July in Northern Hemisphere

ANSWER TO INTEXT QUESTIONS

11.1

1. (a) Air temperature (b) The earth's rotation (c) Presence of water vapour

2. (a) Fortin's barometer (b) Aneriod barometer

3. 1013.25 Millibar

4. (a) 76 cm (b) low pressure (c) Higher pressure

11.2

1. (a) thermal equator (b) altitude

   (c) the air pressure (d) pressure/density

2. (a) (i), (b) (ii), (c) (ii), (d) (iv).

11.3

1. (a) Trade winds (b) Westerlies

   (c) Polar easterlies

2. Winds or moving bodies turn towards their right in the northern hemisphere and towards their left in the Southern hemisphere. It is known as Ferrule's law.

3. (a) (i), (b) (i), (c) (ii), (d) (iii)

11.4

1. (a) (iv) (b) (i)

2. On the leeward side of the Alps Mountains.

3. Chinook

4. (a) Hot, (b) cold, (c) Hot

11.5

1. A large body of air which has uniform temperature and moisture contents is called air mass.

2. Tropical and polar

3. Mid latitudes

HINTS TO TERMINAL QUESTIONS

1. (a) The weight of the air column at a place at a given time.

   (b) Air pressure is measured by an instrument called barometer.

      (i) The unit used for measuring air pressure. It is approximately equal to the force of one gram per square centimeter.

      (ii) Isobars are lines connecting points that have equal values Pressure.

   (d) Pressure decreases with increase in attitude.

2. (a) please refer to para 11.5

   (b) please refer to para 11.6 (a) and (b)

(c) please refer to para 11.6 (c) (iii) (2) and (iv) (1)

(d) please refer to para 11.6 (c) (ii)

3. (a) please refer to para 11.3 (iii)

   (b) please refer to para 11.6 (c) (i)

   (c) please refer to para 11.5 (ii)

4. (a) Air mass: a large body of air having uniformity of temperature, pressure and moisture.

   (b) Front: the boundary line of convergence separating two different air masses.

5. Please refer to para 11.7 (2) (a) and (b)

6. Please refer to para 11.5 (ii)

7. (a) Horse latitudes is the region of sub-tropical high pressure belts of Northern hemisphere.

   (b) Doldrums are the regions of calm in equatorial areas where winds are negligible and ascending air current are prominent.

8. Please see maps 11.3 and 11.4

12

HUMIDITY AND PRECIPITATION

In our previous lesson while discussing the composition of the atmosphere, we noted that water vapour, though a minor component, is a very important constituent of the atmosphere. In this lesson, we will study the role of water vapour in producing day to day weather changes.

OBJECTIVES

After studying this lesson, you will be able to :

- distinguish between absolute and relative humidity;
- establish relationship between temperature (absolute and relative humidity)
- infer conditions in which the relative humidity of a given sample of air increases or decreases;
- distinguish between saturated and unsaturated air;
- identify the factors affecting the rate of evaporation;
- explain the latent heat and its importance;
- describe the various forms of condensation;
- explain conditions conducive to precipitation;
- distinguish among the three types of precipitation (rainfall) with the help of diagrams;
- describe the salient features of distribution of precipitation in the world with reference to regional and seasonal variations;
- identify factors affecting rainfall distribution.

12.1 WATER VAPOUR IN THE ATMOSPHERE

Water vapour is a highly variable component of the atmosphere. Its proportion varies from zero to four percent by volume of the atmosphere. Water can exist in the air in all the three states of matter i.e. solid (ice-crystals), liquid (droplets of water) and gaseous (water vapour). Most commonly water exists in air as tasteless, colourless, transparent gas known as water vapour. The presence of water in the atmosphere has made life possible on the earth. Let us examine its significance for life on the earth.

(i) We have noted in the lesson 10, that water vapour in the atmosphere absorbs a significant portion of both incoming solar energy and outgoing earth radiation. In this way, it prevents great losses of heat from the earth's surface and helps to maintain suitable temperatures on the earth.

(ii) The amount of water vapour present in the air affects the "rate of evaporation.

(iii) The amount of water vapour present in a volume of air decides the quality of latent heat or energy stored in it for producing atmospheric changes;

(iv) The amount of water vapour present in the air of a place or in a region indicates the potential capacity of that air for precipitation.

(v) The amount of water vapour present in the air also affects standing crops favourably. On the other hand hot dry winds damage standing crops as in the case of rabi crops of North- Western India.

(vi) Air, poor in water vapour content, makes our body skin dry and rough. It is because of this fact that we use cream to protect our faces from dry air of cold winters or hot summers.

- The water vapour present in the atmosphere absorbs radiation, controls the rate of evaporation, releases latent heat for weather changes, decides the potentiality for precipitation, affects standing crops and our body skin, hence is of great significance.

12.2 HUMIDITY

How does water changes into water vapour? The heat energy radiated from the sun changes water into water vapour. This invisible water vapour present in gaseous form in the atmosphere at any time and place is termed as humidity. In other words, we can say that the term humidity refers to the amount of water vapour present in a given air. It indicates the degree of dampness or wetness of the air. Humidity of the air is mainly expressed in the following two ways:

(i) Absolute humidity

(ii) Relative humidity

(i) Absolute Humidity

Absolute humidity is the ratio of the mass of water vapour actually in the air to a unit mass of air, including the water vapour. It is expressed in gram per cubic metre of air. For example, if the absolute humidity of air is 10 grams it means that one cubic metre of that air holds 10 grams of moisture in the form of water vapour. Absolute humidity is variable and changes from place to place and with change in time.

The ability of an air to hold water vapour depends entirely on its temperature. The capacity of holding water vapour of an air increases with the increase in its temperature. For example, at 10°C, one cubic metre of an air can hold 11.4 grams of water vapour. If the temperature of the same air increases to 21°C, the same volume of air can hold 22.2 grams of water vapour. The Figure 12.1 shows the relationship between temperature and the maximum amount of water vapour that an air can hold at a given temperature. A cursory glance at this figure indicates how the water holding capacity of the air increases with increase in temperature. Change in temperature and pressure conditions of an air results in the change of its volume and consequently there is change in its absolute humidity. Hence, there is a need of some more reliable measure of humidity.

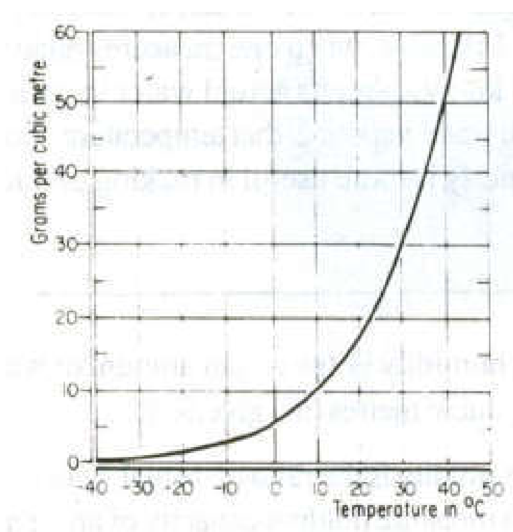


Fig 12.1 Maximum Absolute Humidity for a Wide Range of Temperature

(ii) Relative Humidity

Relative humidity is the most important and reliable measure of atmospheric moisture. It is the ratio of the amount of water vapor actually in a volume occupied by air to the amount the space could contain at saturation.

$$\text{Relative humidity} = \frac{\text{Vapour pressure in the air}}{\text{Saturation vapour pressure}}.$$

From Figure 12.1, it is quite clear that air can hold a definite maximum quantity of water vapour at a given temperature. When this situation is attained, we say the air is fully saturated. The temperature at which a given sample of air becomes fully saturated is called the dew point or saturation point The relative humidity of an air at saturation point is hundred percent. Since the concept of relative humidity is very important in understanding this lesson let us illustrate it with the help of an example. It is clear in Fig 12.1 that an air can hold 22.2 grams of water vapour at 21^{0}C temperature. If this air is holding 11.1 grams of water vapour at the same temperature i.e. 21^{0}C, the relative humidity of the air will be 11.1/22.2x100 or 50 percent. And, if the same air is actually holding 22.2 grams of water vapour at 21^{0}C, the relative humidity of air will be 22.2/22.2x100 or 100 percent. The air become saturated when its relative humidity is cent percent. If the relative humidity of air is less than 100 percent, the air is said to be unsaturated.

The relative humidity increases when the temperature of the air goes down or when more moist air is added to it. The relative humidity decreases when the temperature of the air increases or when less moist air is added to it

In order to make it clear that relative humidity is a better measurement of water vapour in atmosphere than absolute humidity, yet another example can be cited. Suppose, there is a tumbler containing 250 grams of water, one cannot tell how much portion of the tumbler is filled with water till one knows its maximum water containing capacity. When one comes to know that the tumbler can contain maximum of 500 grams of water, one can immediately tell that the tumbler is half filled with water. Likewise, when one measures relative humidity of an air, one not only needs to know about its actual water vapour content but also its total capacity to contain water vapour at that temperature. So, now you can understand why relative humidity is more useful in making predictions about atmospheric conditions.

- Absolute humidity is the actual amount of water vapour present in grams per cubic metres of a given air.
- Relative humidity is the ratio of actual water vapour content to the maximum moisture holding capacity of an air at a given temperature and it is expressed in percentage (RH.=A.H/Max. capacity X 100)
- The temperature at which a given sample of air becomes fully saturated is called dew point or saturation point.

INTEXTQUESTIONS 12.1

1. Name the three forms in which water can exist in the atmosphere.

   (a)________________ (b)______________ and (c)_____________

2. Give a geographical term for each of the following:

   (a) The amount of water vapour present in the atmosphere.

   ____

   (b) The weight of actual water vapour present per volume of air.

   ____

   (c) The ratio of the amount of the water vapour actually is a volume occupied by air to the amount the space could contain of saturation.

   ____

   (d) The air that contains moisture to its full capacity is called

   ____

   (e) The temperature at which a sample of air becomes saturated.

   ____

12.3 EVAPORATION

Evaporation is the process of which water changes from its liquid state to gaseous form. This process takes place at all places, at all times and at all temperatures except at dew point or when the air is saturated. The rate of evaporation is affected by several factors. Important among them are as under:

(i) Accessibility of water bodies

The rate of evaporation is higher over the oceans than on the continents.

(ii) Temperature

We know that hot air holds more moisture than cold air. So, when the temperature of an air is high, it is capable of holding more moisture in its body than at a low temperature. It is because of this that the rate of evaporation is more in summers than in winters. That is why wet clothes dry faster in summers than in winters.

(iii) Air moisture

If the relative humidity of a sample of air is high, it is capable of holding less moisture. On the other hand if the relative humidity is less, it can take more moisture. Hence, the rate of evaporation will be high. Aridity or dryness of the air also increases the rate of evaporation. During rainy days, wet clothes take more time to dry owing to the high percentage of moisture content in the air, than on dry days.

(iv) Wind

Wind also affects the rate of evaporation. If there is no wind, the air which overlies a water surface will get saturated through evaporation. This evaporation will cease once saturation point is reached. However, if there is wind, it will blow that saturated or nearly saturated air away from the evaporating surface and replace it with air of lower humidity. This allows evaporation to continue as long as the wind keep blowing saturated air away and bring drier air.

(v) Cloud cover

The cloud cover prevents solar radiation and thus influences the air temperatures at a place. This way, it indirectly controls the process of evaporation.

It is interesting to note that about 600 calories of heat is used for converting each gram of water into water vapour. A calorie is unit of heat energy spent in raising temperature of one gram of water by 10^0C. The heat energy used for changing the state of water or a body from liquid to gaseous state or from solid (ice) to liquid (water) state without changing its temperature is called latent heat. It is a sort of hidden heat. The effect of which is not seen on the thermometer. The latent heat consumed in changing water into gaseous form is released when water vapour changes into water or ice. The release of latent heat in the air is an important source of energy for causing changes in weather.

A special case of evaporation is transpiration, which entails a loss of water from leaf and stem tissues of growing vegetation. The combined losses of moisture by evaporation and transpiration from a given areas are termed evapo-transpiration.

- The evaporation is the process of changing water into water vapour.
- The rate of evaporation is affected by the accessibility of water, temperature, aridity of air, wind and cloud cover.
- The heat energy used for changing the state of water, or a body from liquid to gaseous state or from solid to liquid state without changing its temperature is called latent heat.

12.4 CONDENSATION

Condensation is the process by which atmospheric water vapour changes into water or ice crystals. It is just reverse of the process of evaporation. When the temperature of saturated air falls below dew point, the air cannot hold the amount of humidity which it was holding earlier at a higher temperature. This extra amount of humidity changes into water droplets or crystals of ice depending upon the temperature at which condensation takes place.

(a) Process of condensation

The temperature of the air falls in two ways. Firstly, cooling occurs around very small particles of freely floating air when it comes in contact with some colder object. Secondly, loss in air temperature takes place on a massive scale due to rising of air to higher altitudes. The condensation takes place around the smoke, salt and dust particles which attract water vapour to condense around them. They are called hygroscopic nuclei. When the relative humidity of an air is high, a slight cooling is required to bring the temperature down below dew point. But when the relative humidity is low and the temperature of the air is high, a lot of cooling of the air will be necessary to bring the temperature down below dew point. Thus, condensation is directly related to the relative humidity and the rate of cooling.

- Condensation is a process of changing water vapour into tiny droplets of water or ice cystals.
- Condensation takes place when temperature of air falls below dew point and is controlled by relative humidity of the air and rate of cooling.

(b) Forms of condensation

Condensation takes place in two situations, firstly, when dew point is below freezing point or below 0° C and secondly, when it is above freezing point. In this way, the forms of condensation may be classified into two groups:

(i) Frost, snow and some clouds are formed when dew point is below freezing point.

(ii) Dew, mist, fog, smog and some clouds are formed when dew point is above freezing point.

The forms of condensation may also be classified on the basis of place where it is occurring, for example, on the ground or natural objects such as grass blades and leaves of the plants or trees, in the air close to the earth's surface or at some height in the troposphere.

(i) Dew: When the atmospheric moisture is condensed and deposited in the form of water droplets on cooler surface of solid objects such as grass blades, leaves of plants and trees and stones, it is termed as dew. Condensation in dew form occurs when there is clear sky, little or no wind, high relative humidity and cold long nights. These conditions lead to greater terrestrial radiation and the solid objects become cold enough to bring the temperature of air down below dew point. In this process the extra moisture of the air gets deposited on these objects. Dew is formed when dew point is above freezing point. Dew formation can be seen if the water is poured into a glass from the bottle kept in a refrigerator. The outer cold surface of the glass brings the temperature of the air in contact with the surface down below dew point and extra moisture gets deposited on the outer wall of the glass.

(ii) **Frost:** When the dew point is below freezing point, under above mentioned conditions, the condensation of extra moisture takes place in the form of very minute particles of ice crystals. It is called frost. In this process, the air moisture condenses directly in the form of tiny crystal of ice. This form of condensation is disastrous for standing crops such as potato, peas, pulses, grams, etc. It also creates problems for road transport system.

(iii) **Mist and Fog:** When condensation takes place in the air near the earth's surface in the form of tiny droplets of water hanging and floating in the air, it is called mist. In mist the visibility is more than one kilometer and less than two kilometers. But when the visibility is reduced to less than one kilometer, it is called fog. Ideal conditions for the formation of mist and fog are clear sky, calm and cold winter nights.

(iv) **Smog:** Smog is a fog that has been polluted and discoloured by smoke, dust, carbon monoxide, sulphur dioxide and other fumes. Smog frequently occurs in large cities and industrial centres. It causes respiratory illness.

(v) **Cloud:** Clouds are visible aggregates of water droplets, ice particles, or a mixture of both along with varying amounts of dust particles. A typical cloud contains billions of droplets having diameters on the order 060.01 to 0.02 mm; yet liquid or solid water accounts for less than 10 parts per million of the cloud volume. Clouds are generally classified on the basis of their general form or appearance and altitude. Combining both these characteristics, clouds may be grouped as under.

Low clouds: The base level of low clouds varies from very near the ground to about 2000m. The basic type of this family is the status, a low, uniform layer resembling fog but not resting on the ground.

Stratocumulus clouds form a low, gray layer composed of globular masses or rolls which are usually arranged in groups, lines, or waves.

Clouds with vertical development fall into two principal. **Categories:** cumulus and cumulonimbus. Cumulus clouds are dense, dome-shaped and have flat bases. They may grow to become cumulonimbus, the extent of vertical development depending upon the force of vertical currents below the clouds as well as upon the amount of latent heat of condensation liberated in the clouds as they form.

To an observer directly beneath, a cumulonimbus cloud may cover the whole sky and have the appearance of Nimbostratus, The word nimbus (or prefix nimbo) applies to a cloud from which rain is falling. It derives from the Latin for "violent rain".

Medium clouds: These clouds are formed at altitudes between 2000 to 6000 metres. This group of clouds include altocumulus and altostratus.

High clouds: These clouds are formed above the altitude of 6000 metres and include cirrus, cirrostratus and cirrocumulus (see fig. 12.2).

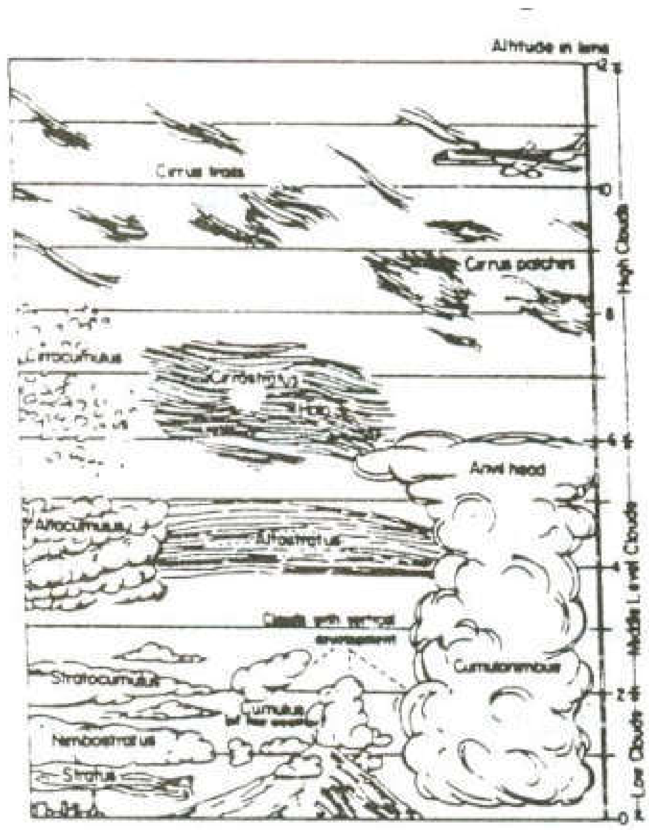


Fig. 12.2 : Cloud types are grouped into families according to height and form

- Forms of condensation include dew, frost, mist, fog, smog and clouds.
- Frost and some clouds are formed when condensation takes place below freezing point.
- Clouds are grouped into three types on the basis of appearance and altitude.

INTEXT QUESTIONS 12.2

(1) List five factors which affect the rate of evaporation.

(a) ______________________ (b) ________________

(c) ______________________ (d) ________________

(e) ______________________

(2) Name the forms of condensation that take place on the solid objects.

(a) ______________________ (b) ________________

(3) Name two forms of condensation that occur in the air just above the ground in most parts of the world.

(a) ______________________ (b) ________________

(4) Give geographical term for each of the following:

(a) The process of change of water into water vapour____________

(b) The process of change of water vapour into liquid or solid state

____

(c) A mass of tiny droplets of water or ice crystals hanging in the air at some height____

(d) Type of clouds formed due to convection and look like wool pack

____

(e) Type of clouds which are chief rain producer______________

12.5 PRECIPITATION

Precipitation is defined as water in liquid or solid forms falling to the earth. It happens when continuous condensation in the body of air helps the water droplets or ice crystals to grow in size and weight that the air cannot hold them and as a result these starts falling on the ground under the force of gravity.

Forms of precipitation

The precipitation falls on the earth in various forms of droplets of water, ice flakes and solid ice balls or hail and at times droplets of water and hail together. The form that precipitation takes is largely dependent upon the method of formation and temperature during the formation. The forms of precipitation are as follows:

(i) **Drizzle and Rainfall :** Drizzle is a fairly uniform precipitation composed exclusively of fine drops of water with diameter less than 0.5 mm. Only when droplets of this size are widely spaced are called rain.

(ii) Snowfall: When condensation takes place below freezing point (-0° C), the water vapour changes into tiny ice crystals. These tiny ice crystals grow in size and form ice flakes which become big and heavy and start falling on the ground. This form of precipitation is called snowfall. Snowfall is very common in Western Himalaya and mid and high latitude regions in winter.

(iii) Sleet: Sleet is frozen rain, formed when rain before falling on the earth, passes through a cold layer of air and freezes. The result is the creation of solid particles of clear ice. It's usually a combination of small ice balls and rime.

(iv) Hail : Hail is precipitation of small balls or pieces of ice (hail stones) with diameters ranging from 5 to 50mm, falling either separately or agglomerated into irregular lumps. Hailstones are comprised of a series of alternating layers of transparent and translucent ice.

- Falling down of atmospheric moisture on the earth's surface is called precipitation.
- The precipitation in the form of tiny droplets of water and bigger water droplets are known as drizzle and rainfall respectively.
- When the precipitation is in the form of big ice balls, it is called Snow fall.

12.6 TYPES OF RAINFALL

We know, when a mass of moist air ascends to high altitudes it cools down to lower temperatures. In doing so it attains dew point which leads to condensation and precipitation. Thus the cooling of air occurs mainly when it rises. There are three important ways in which a mass of air can be forced to rise and each of these ways produces its own characteristic precipitation or rainfall.

(a) Convectional Rainfall

Excessive heating of the earth's surface in tropical region results in the vertical air currents. These currents, lift the warm moist air to higher strata of atmosphere. When-the temperature of such a humid air starts falling below dew point continuously, clouds are formed. These clouds cause heavy rainfall which is associated with lightning and thunder. This type of rainfall is called conventional rainfall. It is very common in equatorial region where it is a daily phenomenon in the afternoon (see fig. 12.3)

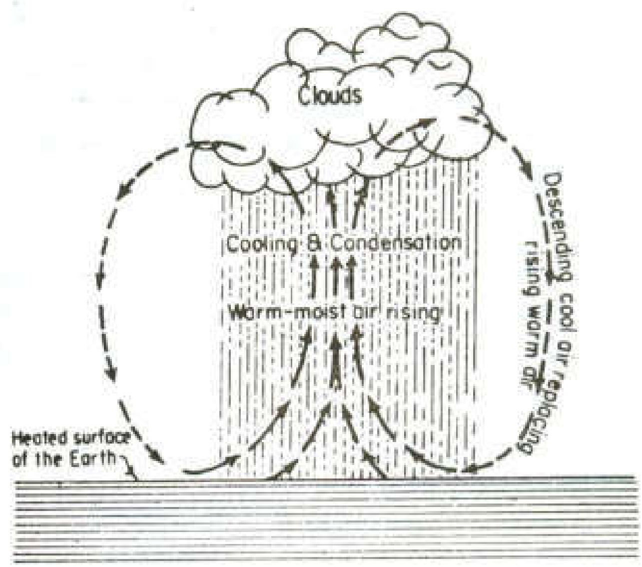


Fig. 12.3 Conventional Rainfall

(b) Orographic or Relief Rainfall

Orographic rainfall on formed where air rises and cools because of a topographic barrier. When their temperature fall below dew point, clouds are formed. These clouds cause widespread rain on the windward slopes of the mountain range. This type of rain is called orographic rainfall. However when these winds cross over the mountain range and descend along the leeward slopes, they get warm and cause little rain. Region lying on the leeward side of the mountain receiving little rain is called rainshadow area (see figure 12.4). A famous example of orographic rainfall is Cherrapunji on the southern margin of the Khasi Hills in Meghalaya India.

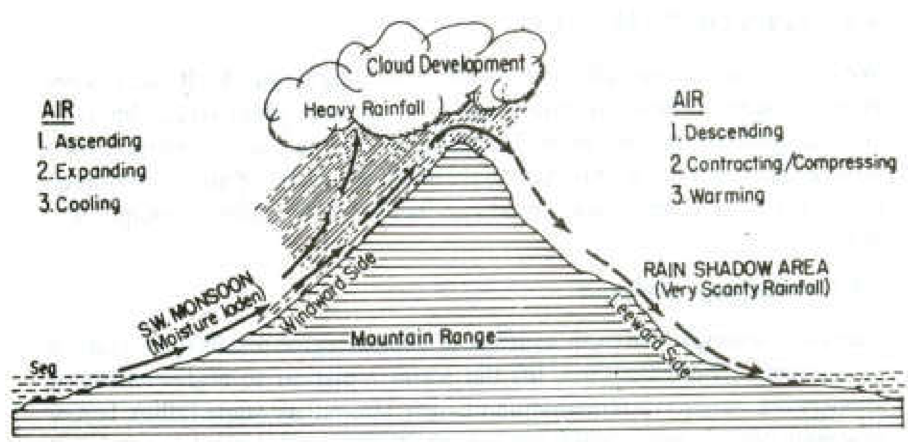
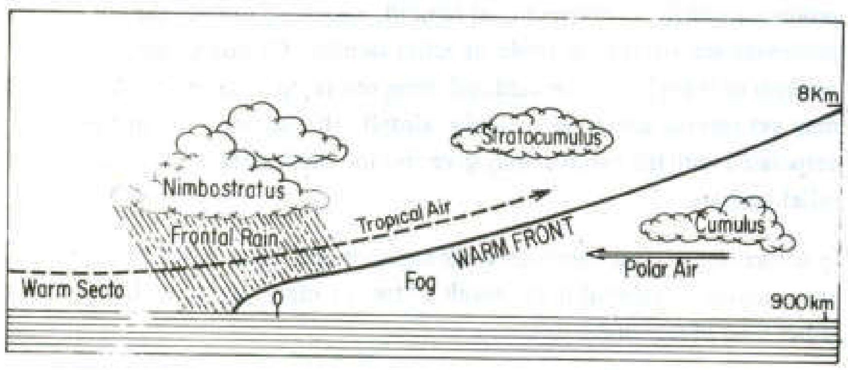


Fig 12.4 Orographic Rainfall

(c) Convergence or Cyclonic Rainfall

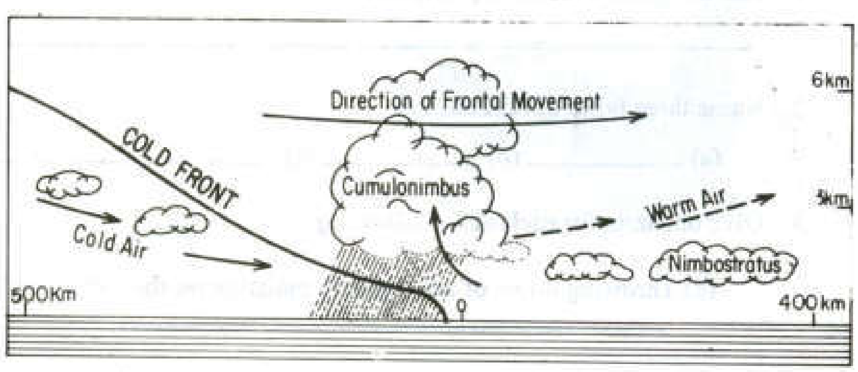
Convergence rainfall, produced where air currents converge and rise. In tropical regions where opposing air currents have comparable temperatures, the lifting is more or less vertical and is usually accompanied by convention. Convectioned activity frequently occurs along fronts where the temperature of the air masses concerned are quite different. Mixing of air along the front also probably contributes to condensation and therefore to the frontal rainfall. When two large air masses of different densities and temperature meet, the warmer moist air mass is lifted above the colder one. When this happens, the rising warm air mass condenses to form clouds which cause extensive down pour. This rainfall is associated with thunder and lightning. 'This type of rainfall is also called frontal rainfall. This type of rainfall is associated with both warm and cold fronts, (fig. 12.5) It is generally steady and may persist for a whole day or even longer.

(a) Rainfall Associated with a warm Front



(b) Rainfall Associated with a Cold Front

Fig. 12.5 Cyclonic Rainfall



In all these types, the cooling of large masses of humid air is essential to produce rainfall. In conventional rainfall, after rising of air, the subsequent processes are similar, to those of relief rainfall

In nature, these three methods work together and infact most of the earth's precipitation or rainfall is the result of two or more causes of lifting of air rather than of anyone.

- On the mode of occurrence, the rainfall is classified into conventional, orographic and convergence.

INTEXT QUESTIONS 12.3

1. List the various forms of precipitation.

   ____

2. Name three types of rainfall.

   (a)________________(b)________________(c)________________

3. Give one term for each of the following:

   (a) Throwing down of atmospheric moisture on the earth's surface

   ____

   (b) Frozen raindrops and melted snow falling on the earth's surface

   ____

   (c) The plane of contact between two air masses of varying characteristics

   ____

   (d) Precipitation in the form of ice balls

   ____

   (e) Rainfall caused by uplift of the air due to excessive heating

   ____

4. Below are given true and false statements. Mark 'T' if the statement is true and 'F' if it is false:

   (a) Precipitation is the process of converting water vapour into liquid or solid state________________________________

   (b) Precipitation in the form of ice flakes is called snowfall ______

   (c) Area lying on the leeward side of a mountain range receive scanty rainfall________________________

   (d) Orographic rainfall is caused by ascend of warm moist air due to excessive heating____________________

12.7 DISTRIBUTION OF PRECIPITATION

The spatial distribution of precipitation is not uniform all over the world. The average annual precipitation for the world as a whole is about 97.5 centimeters but the land receives lesser amount or rainfall than the oceans. The annual precipitation shows marked difference on the land. Different places of the earth's surface receive different amount of annual precipitation and that too in different seasons.

The main features of the distribution of precipitation can be explained with the help of global pressure and wind belts. distribution of land and water bodies and the nature of relief features. Before arriving at any conclusion regarding the causes for regional and seasonal variation, let us first see regional and seasonal distribution patterns of precipitation.

(a) Regional Variations

On the basis of average amount of annual precipitation. We can recognize the following precipitation regions in the world. (see fig. 12.6)

(i) **Regions of Heavy Precipitation:** The regions which receive over 200 centimeters of annual precipitation are included in this category. These regions include equatorial coastal areas of tropical zone and west-coastal regions of temperate zone.

(ii) **Regions of Moderate Precipitation:** The regions which receive 100 to 200 centimeters of annual precipitation are included in this category. These regions lie adjacent to the regions of heavy precipitation. Eastern coastal regions of subtropical zone and coastal regions of the warm temperate zone are included in this category.

(iii) **Regions of Less Precipitation :** This category includes regions which receive precipitation between 50 to 100 centimeters. These regions lie in the interior parts of tropical zone and eastern interior parts of temperate zone.

(iv) **Regions of Scanty Precipitation:** The areas lying in the rain shadows (leeward) side of the mountain ranges, the interior parts of continents, the western margins of continents along tropics and high latitudes receive precipitation less than 50 centimeters. These regions include tropical, temperate and cold deserts of the world.

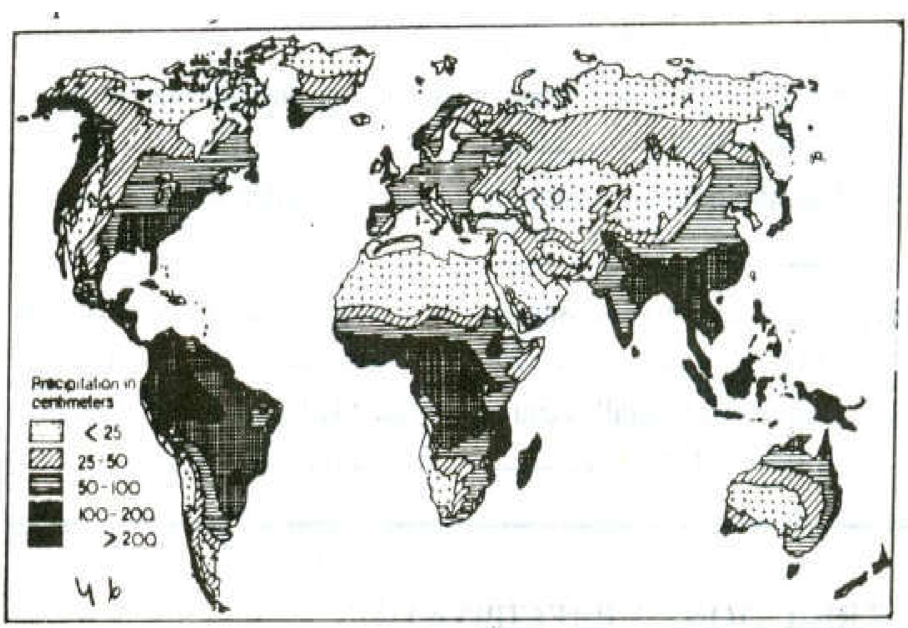


Fig. 12.6 Distribution of Mean Precipitation in the world

Now let us carefully study the map showing the annual average precipitation distribution of the world (fig. 12.6) in order to come to the following conclusions.

(1) Precipitation is greatest in the equatorial region and decreases towards the poles.

(2) Precipitation is heaviest in the coastal regions and decreases towards the interior of the continents.

(3) Eastern coastal areas of tropical lands and western coastal areas of temperate lands receive heavy precipitation including equatorial regions.

(4) Precipitation is very heavy on the windward side of highlands; very dry condition prevail on the leeward side.

(5) Coastal areas adjacent to cold currents are drier than coastal areas near warm currents.

(6) The western margin of tropical land and polar region receive scanty rainfall. The main reason being that easterlies become dry winds and polar winds are cold and dry.

(b) Seasonal Variations

The regional variations in the distribution of precipitation in different parts of the world are based on average annual precipitation which do not give us any correct picture of the nature of precipitation specially of those regions where seasonal fluctuations in the amount of precipitation are very common, for example arid, semi arid or sub-humid regions. Therefore, it is important to study seasonal variations of precipitation in the world. The facts related to this are as follows:

(i) The equatorial regions and the western parts of temperate lands receive precipitation throughout the year. The former receive conventional type of rain while the later gets cyclonic cum orographic type through westerlies.

(ii) About 2 per cent land areas of the world receive precipitation only in winter. These include Mediterranean regions of the world and Coromandel Coast of India. Due to the seasonal shift in pressure and planetary wind systems, these regions (Mediterranean) do not get precipitation in summer as they come under sub-tropical high pressure belts and trade winds which become dry while reaching to the western margins of continents.

(iii) The remaining parts of the world receive precipitation only in summer. It makes us clear that most parts of the world experience marked seasonal variation in precipitation. Seasonal distribution of precipitation provides us idea to judge its effectiveness. For example, the scanty precipitation during short growing season in high latitudes is more effective than that of heavy precipitation in lower latitudes. Likewise, precipitation in the form of dew, fog and mist in some parts like Central India and Kalahari desert has an appreciable affect on standing crops and natural vegetation.

(c) Factors Affecting Rainfall Distribution

(i) Moisture supply to the atmosphere is the main factor in determining the amount of rainfall in any region. Equatorial and rest of the tropical region have highest evaporation and hence highest supply of moisture. Coastal areas have more moisture than interior parts of continents. Frigid regions have very low evaporation hence very scanty precipitation.

(ii) Wind direction in the belts of trades and westerlies winds is very important. Winds blowing from sea to land cause rainfall. Land bearing winds are dry. Winds blowing from higher to lower latitudes will get heated and give no rain while those blowing from lower to higher latitudes will get cooled and cause rainfall. Sub-tropical deserts have very little rainfall because they have off-shore winds.

(iii) Ocean currents : Warm current are associated with warm moist winds which cause rainfal1, cold current have cold dry wind and hence no rainfall.

(iv) Presence of mountain across the direction of wind causes more rainfall on the windward side and creates rain shadow on the leeward side.

(v) Pressure belts are closely related with wind direction and rainfall. Areas of low pressure attract rain bearing winds while areas of high pressure do not.

- The distribution of precipitation in different parts of the world shows marked regional and seasonal variation.
- Factors affecting rainfall distribution are: moisture supply, wind direction, ocean currents, presence of mountains and pressure belts.

INTEXT QUESTIONS 12.4

1. Name any two regions of heavy precipitation.

____

2. Name any two regions of scanty precipitation.

____

3. Name the regions where precipitation is heavy throughout the year.

____

4. Name the regions which receive precipitation only in winters.

____

5. Name five factors affecting rainfall distribution in the world.

(a)__________(b)_______________(c)_____________(d)____________

WHAT YOU HAVE LEARNT

Water vapour is highly variable. It is an important component of atmosphere. It is responsible for global heat balance, atmospheric phenomena and sustaining plant and animal life on our planet. The water vapour present in the atmosphere is called humidity, which is expressed as absolute humidity and relative humidity. Of these, the relative humidity is most reliable measure. Water vapour enters into atmosphere through a process called evaporation. Temperature of the air controls the amount of moisture it can hold at a given volume. The air which holds the moisture to its full capacity is called saturated air and the temperature at which it reaches saturation point is termed as dew point. Condensation is a process of changing of water vapour into liquid or solid state. It happens when temperature of an air falls below dew point. Condensation occurs near the ground as dew, mist, or fog and at higher levels of clouds.

Falling down of atmospheric moisture is called precipitation which occurs due to continuous condensation. Drizzle, rainfall, snowfall, sleet and hail are various forms of precipitation. The rainfall occurs in three different ways conventional, orographic and cyclonic.

The distribution of precipitation in the world shows marked regional and seasonal variation. Some regions receive heavy rainfall while others scanty precipitation. Some regions receive precipitation throughout the year while others only in the winter or summer. Several factors affect rainfall distribution.

TERMINAL QUESTIONS

1. Explain the importance of water vapour present in the atmosphere.
2. What is evaporation? Discuss the factors which affect the rate of evaporation. Give examples in support of your answer.

3. Explain the process and forms of condensation.

4. How does precipitation occur? Discuss the various forms of precipitation.

5. Differentiate between:

   (a) Evaporation and condensation;

   (b) Absolute humidity and relative humidity;

   (c) Saturated air and unsaturated air;

   (d) Rainfall and precipitation;

   (e) Sleet and hail;

   (f) Conventional and orographic rainfall.

6. Discuss in detail the regional and seasonal distribution of precipitation in the world.

7. Give reasons for each of the following:

   (a) Equatorial regions receive precipitation throughout the year.

   (b) Mediterranean regions receive rainfall only in winter.

   (c) Amount of precipitation decreases from coastal areas to interior, parts of continents.

   (d) Tropical deserts are found on the western parts of continent.

   (e) Evaporation decreases towards poles.

8. On the given outline map of the world, show the following with appropriate symbols:

   (a) Two areas getting precipitation above 200 cms.

   (b) Two areas of scanty precipitation in lower latitudes.

   (c) Two regions getting precipitation only in winter.

   (d) Cold deserts of the world.

ANSWER TO INTEXT QUESTIONS

12.1

1. (a) Liquid (b) Solid (c) Gaseous

2. (a) humidity (b) absolute humidity (c) relative humidity (d) saturated air (e) dew point

12.2

1. (a) Temperature (b) air moisture (c) winds (d) cloud cover (e) accessibility of water bodies
2. (a) dew (b) frost
3. (a) mist (b) fog
4. (a) evaporation (b) condensation (c) cloud (d) cumulus (e) cumulonimbus.

12.3

1. Drizzle, rainfall, sleet and hail
2. (a) Conventional (b) Orographic (c) Cyclonic
3. (a) Precipitation (b) Sleet (c) Front (d) Hail (e) Conventional rainfall
4. (a) F (b) T (c) T (d) F

12.4

1. Equatorial, eastern sub-tropical and western coastal temperate regions.
2. Western margins along tropics and interior parts of continents in temperate zone and polar region.
3. Equatorial regions
4. Mediterranean regions
5. (a) Moisture supply (b) wind direction (c) ocean currents (d) presence of mountains (e) pressure belts

HINTS TO TERMINAL QUESTIONS

1. Please refer to section 12.1
2. Please refer to section 12.3
3. Please refer to section 12.4
4. Please refer to section 12.5
5. See under the respective headings.
6. Please refer to section 12.7
7. (a) Due to the uniform high temperature throughout the year in the equatorial region, there is much evaporation, conventional air currents are set up, followed by heavy rainfall of conventional type.

(b) In summer the sun is overhead at the Tropic of Cancer, the belt of influence of the westerlies is shifted a little poleward. The Mediterranean Region falls under the sub-tropical high pressure belt and trade winds. Trade winds become dry before reaching the western margin of continents. Hence no rainfall in summer. But during winter, the Mediterranean region comes under the influence of westerlies due to their shift towards south. Thus the region gets rainfall in winter only.

(c) Precipitation decreases from coastal areas to interior parts because rain bearing winds loose their moisture as they go interior.

(d) The aridity of the tropical deserts located in the western part of continents is mainly due to the effects of off shore Trade winds.

(e) Evaporation decreases towards poles due to low temperatures.

(f) Please see maps.

13

WEATHER AND CLIMATE

In the preceding three lessons, we have discussed about the temperature, atmospheric pressure, winds and precipitation. These elements of weather have an important effect on our lives. For example the houses we construct, the clothes we wear and the food we prefer mainly depend on weather and climatic conditions. In this lesson, we will study about the difference among weather, season and climate and also the factors affecting climate of a place.

OBJECTIVES

After studying this lesson you will be able to:

- name the various elements of weather and climate;
- differentiate among weather, season and climate;
- explain the need for forecasting weather in advance;
- explain with specific example the various factors affecting the climate of a place or region;
- describe the important characteristics of each thermal zone with the help of a diagram;
- state Koeppen's classification of climate.

13.1 WEATHER AND CLIMATE

(i) Weather

Temperature, pressure, wind, humidity and precipitation, interact with each other. They influence the atmospheric conditions like the direction and velocity of wind, amount of insolation, cloud-cover and the amount of precipitation. These are known as the elements of both weather and climate. The influence of these elements differs from place to place and time to time. It may be restricted to a small area and for a short duration of time. We very often describe this influence in the name of weather as sunny, hot, warm, cold, fine, etc depending upon the dominant element of weather at a place and at a point of time. Therefore, **weather is the atmospheric condition of a place for a short duration with respect to its one or more elements.** Two places even a short distance apart may have different kind of weather at one and the same time.

(ii) Weather Forecast

It is important to know by some means the coming weather in advance. You may be planning to go on a hike without knowing that the particular day may be rainy. Farmers, sailors, aviators, tourists and many others are interested to know the weather conditions in advance for their own benefits. That is why newspapers publish weather reports and weather forecasts along with a map showing this information. Now, better weather forecasts are available with the use of weather satellites. Weather conditions are televised every day. When a cyclone or dangerous weather is expected, warnings are issued over the radio, television and newspapers so that people can prepare to save themselves and their property from its hazard.

The weather office collects data on temperature, wind, cloud cover, rainfall and other atmospheric phenomena through its numerous observation centres. These centres are scattered all over the country. Similar information is also received from the ships sailing in the high seas. The analysis of these data thus collected, helps in forecasting weather conditions for the next 48 hours or even for a week. The significance of a weather information supplied through a map and its forecast is better utilised in a country like the U.K. where weather changes are very rapid.

(iii) Season

You know that a year is divided into seasons depending upon variations in atmosphric conditions. They are specified periods in a year which have similar weather conditions. Season is a period of the year charcterized by a particular set of weather conditions resulting from the inclination of the earth's axis and the revolution of the earth round the sun. The same cycle of season is repeated year after year. Four seasons, each of three months duration have been recognized in temperate regions. They are spring, summer, autumn and winter. In our country, we have three distinct seasons which are summer, winter and rainy. The Indian Meteorological Department has recognized four main seasons. They are (1) cold weather season (December to February.) (2) hot weather seasons (March to May) (3) advancing monsoon season or rainy season (June to September.) and. (4) retreating monsoon season (October to November.)

Traditionally there are six seasons in north India. They are (1) Basant Ritu (Chaitra- Vaisakh or March-April), (2) Greeshm Ritu (Jaystha-Asharh or May-June), (3) Varsha Ritu (Shravan-Bhadrapad or July-Aug.), (4) Sharad Ritu (Aswina-Kartika or Sept - Oct.), (5) Hemant Ritu (Margashirsh-Posh or Nov-Dec.) and (6) Shishir Ritu (Magh-Falgun or Jan-Feb.)

The rays of the sun are more or less direct on the equator throughout the year. Hence, equatorial regions experience the same temperature all the year round. Therefore, seasons are insignificant on or near the equator. Near the coast, the oceanic influence reduces the seasonal variations. In the polar regions, there are only two seasons i.e. long winter and short summer.

(iv) Climate

The average weather conditions, prevalent from one season to another in the course of a year, over a large area is known as climate. The average of these weather conditions is calculated from the data collected for several year (about 35 years) for a larger area. Rajasthan, for example, experiences hot and arid climate, Kerala has tropical rainy climate, Greenland has cold desert climate and the climate of Central Asia is temperate continental. Climate of a region is considered more or less permanent.

- Weather is the atmospheric condition of any place for a short period of time with respect to its one or more elements such as temperature, pressure, wind, humidity, precipitation, sunshine, cloud cover etc.
- The periods of the year which are characterised by particular set of weather conditions are mainly caused by the inclination of the earth's axis and the revolution of the earth around the sun, are known as seasons.
- The average weather conditions of a large area for the past several years is known as its climate persisting more or less permanent.

The difference between weather and climate can be tabulated as under

Weather	*Climate*
(1) Weather is the study of atmospheric conditions for short duration of a limited area.	(1) Climate is the study of the average weather conditions observed over a long period of time for a larger area.

(2) Weather is influenced by anyone of its predominant elements i.e., temperature or humidity.	(2) Climate is the collective effect of all its elements.
(3) The weather changes very often	(3) It is more or less permanent.
(4) It is experienced over small areas of a country.	(4) It is experienced over large area of the continent.
(5) A place can experience different types of weather conditions in a year.	(5) A place can experience only one type of climate.

[redacted] appropriate word from those given within brackets against each of the following:

1. Weather depends upon predominance of____________ of its elements {(a) one, (b) two, (c) three (d) one or more}
2. The season is___________in equatorial region {(a) predominants, (b) good, (c) insignificant, (d) always changing.}
3. The average weather conditions for_________duration represent climate. {(a) one year, (b) long, (c) short, (d) many years.}
4. The exposed skin of our body starts cracking in winter season mainly due to__________{(a) rainy season, (b) high humidity, (c) summer season, (d) low humidity}
5. Seasons are caused by______________{(a) ocean currents and revolution, (b) air masses and rotation of the earth (c) ocean current and rotation of the earth, (d) inclination of the earth's axis and earth's revolution}
6. Four seasons each of three months duration are noticed in___________zone/region {(a) Temperate, (b) Tropical, (c) Equatorial, (d) Frigid.}

13.2 FACTORS AFFECTING CLIMATE

Different regions of the world have differences in temperature, humidity and precipitation. You know that these differences influence the lifestyle of the people living under different climatic conditions. To understand different climatic conditions, let us discuss the factors which cause the variations in the climate of a place or a region.

1. Latitude or Distance from the Equator

The places near the equator are warmer than the places which are far away from it. This is because the rays of the sun fall vertical on the equator and slanting in the temperate and polar regions. As we have discussed earlier the vertical rays are concentrated over a small area than the slanting one. Again, the vertical rays pass through a shorter distance in the atmosphere before reaching the earth's surface. Therefore, lower the latitude higher is the temperature and vice versa. Malaysia which is near the equator is warmer than England which is far way from the equator.

2. Altitude or the Height from the mean sea level

We all know that mountains are cooler than the plains. Shimla situated on a higher altitude is cooler than Jalandhar, although both are almost on the same latitude. The temperature decreases with the height of a place. For a vertical rise of 165 metres there is an average decrease in temperature at the rate of 1°C. Thus the temperature decreases with increase in height.

3. Continentally or the Distance from the Sea

The water is a bad conductor of heat i.e. it takes longer time to heat and longer time to cool. Due to this moderating effect of the sea, places near the coast have low range of temperature and high humidity. The places in the interior of the continent do not experience moderating effect of the sea. These places have extreme temperatures. The places far from the sea have higher range of diurnal (daily) and annual temperatures. Mumbai has relatively lower temperature and higher rainfall than Nagpur, although both are almost situated on the same latitude.

4. Nature of the Prevailing Winds

The on-shore winds bring the moisture from the sea and cause rainfall on the area through which they pass. The off-shore winds coming from the land are dry and help in evaporation. In India, the on-shore summer monsoon winds bring rains while off-shore winter monsoon winds are generally dry.

5. Cloud Cover

In areas generally of cloudless sky as in deserts, temperature even under shade are very high because of the hot day time sunshine. At night this heat radiates back from the ground very rapidly. It results in a large diurnal range in temperature. On the other hand under cloudy sky and heavy rainfall at Thiruvananthapuram the range of temperature is very small.

6. Ocean Currents

Ocean waters move from one place to another partly as an attempt to equalize temperature and density of water. Ocean currents are large movements of water usually from a place of warm temperature to one of cooler temperature or vice-versa. The warm ocean currents raise the temperature of the coast and sometimes bring rainfall, while the cold currents lower the temperature and create fog near the coast. Port Bergen in Norway is free from ice even in winter due to warm North Atlantic Drift while Port Quebec in Canada remains frozen during winter months due to chilling effect of the Cold Labrador Current in spite of the fact that Port Quebec is situated in much lower latitude than Port Bergen. The on-shore winds passing over a warm current carry warm air to the interior and raise the temperature of the inland areas. Similarly, the winds blowing over cold current carry cold air to the interior and create fog and mist.

7. Direction of Mountain Chains

The mountain chains act as natural barrier for the wind. The on-shore moisture laden winds are forced to rise after striking against the mountain; and give heavy rainfall on the windward side. These winds descending on the leeward side cause very low rainfall. The great Himalayas check the moisture laden monsoon winds from crossing over to Tibet. This mountain chain also checks biting polar cold winds from entering into India. This is the reason for which northern plains of India get rains while Tibet remains a perpetual rain shadow area with lesser amount of rainfall.

8. Slope and the Aspect

The concentration of heat being more on the gentler slope raises the temperature of air above them. Its lesser concentration along steeper slopes lowers the temperature. At the same time, mountain slopes facing the sun are warmer than the slopes which are away from the sun's rays. The southern slopes of Himalaya are warmer than the northern slopes.

9. The Nature of the Soil and Vegetation Cover

The nature of soil depends upon its texture, structure and composition. These, qualities vary from soil to soil. Stony or sandy soils are good conductor of heat while black clay soils absorb the heat of the sun's rays quickly. The bare surface reradiates the heat easily. The deserts are hot in the day and cold in the night. The forest areas have lower range of temperature throughout the year in contrast to non-forested areas.

- The factors which affect the climate of a place or region are latitude or the distance from the equator, altitude or the height from the mean sea level, continentality or the distance from the sea, nature of the prevailing winds, ocean currents, direction of mountain chain, slope and its aspect, nature of soil and the vegetation cover.

Some of the following statements are false and some are true. Write true against [redacted]nst wrong ones.

1. Higher the latitude lower is the temperature.
2. Higher the altitude lower is the temperature.
3. Nearer the sea coast lower is the range of temperature.
4. Interiors of the continent have lower range of temperature.
5. Cold ocean currents lower the temperature of the coast.

The varied effect of the major weather elements in different parts of the world and [redacted]every location a distinct climate. Hence, the number of different climate is large. In order to easily understand and comprehend this large variety, the climate of the world have been classified into a few major groups, each having certain common important characteristics.

Although several attempts have been made by scholars to classify the climate of the world for the proper understanding of major climate types no single classification is perfect, as climate stands for the generalized and composite weather conditions. However, the Greeks, perhaps, made the first attempt to classify the world climates on the basis of the distribution of temperature and insolation. They divided the world into five latitudinal thermal zones, The boundary of these zones are fixed on the basis of the angle at which the sun's rays strike the earth. The following are the five thermal zones.

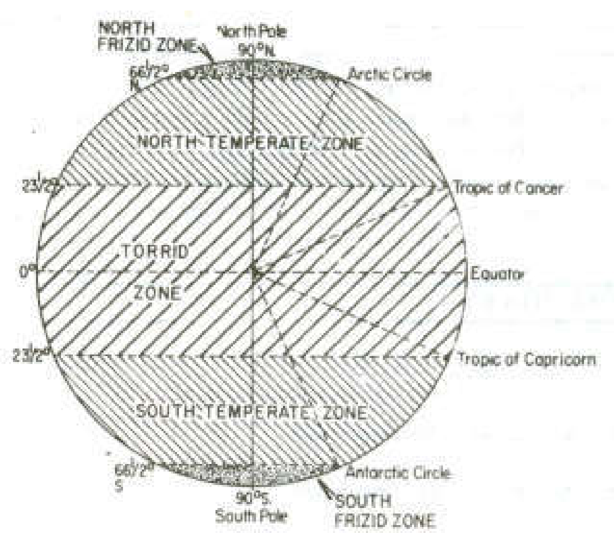


Fig. 13.1 Thermal Zone

(a) The Thermal Zones

(i) Torrid Zone: It is the largest of the thermal zones. It covers, almost half the area of the earth's surface. It is situated between the Tropic of Cancer (23½°N) and Tropic of Capricorn (23½^0 South) (See fig 13.1). The sun's rays are almost vertical throughout the year in this zone. The mid-day sun is overhead at equator on equinoxes, i.e. on 21 st March and 23rd September. It is also overhead at Tropic of Cancer on 21st *June* and at Tropic of Capricorn on 22nd December. The duration's of day and night are always equal i.e. 12 hours each *on* the equator and they increase to 13 hours 27 minutes at tropics. The range *of* temperature is lowest at the equator and it increases towards the tropics.

(ii) Temperate Zone: The temperate zones are on either side of the Torrid zone. The North Temperate Zone lies between Tropic of Cancer (23½^0 North) and Arctic Circle (66½^o North) The South Temperate Zone lies between Tropic of Capricorn (23½° South) and Antarctic Circle (66½° South) (see fig. 13.1). The sun is never overhead In this zone in winter season, the nights are longer and days are shorter and vice versa in summer. The difference between the duration of the day and night increases towards the poles. The maximum duration of day in summer and that of night in winter in the polar circles is 24 hours. When it is summer in the northern hemisphere it is winter in the southern hemisphere and vice versa,

(iii) Frigid Zones: Like the temperate zone, frigid zone is also found in both the hemispheres. The North Frigid Zone lies between Arctic Circle (66½^{0}N) and North Pole (90° North). The South Frigid Zone lies between Antarctic Circle (66½^0 South) and South Pole (90^0 South). During winter season, the sun does not rise above the horizon for almost six months. These are the coldest regions of the world. The surface remains permanently frozen under thick snow.

- The earth is divided into five thermal zones on the basis of distribution of insolation and temperature.
- Five thermal zones are torrid zone, north and south temperate zones and north and south frigid zones.

INTEXT QUESTIONS 13.3

1. Fill in the blanks with suitable answers:

   (i) The concept of thermal zones was first given by ______________

   (ii) The____________passes through the middle of the torrid zone.

(iii) Days and nights are always equal at the_____________

(iv) The sun is overhead twice at_______________on 21st March and 23rd September.

(v) The sun is overhead throughout the year in__________zone.

(vi) The ____________ Zone lies between 23½0 South and 66½° South.

(vii) The North Frigid Zone lies between 66½0 North and __________

(viii) The perpetual thick snow covers the______________zone.

(b) Climatic Types

The concept of thermal zone is theoretical and explains the distribution of solar energy over the earth's surface. As discussed earlier, there are several other factors besides the angle of the sun's rays which influence the climate of a place. Keeping in view other factors responsible for the distribution and combined influence of temperature and rainfall, modem scientists have arrived to several classifications of climate and its types. The most widely used system of climatic classification in its various modified forms is that of Wladimir koeppen (1846-1940). It is based upon temperature, precipitation and their seasonal characteristics. The relationship of climate with the vegetation is also included with it. According to this scheme, the world has been divided into five climatic groups and they are further sub-divided into 13 climatic types. They are as follows:

I	Climatic Groups		Climatic Types	
	(A) Tropical climates (hot all seasons)	Af	(i)	Tropical rain forest
		Aw	(ii)	Savanna Climate
		Am	(iii)	Monsoon Climate
	(B) Dry climates	Bw	(iv)	Desert Climate
		Bs	(v)	Steppe Climate
	(C) Warm temperate rainy or Middle latitude rainy climates (mild winters)	Cs	(vi)	Mediterranean Climate
		Cw	(vii)	China Type Climate
		Cf	(viii)	West European Climate
	(D) Humid Middle latitude climates (severe winters)	Dw	(ix)	Taiga Climate
		Df	(x)	Cool East-coast Climate
			(xi)	The Continental Climate

7	(E)	Polar climates	Et	(xii) Tundra Climate
			Ef	(xiii) Ice-cap Climate

You will study the specific characteristics of some of these climatic types in the subsequent lesson dealing with the life of people in low latitude, mid-latitude and high latitude regions of the world.

- W.Koeppens scheme of climatic classification is based on temperature precipitation and their seasonal characteristics
- According to this scheme the world has been divided into 5 climatic groups and 13 climatic types.

INTEXT QUESTIONS 13.4

1. Match correctly each item of column A with that of column B

A Climate Group	B Climatic Types
(a) Tropical Climate	(1) Tundra Climate
(b) Dry Climate	(2) Taiga Climate
(c) Warm Temperate Climate	(3) Savanna Climate
(d) Humid Middle Latitude Climates (severs winters)	(4) Steppe Climate
(e) Polar Climates	(5) Mediterranean Climate

WHAT YOU HAVE LEARNT

The difference among weather, season and climate is that of duration, extent and permanency. Weather is the atmospheric condition of a place for a short period of time with respect to one or more of its elements. It is not permanent. Season is the period of a year which is characterized by a particular set of weather condition. It is mainly caused by the inclination of the earth's axis and revolution of the earth round the sun. Its cycle is repeated year after year. Climate is the average weather conditions of a large area for the past several years. It is more or less permanent. Climate of any place or region is affected by several factors, such as distance from the equator, ocean currents, direction of mountains. slope and aspect, soil and vegetation cover etc. Ancient Greeks divided the world into torrid, temperate and frigid zones based upon the distribution of temperature. Torrid zone is the hottest. the frigid zone is the coldest and the temperature zone lies in between the two. It has a mild temperature. The length of the day varies from equator to poles. The days and the nights are almost equal on the equator. The length of the day increases in summer and decreases in winter as we move towards the poles.

Climate types are the outcome of the classification based upon regions of their formation. W. Koeppen classified the world into five climatic groups, namely (A) Tropical Climate, (B) Dry Climate, (C) Humid Mid-latitudes Climate (mid winters), (D) Humid Mid-Latitudes Climate (severe winters) and (E) Polar Climate. His classification is based on temperature, precipitation and their seasonal variation. He sub-divided the climatic groups into 13 climatic types.

[redacted]ct climate of a place.

2. Draw a simplified diagram of thermal zones and write important characteristics of each zone.

3. Distinguish between weather and climate by describing five points of distinction of each.

4. Name the three main basis of Koeppen's classification of climate and also state the five climatic groups and their sub-divisions into climatic types.

[redacted]

1. (d); 2. (c); 3. (d); 4. (d); 5. (d); 6. (a)

13.2

1. True;. 2. True; True; 4. False; 5. True

13.3

(i) Greeks; (ii) equator; (iii) equator; (iv) equator; (v) Torrid; (vi) South Temperate; (vii) 90° N *or* North Pole; (viii) Frigid

13.4

(a). (3); (b) . (4) ; (c) . (5) ; (d) . (2) ; (c) . (1)

HINTS TO TERMINAL QUESTIONS

1. Please see para 13.2
2. Please see para 13.3 (a)
3. Please see para 13.1 (iv)
4. Please see para 13.3 (b)

14

BIOSPHERE

We know that our earth is the only planet where life is found. That is why this planet is also known as living planet or 'sphare' of 'life'. This sphere contains those qualities atmosphere, lithosphere and hydrosphere. They all enable the life to exist on this planet. But do you know this is a very small portion of the earth where life exists. Beyond this narrow space of the earth, there is no life forms found. What is so special about this narrow zone of the earth which made life possible? It is because of right mixture of many things – energy, some living beings and some non-living things and their interaction. For millions of years, nature has provided some checks and balances which sustain these life forms without any problems. But today the situation has changed. Now this living planet is in danger. This is mainly due to unsustainable human intervention. Our Father of Nation, Mahatma Gandhi has rightly said "Earth has everything to meet human needs but not its greed." It we want to save this unique living planet, then we have to control our greed and change our life style and behaviour pattern. In this lesson we will discuss about some of these issues related to biosphere.

OBJECTIVES

After studying this lesson you will be able to:

- state the elements of biosphere and its inter-relationship with lithosphere, atmosphere and hydrosphere;
- infer the limits of biosphere;
- give reasons for the unique nature of biosphere;
- define the key concepts like ecology, eco-system, global warming, ozone layer depletion, acid rain and sustainable development;
- state the ecological processes in the eco-system;
- understand the interactions of the biosphere with different types of environments;

- appreciate the importance of balance, inter-dependance and energy flow in different ecosystems;
- identify the causes of climatic changes as global warming, ozone layer depletion, acid rain and also those caused by human activities;
- highlight the efforts made for coping with the elements of climatic change at global and local level;
- explain the need and importance of sustainable development.

14.1 BIOSPHERE AND ITS LIMIT

In simpler terms, biosphere refers to the narrow zone of the earth in which all life forms exist. Do you know why life becomes possible in this zone? It is because this is the zone in which all the three essentials things which are required for susteinance of life are found in a right mixture. They are land (lithosphere), air (atmosphere) and water (hydrosphere). In other words, this narrow zone is a place where lithosphere, atmosphere and hydrosphere meet (see fig. 14.1). We must appreciate that how narrow this zone is? It extends vertically into the atmosphere to about 10km, downward into the ocean to depths of about 10.4 km and into about 27,000 ft of the earth's surface where maximum living organism have been found. There are some life forms which are found in extreme conditions. Two examples of this type are algae and thermophillic. Algae which is supposed to be one of the earliest forms of life can exist even in the most hostile environment such as frozen Antarctica. On the other extreme side, thermophillic (heat loving) bacteria usually inhabit deep sea volcanic vents having a temperature of more than 300^0C. In fact, these bacteria can not survive in a temperature below boiling point.

The situation was not like this when the life form began. About 700 million years ago, it is believed to have been only a narrow discontinuous land encompassing only shallow parts of the oceans. As per the trend of expansion of area in terms of the availability of life form, it can be predicated that may be after a few million years, the expanse of the biosphere gets extended beyond the upper troposphere. This shows that biosphere has been evolving over the time. Till now we have discussed about the vertical expansion, but horizontally the biosphere covers the entire globe, though the life may not be possible in some of the hottest and the coldest parts. However, most living things are confined to a narrow band which permits the capture of solar energy through the process of photosynthesis, which is essential for any organic life. This narrow region extends from about 180-200 feet below sea level to the highest value of snowline in Tropical and sub-tropical mountain ranges (say 6,550M above sea levels). When it extends beyond this line, life forms become very limited.

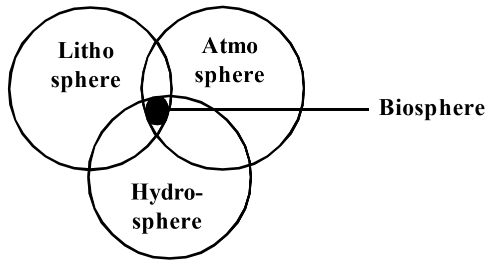


Fig. 14.1 Biosphere

14.2 COMPONENTS OF BIOSPHERE

Biosphere has three basic components. These are (A) abiotic (physical and inorganic) components; (B) biotic (organic) components and (C) energy components. Let us discuss about these three components in detail.

(A) Abiotic Components: These components broadly consist of all non-living elements which are essential for the survival of all living organisms. These are (i) lithosphere (solid part of the earth crust), (ii) atmosphere and (iii) hydrosphere. Mineral nutrients, certain gases and water are the three basic requirements of organic life. Soils and sediments constitute the chief reservoir of mineral nutrients. Atmosphere constitutes the chief reservoir of gases essential for organic life. Ocean consitutes the chief reservoir of liquid water. where all these three reservoirs intermingle and that area becomes the most fertile area for organic life. The upper layer of the soil and shallow parts of the ocean constitute the most important areas, box sustaining organic life. The upper layer of soil, permits easy penetration of gases and percolation of moisture, while shallow parts of oceans, allow penetration of sunlight, inter-mingling of dissolved gases and nutrients from land surface and ocean bottoms.

(B) Biotic Components: Plants, animals and human beings including micro-organisms constitute the three biotic components of environment. In a way these can be called as the three sub-systems.

(i) Plants: Plants are most important among biotic components. They are the only primary producers as they produce their own food through the process of photo synthesis and hence are called autotrophs. Not only plants alone produce all kinds of organic matter but also help in cycling and recycling of organic matters and nutrients. Thus, plants are the major source of food as well as energy for all organisms.

(ii) Animals: While plants are the primary producers, the animals are the main consumers. Therefore, animals are heterotrophs. There are three main functions of animals: (i) to use organic matter made available by plants as food. (ii) to transform the food into energy and (iii) to utilise the energy for growth and development.

(iii) **Micro-organisms:** These consist of a variety of micro-bacteria, fungi etc. Their numbers are unlimited and are popularly known as decomposers. As the name suggest, these organisms decompose the dead plants and animals and other organic matters. It is through this process they obtain their food. Through this process of decomposition, they differentiate and separate the complex organic matter, so that the same could be put to re-use by the primary producers i.e., the plants.

(C) Energy: This is the third and vital component of the biosphere without which life could not have been possible on this planet. It is essential for generation and reproduction of all biological life on this planet. All organisms in the biosphere are like machines which use energy to work and also to convert one form of energy into another. But do you know the source of such energy required for the functioning of the biosphere? Sun is the major source of energy without which we can not think about the existence of the biosphere.

INTEXT QUESTION 14.1

1. Give one word for each of the following
   (a) The narrow zone in which life exists. ____________
   (b) The non-living components of the biosphere. _____________
   (c) The living component of the biosphere. __________
   (d) The organisms which decompose, plant, animal, and organic matters. ________
2. Fill in the blanks:
   (a) ___________ is the primary source of energy for the biosphere.
   (b) ___________ are those who take their food through their mouth.
   (c) The biotic component of the biosphere mainly consists __________, _______ and __________.
   (d) Biosphere is a narrow zone where _________, __________ and ________ meet which made life possible.

14.3 ECOLOGY AND ECO SYSTEM

Ecology is the study of interactions between the organisms and their environment. Now, the ecologists feel that the two components of nature–organisms and environment, are not only related but both these components function in an orderly manner as a definite system. Infact, the two components, organisms and environment are not distinct. For a particular organisms, other organisms can constitute a part of its environments. Similarly, environment can also be modified and influenced by organisms, thus, organisms and environment are interacting parts of a system.

Therefore, the term ecosystem is now used to describe such a system. The word eco-system is a short form of ecological system. The term was first used by A.G. Tansley in 1935. An ecosystem can be defined as a system of regularly interacting and interdependent components forming a unified whole. In otherwords, any segment of the landscape that includes biotic and abiotic components is known as ecosystem, if all it's components are integrated with each other. For example, a lake or pond is an eco-system when it is considered in its totality and not just a water body. In that sense, pond is a representative of small ecosystem and biosphere is considered as the largest ecosystem. Basically, the concept revolves around two aspects.

(i) First, it studies inter-action among the various components and sub-components and

(ii) Second, flow of energy among various components of eco-system which is the essential determinants of how a biological community functions.

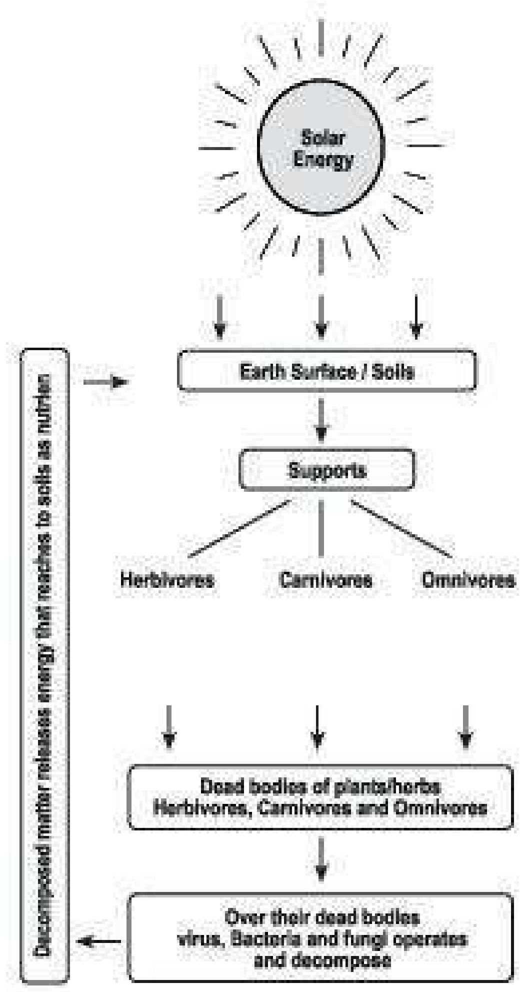


Fig. 14.2 : Flow of Energy in an Ecosystem

Therefore, if we study functional aspects of an ecosystem, then, we may study it in terms of the following:

- Energy flow
- Food Chain
- Nutrient or bio-geochemical cycles.
- Development and evolution.
- Control mechanisms or cybernetics.
- Diversity pattern in time and space
- Let us study each components briefly.

(a) Flow of Energy in the Ecosystem

As discussed earlier that continuous interaction goes on within an eco-system. This interaction between components and sub-components involves the flow of energy and cycling of mineral nutrients. A generalized diagrammatic representation of energy and mineral movements are given above (See figure No). In this process transfer of energy takes place from one level to another. This is known as trophic level. Therefore, trophic level is the level or the stage at which food energy passes from one group to another. To understand it in a better manner we have to discuss about food chain and it's associated activities. In the biosphere, there are broadly two groups of living organisms. Autotrophs and heterotrophs. On the basis of food habits, these heterotrophs are further sub-divided into three categories. They are herbivores, carnivores and omnivores. Herbivores are plant eating animals, carnivores are flesh eating animals and omnivores are both plant and animal eaters organisms.

(b) Food chain/cycle

Let us now understand what is a food chain? Food chain can be defined as a sequence of transfer of energy from organisms in one trophic level to those in another trophic level. Sun is the major source of energy. It helps in the growth of plants on the soil and water bodies. Plants form the basis of food for large number of herbivores. These herbivores are used as food substances for carnivores. Besides, there are omnivores who feed on plants as well as animal flesh. The solar energy absorbed by the soil is reflected in the form of plants and animals. These organism have a limited cycle and die after some time. Once these organisms die, another group of organism start their functioning as they feed on dead material. They help in decomposing the dead bodies of plants and animals on releasing the energy which is again absorbed by the soil to enrich its production of plants. Thus cycle completes.

The above said food chains are very simple food chain But food chains are not always so simple and isolated sequences. Several inter-connected and overlapping food chains present a complicated patterns. Such patterns are called food web.

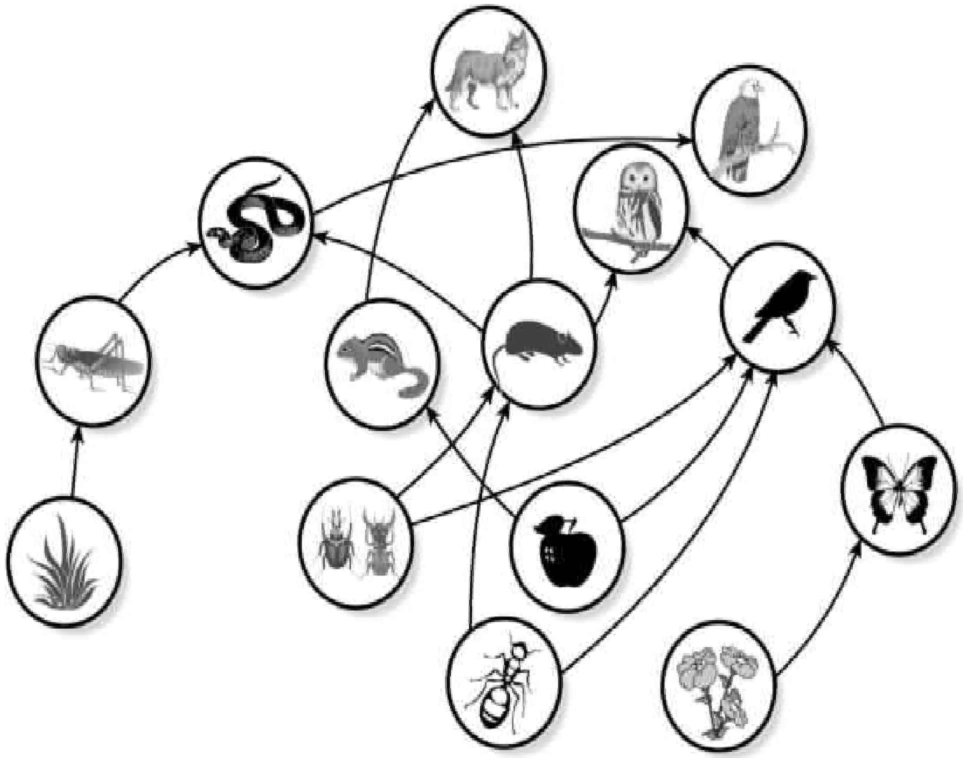


Fig. 14.3: Food Web

Now let us see what are the various trophic levels? As we have discussed earlier sun or solar energy is the source for all the plants for preparation of their food. The energy which is stored by the plants is known as trophic level I. It becomes the source of energy for the herbivores. Therefore, transfer of energy from trophic level I to trophic level II takes place when the plant eating animals consume these plants. Again this chemical energy (through foods) consumed by herbivores gets stored at trophic level II and becomes source of energy for the carnivores at trophic level III. Carnivores are flesh eating animals and depend upon other animals for food. These animals require a lot of energy for building their tissues. They receive their energy from trophic level II through food consumption. A part of the chemical energy from this level III of the food chain is transferred to omnivores at trophic level IV. Therefore, omnivores are at the top level of the food chain which receives their energy from all the three levels. So, in a food chain the members at the successive higher levels becomes smaller in number. When the numbers at successive levels are plotted, they assume the shape of a pyramid, hence it is called food pyramid or pyramid of numbers. (see figure)

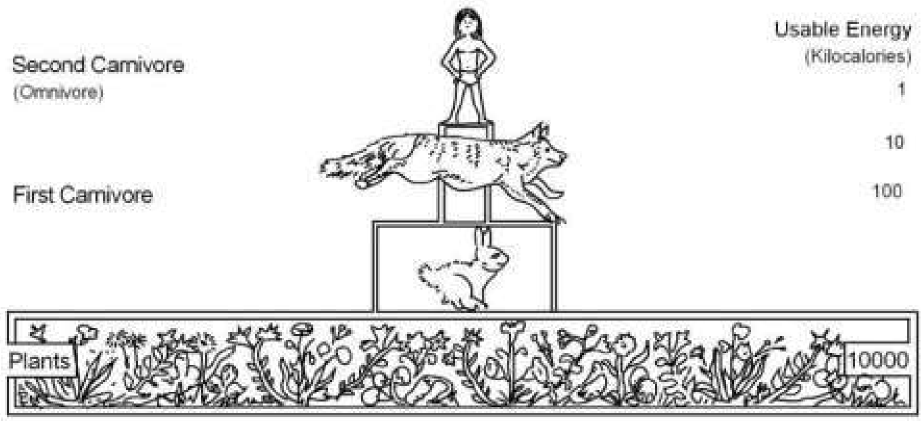


Fig. 14.4: Food Pyramid

The number of organisms at any trophic level depends upon the availability of food at its lower level. With an increase in availability of food at the lower level, there is a consequent increase in the number and variety of organisms at its higher trophic level. Thus, availability of food is the main factor which maintains the grand balance of nature. This balance is dynamic and fluctuates within certain limits. So, every ecosystem has its own system of mechanism to control the balance. This happens because in an eco-system there are certain inherent processes in which nutrients or materials are transferred. Some times in a single direction and some times in cycles. Let us discuss some of these cycles.

(c) Natural / Bio-geochemical Cycles

Biogeochemical cycles (biological, geological and chemical interactions) are nothing but the movement and circulation of soluble inorganic substances (nutrients) derived from soil and atmospheric phases of inorganic substances through organic phase of various biotic components. Simillarly, a retun circulation and movement of organic substances takes place in favour of inorganic objects such as soil and atmosphere. Thus these two systems are supplementary to each other and complete the cycle. The study of biogeochemical cycles can be approached on two scales e.g., (i) cycling of all elements together or (ii) cycling of individual elements e.g., hydrological cycle, carbon cycle, nitrogen cycle, phosphorous cycle, oxygen cycle, sulphur cycle etc. Besides these cycles, sediment cycles and mineral cycles are also included in the broader biogeochemical cycles. These natural or biogeochemical cycles functions in a balanced manner which stabilizes biosphere and sustains the life processes on the earth. If we disturb them, it will lead to various negative consequences which ultimately affects the biosphere. Let us discuss some of these cycles in brief. (These cycles are already discussed in lesson nine of this book, but here our discussion is related to biosphere or environment. You can refer these cycles which are given in detail under lesson – 9)

1. The Hydrological Cycle

This cycle helps in exchange of water between air, land, sea, living plants and animals. Solar energy is used to drive the hydrological cycle. Massive evaporation of water from the oceans, cloud formation and rainfall gives us our supply and reserves of fresh water.

At sub-zero temperature, rainwater freezes into snow and in presence of strong wind forms hail. Water as rain, snow and hail is precipitated on land and water surfaces. On land surface water seeps into the soil and is stored as ground water. The natural water level or water table exists below the ground. The water table is supported by the underlying clay and rock strata. Ground water does not remain static but moves in various directions. It moves up through capillary action and reaches soil surfaces where it is drawn by plant roots.

2. The Nitrogen Cycle

Nitrogen and its compounds are essential for life processes in the biosphere. There is continuous exchange of nitrogen within the ecosystem operating the nitrogen cycle. Proteins produced by plants and animals in their metabolic processes are organic compounds of nitrogen. The major load of nitrogenous organic residue in soil originates from death and decay of plants and excreta of animals. These organic residues in soil are taken up by various soil micro-organisms who break down soil nitrate into nitrogen by denitrification process while others transform nitrogen into soluble nitrogen compounds.

3. The Carbon Cycle

The carbon cycle is a very important chemical cycle. The atmosphere is the minor reservoir of carbon. Hydrosphere is the major reservoir which contains approximately 50 times more as that of atmosphere. It is stored as bicarbonate mineral deposit on the ocean floor. The later regulates the carbon dioxide level in the atmosphere. The cycle operates in the form of carbon dioxide exchanging among the atmosphere, biosphere and the oceans.

14.4 TYPES OF ECO-SYSTEMS

Ecosystem can be classified into various types on various basis. The most widely used and simple classification is on the basis of habitats. The idea behind this classification is that each habitat exhibits a particular physical environmental condition. These conditions determine the nature and characteristics of biotic communities and therefore there are spatial variations in the biotic communities. On this basis the eco-system can broadly be divided as (i) terrestrial ecosystems and (ii) aquatic ecosystems. These ecosystems are further sub-divided in to various sub-types. We will discuss briefly about these two eco-systems and their sub-types.

(i) Terrestrial Ecosystems

As the name suggests it covers the entire 29% of the land area found on the earth surface. The terrestrial ecosystems are the major source of food and raw material for human beings. Here, the plant and animal communities are more diversified than aquatic eco-systems. Land organisms have a greater range of tolerance than the aquatic ecosystem. But, in some cases, water is a limiting factor for terrestrial ecosystems. As far as productivity is concerned, terrestrial ecosystems are more productive than aquatic ecosystem.

The above said discussion is a comparison between terrestrial and aquatic ecosystem in general. But there are further variations in the terrestrial ecosystems in terms of physical conditions and their response to biotic communities. Therefore, the terrestrial eco-systems are further sub-divided into various sub-types. Major sub-types are (i) upland or mountain eco-system (ii) low land eco-system (iii) desert eco-system etc. These sub-systems, may be further sub-divided depending on specific purpose and objectives. Maximum life forms are found in low lands and they keep on decreasing with the increase in height as the level of oxygen and atmospheric pressure decreases.

(ii) Aquatic Eco-system

This ecosystem refers to the 71% of the water present on the earth surface in various forms. Like terrestrial eco-system, aquatic ecosystem can be further divided into various sub-types. But the major sub-divisions of this ecosystem may be fresh water, estuarine and marine. Again these ecosystems can be further subdivided into smaller ones. If we see interms of extent or what we call in geography in terms of scale, it ranges from open sea to small pond. The variations within the various types of aquatic ecosystem are mainly related to abiotic factors. But, there are also variations in terms of biotic communities that are living within these ecosystems. Why are these variations?

As discussed earlier, the limiting factors in aquatic eco-systems are the depth upto which sunlight can penetrate, the availability of nutrients and the concentration of dissolved oxygen. If we keep all these factors into consideration, it is found that estuarine ecosystems are the most productive of aquatic eco-systems. In marine ecosystems, shallow continental shelves are more productive than open oceans. Though open oceans are most extensive in areas, they are the least productive of all ecosystems like the deserts in terrestrial ecosystem.

Another aspects which is the determinants of diversity of life in acquatic ecosystem is the adaptability of organisms. Some of the organisms exclusively live in water namely fishes whereas some of the organisms are amphibious in nature. Some of the important amphibians are frogs, crocodiles, hippopotamus and variety of aquatic birds. Again within water, some organisms live only in either fresh water or saline water and some organisms live in both fresh water and saline water. Hilsa fish is an example of the later type. Echinoderms and Coelenterates live only in saline water and there are various types of fishes like Rohu, Catla etc found only in fresh water.

INTEXT QUESTION 14.2

1. Fill in the blanks with appropriate words.

   (a) ____________ are those which manufacture their own foods.

   (b) Plant eating animals are known as _____________.

   (c) On the basis of food habits human being belongs to which category __________.

   (d) Several inter-connected and overlapping food chains present a complicated pattern which is known as ___________.

   (e) _________ is considered as the largest ecosystem.

2. Answer the following questions very briefly

   (a) Define ecology.

   ____

   (b) What is a food chain?

   ____

   (c) What is a food pyramid?

   ____

   (d) What is a biogechemical cycle?

   ____

14.5 GLOBAL CLIMATIC CHANGE

We have read under bio-geochemical cycle that for the last billion years or so, earth's atmosphere and hydrosphere have been composed of approximately the same balance of chemical components we live with today. The earth has a unique mechanisms for stabilizing and controlling the global climate. These mechanisms are as follows:

(i) The plants and animals balance carbon dioxide level of the atmosphere which in twin acts as global thermostat. It means these elements control the temperature balance within optimum limits.

(ii) The water bodies play important role in regulating global climate.

In recent years, the rapid growth of human population, the rate at which we consume the earth's resources, extravagant life styles etc. lead to substantial increase in the carbon level of atmosphere which has accelerated the process of climatic change.

Let us discuss some of these processes affecting the climatic change.

(a) Green House Effects and Global Warming

Global warming refers to a gradual rise of atmospheric temperature and consequent changes in the radiation balance mainly due to human action leading to climatic change at different levels – local, regional and global. As per recent estimates, it has been found that the surface air temperature over the past 100 years has increased by about 0.5^0C to 0.7^0C. Do you know why it is happenning. This is due to green house effect. To have a better understanding about global warming, we should know the functioning of a green house (See Box)

Working of a Green House

In cold countries, a green house is meant for plants, where total heat, especially during winter season, is not sufficient to support plant growth. The transparent walls and roof of the green house are such that these allow the visible sunlight to enter but prevent the longwave radiations to go out. Thus, the sunlight is absorbed by the soil and structure of the green house. It is then re-emitted as heat which can not pass through the glass. The amount of energy in the green house thus increases until its temperature is high enough for the slight leakage of heat through the glass to take away as much energy as gets in as sunlight. Subsequently walls and roof re-emit absorbed radiation into the house. Thus, during the day time, infra-red radiation pass into the green house and warm the atmosphere and the ground on which the green house stands. Coating of glass with a non-heat radiation film transparent to sunlight further maximizes heating effect of the radiation.

Therefore, if our earth has become a green house, then there are certain gases which act like the glass panels of a green house allowing the sun's rays to pass through but preventing the heat from escaping into the outer space and there by warming the atmosphere. This is happening due to deforestation and industrialization. These gases are carbon dioxide (CO_2), methane (CH_4) nitrous oxides (NO_x) and chlorofluorocarbon (CFC) and hence known as green house gases. Out of these four gases, carbon dioxide contributes about 55%, chlorofluorocarbon contributes about 24%, methane (about 15%) and nitrous oxide (about 6%) towards heating of the atmosphere.

Do you know the sources of these gases? Burning of fossil fuels and fire woods, large fleet of automobiles and number of factories emit carbon dioxides. Growing paddies, livestock, waste dumps and coal mining are the major source of methane. The use of aerosols as coolants in refrigerators and air conditioning devices release chlorofluorocarbons into the atmosphere Nitrous oxide is mainly emitted from chemical industries, and due to deforestation and certain agricultural practices.

Construction of green houses in temperate region helps the plant protection and ecological balances whereas concentration of green house gases on the earth's atmosphere upsets the earth's biological system.

Consequences of green house effect

1. It is estimated that if the present rate of increase in CO_2 level continues, it will result in rise of atmospheric temperature by 2^0C to 3^0C by end of 21^{st} century. This will result in receding many glaciers; melting of icecaps in the polar regions and disappearance of deposits of ice on the other parts of world in large scale. According to an estimate, if all the ice on the earth would melt, about 60M of water would be added to surface of all oceans and low lying coastal areas. A rise in sea-level of only 50-100 cm caused by global warming would flood low lying areas of the world such as Bangladesh, West Bengal as well as densely populated coastal cities from Shanghai to San-Fancisco.
2. Because of increased concentration of CO_2 and due to much warmer tropical oceans, there may occur more cyclones and hurricanes. Early snow melt in mountains will cause more floods during monsoon. According to United Nations Environment Programme (UNEP), within about three decades, rising levels of seas will be able to and flood coastal cities like Bombay, Boston, Chittgang and Manila.
3. A slight increase in global temperature can adversely affect the world food

production. Thus the wheat production zones in the northern latitudes will be shifted to north of temperate latitudes.

4. The biological productivity of the ocean would also decrease due to warming of the surface layer, which in turn reduces the transport of nutrients from deeper layers to the surface by vertical circulation.

Control and Remedial Measures of Green House Effect

The following measures may be adopted to reduce the ever increasing green house effect.

1. CO_2 concentration can be reduced by drastic cut in the consumption of fossil fuels in the highly developed and industrialized countries like USA and Japan and developing country like China and India.
2. Scientific efforts should be made to develop alternative efficient fuels. Methane may be a substitute of petroleum.

   Development of hydro-electric and thermal power are better alternatives.
3. There should be a restriction on the emission of dangerous CO_2, CFCs, and as NO_2 from the factories and automobiles.
4. Limiting the driving days in megacities can be another option. Cities like singapore and mexico are following the practice.
5. In tropical and sub-tropical countries, the solar energy may be developed as an alternative to the fossil fuels.
6. Biogas plants should be used which is another source of conventional energy for domestic use.
7. Enhancing afforestation will certainly reduce the CO_2 level thereby decreasing the green house effect.

(b) Ozone Layer Depletion

Before discussing about the problem of ozone layer depletion, we should know about ozone and the ozone layer. Ozone is a form of oxygen that has three atoms (O_3) rather than the more common two atoms (O_2). It is created in the upper atmosphere by the action of solar radiation on oxygen molecules. As far as its position is concerned, it is found in the form of a thin layer in the stratosphere between 15 to 48 kilometre. About 90% of all atmospheric ozone is found in this layer. Ozne constitutes only less than 0.002 percent of the volume of the atmosphere. However, it's role is very critical as far as lives on the earth is concerned. It strongly absorbs ultraviolet radiation from the sun. Ultraviolet radiation is biologically destructive in many ways. It causes skin cancer and cataracts, suppresses the human immune system, dimimshes the yield of many crops, disrupts the acquatic food chain by killing micro-organisms on the ocean surface and many other negative effects which is still undiscovered.

This is happening due to certain recent human activities which have injected certain chemicals in the stratosphere which consume ozone and reduce its concentration. Depletion is mainly caused by chlorofluorocarbons (CFCs), halons, methyl chloroform and carbon tetrachlorides. These chemical substances are mainly either chlorine or bromine which can reach the stratosphere and catalytically break down ozone into oxygen. CFCs are odourless, non-flamable, non-corosive and nontoxic. For this reason, scientist originally believed CFCs could not possibly have any effect on the environment. That is why it is widely used in refrigeration and air conditioning, in foam and plastic manufacturing and in aerosol sprays.

Not only is the ozone layer thinning, in some places it has temporarily disappeared. A hole in the layer has developed over Antarctic since 1979 and that hole has persisted for a longer and longer time every year. In 1988, an ozone hole was found over the Arctic for the first time and it too has lasted longer and longer each year since then.

Can we prevent this disaster? It needs certain actions both at individual as well as governmental level. Since the last two decades, certain actions have been initiated at global level. Among these Montreal Protocol of 1987 and London Conference of 1992 are important. In both these conferences it was decided that the developed countries would totally ban CFC production by 2000 and the developing countries by 2010AD. Even if it is sincerely followed and strictly implemented by all the 150 countries including India, who are signatory to Montreal Protocol even then the chlorofluorocarbon and chlorine shall continue their influance for another 100 years. Therefore, all over the world research efforts are continuing for development of substitutes of CFC as coolants for refrigerators and air conditioners.

(c) Acid Rain

The term 'acid rain' refers to the deposition of wet or dry acidic materials from the atmosphere on the earth's surface. Although most conspicuously associated with rainfall, the pollutants may fall on the earth's surface either in the form of snow, sleet, hail or fog or in the dry form of gases or particulate matter. Sulphuric acid and nitric acid is considered as the principal agents responsible for acid rain. But the major culprit are human beings. Smokes emitted from the industries is the major source of sulphur dioxide whereas smokes emitted from the motor vehicle is the major source of nitrogen oxide. These emissions mixed with atmospheric moisture form the sulphuric acid and nitric acids which, sooner or later precipitate on earth in various form.

Acidity is measured on a pH scale based on the relative concentration of hydrogen ions. The scale ranges from 0 to 14, where the lower end represents extreme acidity and the upper end extreme alkalinity. (see diagram). As stated earlier acid rain is associated with various forms of precipitation. It we look at rainfall in clean and dust free air, a pH value varies between 5.6 to 6.0, which is slightly acidic in nature. Whenever or wherever the pH value is below 5.6, then the damage becomes noticeable.

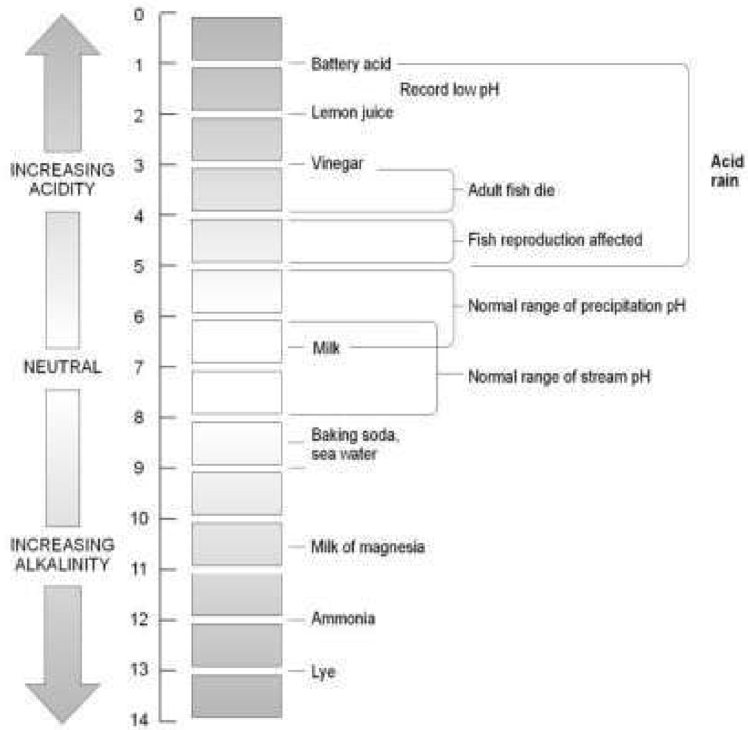


Fig. 14.5 A pH Scale

The long – term effects of acid precipitation on human health and agricultural production have not yet been ascertained precisely. However, the most conspicuous damage is being done to aquatic eco-system. Below given are some of the effects of acid rain. The eco-system of a stream or lake may be severely affected when its pH falls below 5. Total biomass in such systems is reduced from two to ten times because few organisms can tolerate acid. The diversity of species also decreases. The most severe effect of acidification is on fish. Acidic conditions affect the reproductive capabilities of fish, resulting in a slow decline of fish population. This has been documented in various parts of Europe and North America. In Norway, thousands of lakes and streams have largely lost their fish population, over an areas of 33,000 square kilometer. Several lakes in Eastern United States and Canada have become biological deserts during the last quarter century. The precise effects of acid rain on forest are not clearly understood, evidence, however, shows that it is responsible for forests dieback which is occurring in each continent. Forest dieback is a German word which means death or decline of forest. Even buildings and monuments are being destroyed because acid deposition accelerated erosion capacity.

Acid rain is a serious global problem and its impact can spread over long distances from the origin of the pollutant. That is why Scandinavian countries complain about British pollution in Europe whereas Canadians blame United States in North America.

INTEXT QUESTIONS 14.3

1. Answer the following questions briefly

   (a) Name any two factors that are responsible for irrepairable damage to the biosphere

   (i) ____________________ (ii) ____________________

   (b) Name any two major green house gases.

   (i) ____________________ (ii) ____________________

   (c) Which are the two leading nations in the world that produced carbon dioxide gases.

   (i) ____________________ (ii) ____________________

   (d) Where do we generally find ozone layer in the atmosphere

   (i) ____________________ (ii) ____________________

   (e) Name any two major chemical substances that are responsible for ozone layer depletion.

   (i) ____________________ (ii) ____________________

   (f) What are the two main agents that are responsible for acid rain?

   (i) ____________________ (ii) ____________________

   (g) Name any two major effects of acid rain.

   (i) ____________________ (ii) ____________________

14.6 SUSTAINABLE DEVELOPMENT

Today, the world has made a lot of progress. Human being with the help of technological advancement and consumption of energy resources have made many inventions and discoveries to make their life more and more comfortable. At present , without technology and mineral and power resources we can not think about the life. It has entered in a large scale in almost every sector, be it agriculture, industry, transport, communication and domestic. Have we ever thought that how it affects the life on earth? Even the situation is such that our ecology is in danger. If we continue in this fashion most of the minerals and power resources will be consumed within next hundred years. Simultaneously, it has affected and endangered four components of ecosphere. These are the climatic system, the hydrological cycle, nutrient cycle and the bio diversity. The situation has worsened to that extent that the resources which are considered renewable become non-renewable. Let us explain this with one example. Take the case of Yamuna water in Delhi. We have polluted the water to such an extent that little aquatic life (mostly fish) is found in this water within Delhi likely. This water can not be consumed despite the treatment.

It has also affected plants and their products. Then the questions arises what is the use of that water which could not be used though it is renewable. Same is the case with air, soil etc. Due to careless and selfish action of the human beings, these natural resources are degraded to such an extent that it becomes non-renewable.

It puts a question mark on the development itself. Does it mean that the world community needs to put a full stop to further development? This is not at all possible. This dilemma bothered entire human kind. A conscious effort was made to address this particular problem. A committee was formed by United Nations under the chairmanship of the then Norway Prime Minister Gro Harlem Brundtland. This Commission was known as United Nations Commission on Environment and Development (UNCED) or popularly Brundtland Commission.

The title of the report prepared by Commission is “Our Common Future.” In the beginning, the world was divided into two groups – developed and developing countries and started blaming each other. Developed countries blamed developing countries for the rapid population growth, poverty and primitive technology which leads to pollution. The argument of developing countries was that extravagant life styles of developed countries puts a lot of pressure on existing resources. But after a lot of heated discussions and arguments, it was felt that there should be some common grounds in which all the world should agree to protect it for future. It was felt that there should be balance between ecology, economics and technology. Therefore, Brundtland Commission defined sustainable development as “meeting the needs of the present generation without compromising the ability of future generation to meet their own needs.”

Strategies to be adopted for Sustainable Development

Some strategies are given below for achieving sustainable development.

1. **Reviving growth:** Sustainable development must address the issue of poverty. Poverty increases pressure on the environment by following life styles that degrade environment. For example forest cutting for fuel use or expanding deserts by overgrazing activities. At the same time, they are helpless as they do not have alternate sources of livelihood. Majority of people living below poverty line are found in Africa and Asia. Efforts should be made to provide them certain alternatives like skills, training, education, etc. so that they can earn livelihood and come out of poverty. Otherwise, the very purpose of sustainability or sustainable development will be fore feited. Because, as long as poverty will be there, poor people will depend upon nature for their survival.

2. **Ensuring a sustainable level of population:** Today one of the major challenge is to tackle the highest rate of population growth especially in Africa, South Asia and Middle East. Explosion of population has a direct link with quality of life, parameters like access to education, health, housing, safe drinking water, sanitation and means of livelihood. It puts a lot of stress on government to provide additional facilities when population is increasing rapidly.

3. **Meeting essential human needs:** This is a pre-requisite for reviving growth. It is evident that unless the basic needs are satisfied, the individual can not participate in the growth process. Essential human needs include enough food, adequate housing, fresh water supply and health Facilities. More food and quality food should be provided because this is not just to feed people but to attack under nourishment and to develop immune system for preventing diseases.

4. **Changing the quality of growth:** There is a need to change the orientation of growth. When we say growth, we always mean economic growth or materialistic growth, but there is a need for making growth less materialistic, less energy intensive and more equitable. Economic and social development have to be mutually reinforcing. In other words economic development should pay attention towards better social development like education, health, sanitation, etc. Simultaneously social development can boost the economy of the areas, region and country.

5. **Conserving and enhancing the resources base:** There are moral as well as economic arguments for this. The moral argument is that we have to preserve resources for the sustenance of next generation. But simultaneously we have to see economic argument also. The economic argument is that we can not say to the poor people that they must remain in poverty to protect environment. On the otherside, there is a need to challenge the consumerism of the developed countries and through following pro-capitalist economic systems. Somewhere, the process of liberalization, privatization and globalisation must answer the problem of inequality only meeting basic human needs of common people. The challenge in sustainability is that how we conserve resources without geopardising the growth and equal access to resources for livelihood. Simultaneously there is a need to find out alternatives to non-renewable resources, more efficient use of resources, discovery of new resources and discovery of low waste technologies.

6. **Reorienting technology and managing risk:** The implications of above five strategies are for the orientation of technology in two principal ways. First the capacity for innovation needs to be greatly enhanced in developing countries. Second, the effort by developed countries must play a vital role as far as the transfer of technology is concerned. Therefore, all the technological development must pay greater attention to environmental factors. This is closely linked to the issue of risk management wherein environmental impact has to be effectively minimized.

7. **Merging environment and economics in decision making:** Economics and ecology should not be seen in opposition but as interlocking. Sustainable development requires the unification of economics and ecology in international relations.

INTEXT QUESTION 14.4

1. Answer the following question briefly

   (a) Under whose Chairpersonship the United Nation Commission on Environment and Development (UNCED) was formed?

   ____

   (b) What is the title of the report submitted by UNCED?

   ____

   (c) Define sustainable development.

   ____

   (d) Name any three strategies to be adopted for sustainable development.

   (i) ____

   (ii) ____

   (iii) ____

WHAT YOU HAVE LEARNT

Probably, our earth is the only planet where life is found. Biosphere refers to the narrow part of the earth in which all life form exists. Life is found in this region due to availability of right mixture of land, air and water. There are three major components of biosphere. These are abiotic, biotic and energy component. Examples of abiotic components are soil, air, water etc. whereas plants, animals and micro-organisms are major constituents of biotic component. The third one is energy component for which sun is the major source without which existence of biosphere is not possible.

Ecology is the study of interactions between the organisms and their physical environments on the one hand and among the organisms on the other hand. An eco-system can be defined as a system of regularly interacting and interdependent components forming a unified hole. It we study functional aspects of eco-system then an eco-system can be studied in terms of energy flow, food chain, diversity pattern in terms of time and space, bio-geo-chemical cycle, development and evolution and control mechanisms or cybernetics. In an eco-system, continuous interaction goes on between components and sub-components which involves the flow of energy. Food chain is one such example in which transfer of energy takes place in a sequential manner in one trophic level to those in another trophic level. In a food chain the members at the successive higher levels become smaller in number. When the numbers at successive levels are plotted, they assume the shape of a pyramid, hence it is called food pyramid. Each ecosystem has certain inbuilt mechanism to maintain balance. Natural/biogeochemical cycle is one way. Biogeochemical cycles are nothing but the movement and circulation of soluble substances derived from sedimentary and atmospheric phases of inorganic substances through organic phase of various biotic components and finally their return to inorganic state. Some of the bio-geochemical cycles include hydrological cycle, carbon cycle, nitrogen cycle and phosphorous cycle.

Ecosystem can be classified into various types. The most widely used and simple classification is on the basis of habitats. On this basis, ecosystem can be divided as terrestrial and aquatic ecosystem. These ecosystems are further subdivided into various subtypes. Biosphere as the largest ecosystem remained undisturbed for billion years. But in recent years due to adverse human actions, lot of damage has been made and some of these are irreversible. Some of these phenomena are global warming, ozone layer depletion, acid rain, sea level changes etc. Today, at the global level, initiatives have been taken to address these problems. One of the significant development was United Nation Commission on Environment and Development. The Commission submitted its report whose title was "Our Common Future". In this report the concept of sustainable development was brought forward. Sustainable development was defined as "meeting the needs of present generation without compromising the ability for future generation to meet their own needs". Some of the strategies for sustainable development include revising growth, meeting essential human needs, ensuring a sustainable level of population, changing the quality of growth, conserving and enhancing the resource base, re-orienting technologies and managing the risks, and merging environment and economics in decision making process.

TERMINAL QUESTIONS

1. What is biosphere? Describe various components of biosphere with suitable examples.
2. Define eco-system. Explain the energy flow in the ecosystem with appropriate diagrams and examples.
3. What are bio-geochemical cycles? Explain hydrological cycles with suitable diagram.
4. Describe various causes and consequences of global warming?
5. Define sustainable development? Suggest measures to be adopted for achieving sustainable development.

ANSWER TO INTEXT QUESTIONS

14.1

1. (a) biosphere (b) biotic (c) biotic (d) decomposer
2. (a) sun (b) biologic (c) plants, animals and micro-organisms (d) lithosphere atmosphere and hydrosphere.

14.2

1. (a) autographs (b) herbivores (c) omnivores (d) food web (e) biosphere
2. (a) Ecology is the study of interactions between the organisms and their interaction
   (b) Food chain can be defined as the sequence of transfer of energy from organisms in one trophic level to those in another trophic level.
   (c) When the numbers at successive levels are plotted they assume the shape of a pyramid, hence it is called food pyramid.
   (d) Bio-geochemical cycles are nothing but the movement and circulation of soluble inorganic substances derived from sedimentary and atmospheric phases of inorganic substances through organic phase of various biotic components and finally their return to inorganic state.

14.3

3. (a) Rapid growth of human population, alarming rate of consumption, extravagant life styles (any two)
   (b) Carbon dioxide, methane, nitrous oxide and chlorofluorocarbon (CFC) (any two)
   (c) United States and Russia
   (d) Stratosphere
   (e) CFCs, halons, methyl chloroform, carbon tetrachloride
   (f) Sulphuric acid and nitric acid
   (g) Effects of acid rain are
      (i) Severely affects biomass and aquatic life in the lakes and streams
      (ii) Death or decline of forest (iii) destroy building and monuments

14.4

1. (a) Gro-Harlem Brundtlandt
   (b) Our common Future

(c) "Meeting the needs of the present generation without compromising the ability for future generation to meet their own needs"

(d) (i) Reviving growth (ii) Meeting essential human needs (iii) Ensuring a sustainable level of population (iv) changing the quality of growth. (v) conserving and enhancing the resource base (vi) Reorienting technology and managing risk (vii) Merging Government and economics in decision making. (Any three)

HINTS TO TERMINAL QUESTIONS

1. Please see para 14.1 and 14.2
2. Please see 14.3 Ecology and Ecosystem and its part (a) Flow of energy in the Ecosystem.
3. Please see para 14.3 (c) Natural/Bio-geo-chemical cycles
4. Please see para 14.5 (a) Green House Effects and Global warming
5. Please see para 14.6

15

BIOMES

In the previous lesson, you have learnt about the various aspects of biosphere. We have also discussed how various components of biosphere interact as well as complement each other. Energy which reaches from sun is the prime source for various lives on the earth. But, its distribution on the surface of the earth varies because of various reasons which you have already studied in the previous chapters. Because of this reason, the biotic life varies tremendously from hot humid to cold dry. Hence, they give rise to assemblage of plants and animal life in various geographical settings. In this context we will study the biotic lives and their interactions.

OBJECTIVES

After studying this lesson, you will be able to:

- recall the meaning of terms ecology, ecosystem, energy Flow etc.
- explain the term biome;
- identify different types of biomes;
- locate different types of biomes on the map of the world;
- describe environmental conditions of these biomes;
- establish the relationships between plant and animal communities;
- analyse the human responses with the biotic lives of that region.

15.1 MEANING OF BIOME

The word biome is a short form of biological home. There is no unanimity among the scientists as for as the definition as well as classification of biome is concerned. Biome may be defined as a large natural eco-system wherein we study the total assemblage of plant and animal communities. Here, all the biota have the minimum common characteristics and all the areas of biomes are characterized by more or less uniform environmental conditions. Though a biome includes both plant and animal communities but a biome is usually identified and named on the basis of its dominant vegetation, which normally constitutes the bulk of the biomass. These vegetations are most obvious and conspicuous visible component of the landscape. By biomass we mean the total weight of all living organisms – plants and animals, found in the biome.

Factors Affecting Biomes

There are various factors which affects the size, location, and character of a biome. Important factors are as follow:

(i) Length of day light and darkness. This is mainly responsible for duration of photosynthesis.

(ii) Mean temperature as well as difference in temperature. Differences (both diurnal and annual) to find out extreme conditions.

(iii) Length of growing season.

(iv) Precipitation which includes total amount, variations over time and intensity.

(v) Wind flow that include speed, direction, duration and frequency.

(vi) Soil types

(vii) Slope

(viii) Drainage

(ix) Other plant and animal species.

15.2 CLASSIFICATION OF BIOME

There are two major bases of classifying biome.

In this section we will discuss two classifications which are simple and widely used. The bases of these two classifications and its various types are discussed below:

(A) On the basis of climate with special emphasis on availability of moisture

According to this basis biomes are determined by the degree to which moisture is available to plants in a scale hanging from abundant (forest biome) to almost scarce (desert biome). But within each biome, conditions of temperature are vastly different from low to high altitudes and low to high latitudes. Consequently there is a need to sub-divide each biome in to further sub-types. However, according to this classification, there are four major types of biomes:

(i) Forest biome

(ii) Savanna biome

(iii) Grossland biome

(iv) Desert biome

(B) On the basis of climate and vegetation

This classification argues that there is a close relationship between the world distributional patterns of plants and animal species and the climatic types of the world. Thus, based on this relationship the world has been divided into different biome types. The vegetation is the most dominant component of the biomes. As the vegetation and climate have intimate relationship the world is divided into various types on the basis of climates. Further, these climate based biomes are divided into various sub-types on the basis of vegetation. Look at the table No. 15.1 given below.

Table No. 15.1
Classification of Biomes on the basis of climate and vegetation

Biomes of the first order (Based on climatic zones)	Biomes of the Second order (Based on Vegetation)	Biomes of the Third order (Combination of climate and vegetation)
1. Tropical Biome	(i) Tropical Forest Biome	(a) Evergreen Rain-Forest Biome
		(b) Semi-evergreen Forest Biome
		(c) Deciduous Forest Biome
		(d) Semi-deciduous Forest Biome
		(e) Monanne Forest Biome
		(f) Swamp Forest Biome
	(ii) Savanna Biome	(a) Savanna Forest Biome
		(b) Savanna Grassland Biome
	(iii) Desert Biome	(a) Dry and arid desert Biome
		(b) Semi-arid Biome
2. Temperate Biome	(i) Boreal Forest Biome (Taiga Forest Biome)	(a) North American Biome (b) Asiatic Biome (c) Mountain Forest Biome
	(ii) Temperate Deciduous Forest Biome	(a) North American Biome (b) European Biome
	(iii) Temperate Grassland Biome	(a) Soviet Steppe Biome (b) North-American Praries Biome (c) Pampa Biome
	(iv) The Mediterranean Biome	(i) Austration Grassland Biome (ii) Southern Hemisphere Biome
	(v) Warm Temperate Biome	
3. Tundra Biome	(i) Arctic Tundra Biome	
	(ii) Alpine Tundra Biome	

From the table 15.1 it is quite clear that a number of biomes are found in different parts of the globe. For detailed study, three Biomes – One from each climatic zone have been selected. Those three biomes are:-

(i) The Evergreen Rainforest Biome

(ii) The Temperate Grassland Biome

(iii) The Arctic Tundra Biomes

15.3 THE EVERGREEN RAINFOREST BIOME

(i) Geographical Background

This biome extends upto 10^0 latitude on both sides of the equator. It covers the area of Amazon low land of south America, Congo basin of equatorial Africa and South Eastern Asian Islands extending from Sumatra to New Guinea. This area is shown in the Fig. 15.2.

This area experiences high temperature throught the year with range as little as 2^0C. However, the daily range of temperature is much higher than the annual range of temperature. This area gets heavy rainfall ranging between 150cm-250cm. It is distributed throughout the year. Rainfall occurs in the afternoon almost on daily basis. This also happens because of huge amount of water vapor reaching in the atmosphere due to high temperature. Hence, this area is considered to be an equable climate as both temperature and rainfall are high for whole of the year.

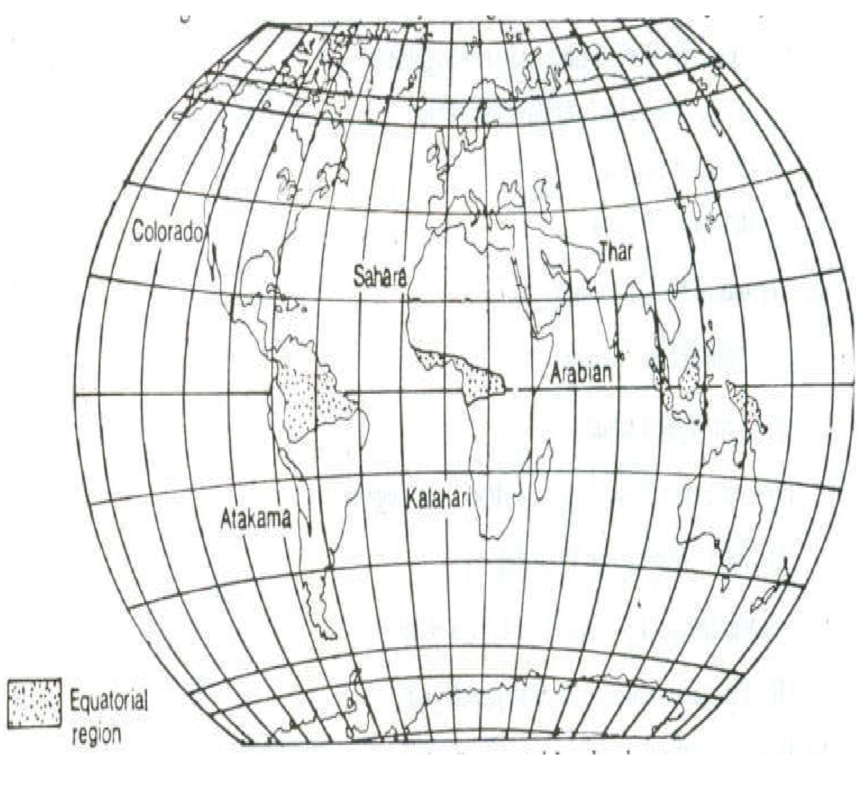


Fig. 15.1 The Evergreen Rainforest Biome

(ii) Natural Vegetation and Animal Life

The combination of heat and moisture make this biome as perfect environment for a great variety of plants and animal species. The variety of plant species can be understood from the fact that one square kilometer may contain as many as about thousand of different types of plant species. Most of the trees have buttressed trunks, shallow roots and large dark evergreen leaves. The evergreen rainforest arranged in three levels. (a) The canopy or upper level where trees lies between about 20 metres to 50 metres. Most of them are hard wood trees like ebony, Mahogany, rose wood, sandalwood, cinchona, etc. (b) The second level of intermediary level where trees lies between about 10 meters to 20 meters. The most important plant of this group is palm trees. Apart from palm trees, epiphytic and parasitic plants are also found in this layer (c) The third or lower level lies from surface level to about 10 meters of heights. Under this category variety of plants are found namely orchids, ferns, mosses, herbs, bananas, pineapples etc. Because of tall and broad leaved dense plants, sunlight could not reach at the lowest level/surface. Because of poor photo-synthesis process at this level, number of plant species are very low.

Like vegetation, evergreen rainforest is inhabited by numerous birds, mammals, insets etc. Some important animals of this biome are Jaguar, lemur, orangutan, elephant, etc. Macaw parrot, sloth and toucan are some of the important birds of this area. Most of the birds are colorful. The water bodies of the equatorial areas are also rich in animal life with alligators, tactless, fishes, frogs, Hippopotamus etc. Because of the impenetrability and high vegetation growth in the lower part, most of the insects, birds and animals resides on the branches of the trees. Generally, they do not come down to the ground.

The productivity of the tropical rainforest biome is the highest of all biome types of the world. It may be pointed out that the rainforest biome represents only 13 percent of the total geographical area of the world but this biome accounts for the 40 percent of the total productivity of the world.

(iii) Human Response

Human being has also started to damage this biologically rich eco-system through various developmental activities. These activities are construction of large dams and reservoirs, roads and high ways, extraction of timber clearance for pasture or crops, encroachment and clearance by landless peasants etc.

Ecologists argue that if clearance continues at recent rates, all of the world's undisturbed rainforest is likely to have disappeared or to be damaged by 2020. This would lead to an irrepairable loss of biological assets. Rainforests contain about 40% of all known species of plants and animals. Clearance of rain forest causes the loss of valuable natural resources including hard wood trees and tree products such as quinine rubber vegetable gums etc.

This loss is just not ecological but also has very significant environmental consequences. The evergreen forest provides various environmental services by helping to regulate global weather patterns, soil erosion, river flooding in the tropics etc. Evidences show that tropical deforestation have lead to the green house effect and global warming by removing an important carbon sink.

INTEXT QUESTION 15.1

1. Answer not more than one sentence.

   (i) What is the latitudinal extent of the tropical evergreen forest in the northern and southern hemisphere.

   ____

   (ii) During which part of the day is most of the rainfall in the tropical evergreen forest occurs.

   ____

   (iii) Name the three levels in which plant species are arranged in tropical evergreen forest biome.

   (a)_____________(b)_______________ (c) _____________

   (iv) Name any three factors responsible for deforestation in tropical evergreen forest.

   (i)_____________(ii)_______________ (iii) _____________

   (v) What are the two major environmental consequences of deforestation in tropical evergreen forest.

   (a) ___________________ (b) ____________________

15.4 TEMPERATE GRASSLAND BIOME

(i) Geographical Background

Temperate grasslands are located in two typical locations i.e. interior of the continent in the northern hemisphere and margin of the continents in the southern hemisphere. Therefore, the temperate grasslands of the southern hemisphere have moderate climate than their counterparts of the northern hemisphere because of more marine influences as they are closer to the coast. The temperate grasslands of the northern hemisphere are characterized by continental climate wherein extremes of summer and winter temperatures are well marked. Though grasslands in the southern hemisphere are located along the coast, these are located in the rain shadow areas of the high coastal mountains. These locations account for scanty rainfall in all these regions.

These grasslands are found in all the continents under different names. In the northern hemisphere, the grasslands are far more extensive. In Eurasia, they are called the steppes and stretch east wards from the shores of the Black sea to the plains of Manchuria in china. In North America, the grasslands are quite extensive and they are called praries. They lie between the foot hills of the Rockies and the Great Lakes. In the southern hemisphere, these grasslands are less extensive. These are known as Pampas in Argentina and Uruguay. In South Africa, these grasslands are sandwitched between Darkensberg mountains and the Kalahari desert and are called veldt. In Australia, these grasslands are known as Downs and are found in the Murrary – Darling basins of South Australia. Since all these grassland are located in the temperate zones, they are also known as temperate grasslands (see figure no. 15.3).

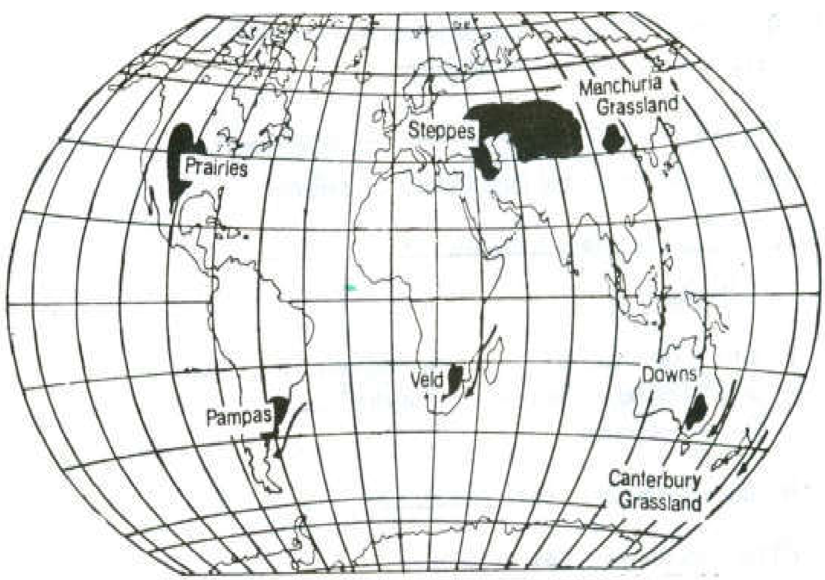


Fig. 15.2 Temperate Grassland Biome

(ii) Natural Vegetation and Animal Life

As the precipitation is too low for the growth of trees but is sufficient for the growth of grass. The natural vegetation of these regions comprises treeless grasslands. Trees appear only on slopes of mountains where precipitation is more. The height of grass varies from place to place according to the amount of precipitation and fertility of the soil. Steppes in particular are known for short and nutritious grass. The appearance of these grasses on these lands varies with the seasons. In springs, the grass beings to appear green, fresh and blooming with small and colourfull flowers. In summers, due to the scorching heat and evapouration, the green grass turns yellow and then brown. Towards autumn, the grass withers and dies, but, the roots remain alive and lie dormant throughout the cold winter season. When spring comes, the whole cycle is repeated.

These grasslands are natural habitat of a variety of animals. Note worthy among them are antelopes, wild asses, horses, wolves, kangaroo, emu, and dingo or wild dog.

(iii) Human Response

No other biomes has ever undergone so many changes as the temperate grassland biomes. This has happened due to the human activities. (i) Majority of the grasslands have been converted into agricultural lands which have now become famous 'granaries of the world' (ii) The second crucial factor responsible for alteration of this virgin grasslands is pastoralism or domesticated of animals. Today virgin grass lands are very rare sight (iii) Large scale hunting of animals has resulted into phenomenal decrease of the population of some animals and disappearance and extinction of some animals. For example many species of animals such as antelope, Zebra, lions, leopards, hayenas have disappeared from the African Veldts by the mass hunting of animals by the European immigrants. (iv) The introduction of new animal and plant species has altogether changed the composition of native vegetation. For example introduction of sheep by the European settlers in Australia have changed the composition of vegetation community which was originally suited to the native marsupial animals. Like this introduction of few leguminous plants in Australian temperate grasslands suppressed several species of native perennial grasses.

INTEXT QUESTION 15.2

1. Fill in the blanks by selecting appropriate words from those given in the bracket:
(granaries, interior, low, more, less)

(a) Mid-latitude grasslands of the northern hemisphere are located in the __________ parts of the continents.

(b) The annual precipitation in mid-latitude grasslands are very ___________.

(c) In the northern hemisphere grasslands are for extensive whereas in the southern hemisphere grass lands are _______ extensive.

(d) Mid-latitude grasslands are known as the _________ of the world.

2. Match the following

Continents	Name of the grasslands
(a) South Africa	(i) Praries
(b) Eurasia	(ii) Pampas
(c) North America	(iii) Veldt
(d) Australia	(iv) Steppes
(e) South America	(v) Downs

15.5 THE ARCTIC TUNDRA BIOME

(i) Geographical Background

This is essentially a cold desert in which atmospheric moisture is scarce and summers are so short and cool that trees are unable to survive. This biome is distributed along the northern edge of the Northern Hemisphere. It covers parts of Alaska, northern parts of Canada, the coastal areas of Greenland and the Arctic Coastal regions of Russia and Northern Siberia (see map No. 15.4).

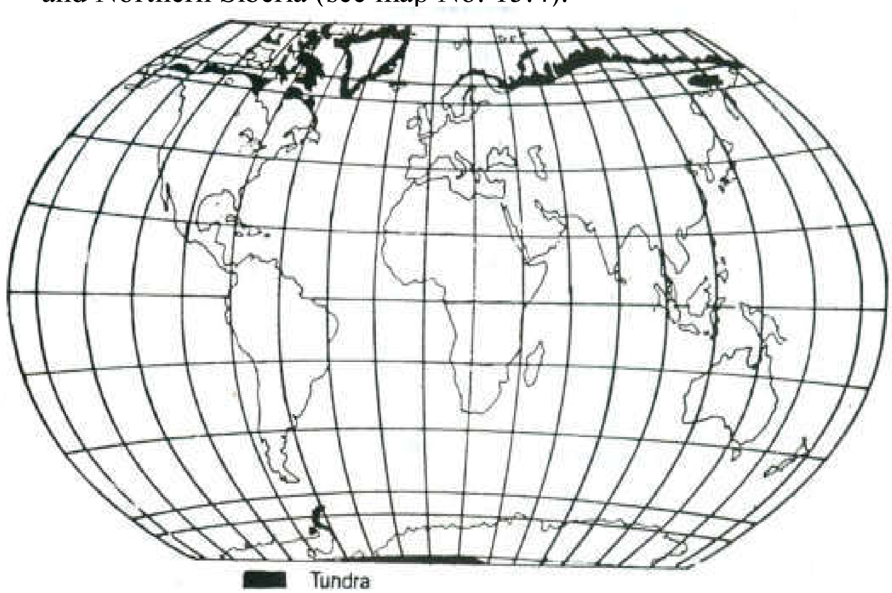


Fig. No. 15.3 Arctic Tundra Biome

(ii) Natural Vegetation and Animal Life

The plant cover consists of a considerable mixture of species. Many of these species are dwarf form such as grasses, mosses, lichens, flowering herbs, and a scattering of low shrubs. These plants often occur in a dense, ground hugging arrangements. The plants complete their annual cycle hastily during the brief summers, when the ground is often moist and waterlogged because of inadequate surface drainage.

The animal of this biome may be categorized as (i) resident and (ii) migrant. Resident animals like ptarmigan can adjust themselves to the changing climatic conditions. The migratory animals, in contrast, begin migrating to the warmer places in the very beginning of winter. Examples are birds such as water fowl, ducks, swans, geese etc. which leave their places of origin in the first half of autumn and return in the following spring or early summer. Mosquitoes, flies and other insects proliferate astoundingly during the short warm season, laying eggs that can survive the bitter winter. Other forms of animal life are scarce – a few species of mammals and freshwater fishes but almost no reptiles or amphibians. Besides, the rein deer, wolves, foxes, musk-ox, artic hare, seal and lemmings also live in this region. Productivity in tundra biome is exceedingly low.

Productivity is defined as the total accumulated amount of energy stored by the autographic primary producers per unit area per unit time is called productivity.

The reasons for low productivity are (i) minimum sunlight and insolation (ii) absence or scarcity of nutrients such as nitrogen and phosphorous in the soils, (iii) poorly developed soils (iv) scarcity of moisture in the soils, (v) permanently frozen ground and (vi) very short growing period.

The tundra comes alive diving the summer thaw, when flowering plants support large populations of mosquitoes and flies, which in turn provide food for large numbers of migratory waterfowl.

(iii) Human Response

The harsh environment supports less population. The tribes of Samoyeds, Lapps, Finns and Yakuts in Eurasian Tundra and Eskimos of Canada and Alaska are some of the original inhabitants of this place and lead nomadic life for centuries. These tribes are now leading permanent or seminomadic life. They have adapted to new technologies. For example, deadly rifles have replaced the traditional and outdated harpoons. Thus the modern Eskimos equipped with modern technologies are now in a position to damage the tundra ecosystem in the same way as is done by already technologically advanced man in other biomes. The Samoyeds and other tribes of the Eurasian Tundra have also adapted new way of life. Some of them are leading permanently settled life. They rear reindeers and fur animals and foods crops mainly wheat in Siberian Tundra. The recent discoveries of minerals such as gold and mineral oil in Alaska, iron ore in Labrador, nickel in Siberia have encouraged the growth of mining settlements and development of transport facilities. But mining activities have also lead to pollution and other environmental problem to this fragile eco-system.

INTEXT QUESTION 15.3

Answer the following questions briefly.

(a) Name any three animals of Tundra region.

(i)________________(ii)_________________(iii)______________

(b) Which are the three important minerals found in these regions.

(i)________________(ii)_________________(iii)______________

(c) Why productivity is low in tundra region. Give any two reasons.

(i)_____________ (ii)_____________

(d) Name any two tribes found in the tundra region.

(i)________________and (ii)_________________

WHAT YOU HAVE LEARNT

The word biome is a short form of biological home. Biome may be defined as a large natural ecosystem wherein we study the total assemblage of plant and animal communities. Here all the biota have minimum common characteristics and all the biomes are characterized by more or less uniform environmental condition. There are various factors which affect the size, location and character of a biome. These factors are length of daylight and darkness, mean temperature, length of growing season, precipitation, windflow, soil types, slope, drainage etc. There are two major bases of classifying biome – on the basis of climate with special emphasis on availability of moisture and on the basis of climate and vegetation.

Three biomes – one from each climatic zone have been selected for detailed study. These are (i) the Evergreen Rainforest biome (ii) the Temperate

Grassland biome and (iii) the Arctic Tundra Biome. The evergreen rainforest biome extends upto 10^0 latitude on both sides of the equator. This area experiences high temperature and heavy rainfall throughout the year. The combination of heat and moisture make this biome as perfect environment for a great variety of plants and animal species. Important plants found in this area are ebony, Mahogany, rosewood, sandal wood etc. Along with plants, there are various types of orchids, term, mosses, herbs are also found at the ground level. These plants are mostly hard-wood trees. Like vegetation, evergreen rainforest is inhabited by numerous birds, mammals, insects etc. both in land as well as in water. The productivity of the tropical rainforest biome is highest of all biome types of the world. Today, human being has also started to damage this biologically rich eco-system through various developmental activities. Due to this, various ecological as well environmental problems have emerged like green house effect and global warming. The temperate grasslands are located in two typical locations – interior of the continents in northern hemisphere and margins of the continent in the southern hemisphere. Both the locations receive scanty rainfall. These grasslands are known by different names in different parts of the world – steppes in Eurasia, prairies in North America, downs in Australia and veldt in South Africa. The natural vegetation of these regions comprises treeless grasslands. Trees appear only on mountain stapes where precipitation is more. These grasslands are inhabited by antelopes, wild asses, horses, wolves, kangaroos, emu and dingo or wild dog. No other biomes has ever undergone so much change than the temperate grassland biomes. This has happened due to various human activities. The Arctic Tundra Biome is essentially a cold desert in which atmospheric moisture is scarce and summers are short and cool. This biome is distributed along the northern edge of the northern hemisphere. The plant and animal species are Few. The plant cover consists of a considerable mixture of species. Many of the species are dwarf forms such as grasses, mosses, lichens, flowering herbs and a scattering of low shrubs. The animals of this biome may be categorized as (i) resident and (ii) migrant. Important species are rindeer, wolves, foxes, musk-ox, artic-hare, seal and lemmings. The harsh environment of this biome supports less population. The tribes of Samoyeds, Lapps, Finns and Yakuts in Eurasia, Eskimos of Canada and Alaska are the original inhabitants of this biome and lead nomadic life for centuries. They inflected damage to Tundra animals through hunting. Now many of these tribes have adopted settled life. The recent discoveries of minerals have encouraged the growth of mining settlements. But mining activities have also lead to pollution and other environmental problems to this fragile eco-system.

TERMINAL QUESTIONS

1. What is a biome? Describe the classification of biomes on the basis of climate and vegetation.

2. Explain the location, climate, natural vegetation and animal life in the evergreen rainforest biome.

3. Describe various factors responsible for the size, location, and character of a biome.

4. "No other biomes has undergone so much changes as the temperate biomes" Justify the statements with suitable arguments.

5. Analyse the role of climate on the plants and animal life in the Tundra region.

ANSWER TO INTEXT QUESTIONS

15.1

1. (i) 10^0 North and South

   (ii) Afternoon

   (iii) (a) Construction of large dams and reservoirs (b) Construction of roads and highways (c) Extraction of timber (d) Clearance for pasture or crops (e) Encroachment and clearance by landless peasants.

   (iv) (a) green house effect (b) global warming.

15.2

1. (a) interior

   (b) low

   (c) more, less

   (d) granaries.

2. a. iii

   b. iv

   c. i

   d. v

   e. ii

15.3

(a) rein deer, wolves, foxes, musk-ox, arctic hare, seal, lemmings (any three)

(b) gold, iron and mineral oil.

(c) (i) minimum sunlight and insolation (ii) absence of nutrients (iii) poorly developed soil (iv) scarcity of moisture in the soils, (v) permanently frozen ground and (vi) very short growing period (any three)

(d) Samoyeds, Lapps, Finns, Yakuts, Eskimos (Any two)

HINTS TO TERMINAL QUESTIONS

1. Refer to section 15.1 and 15.2
2. Refer to section 15.3
3. Refer to section 15.1
4. Refer to section 15.4 (iii)
5. Refer to section 15.5

16

INDIA - PHYSICAL FEATURES

Historically, India is an ancient country, known as *Bharatvarsh*. It is surrounded by the sea on three sides, separated from the rest of Asia by a lofty mountain chain. Hence, it has become an independent entity called the Indian subcontinent. In size, India is the seventh largest country in the world. It is a vast country characterized by great diversity in its physical feature. Therefore, it is necessary to acquire some knowledge about principal physical features. The students should make themselves familiar with the main aspects of its geography, the broad facts regarding the external relief, mountain systems, plateaus, plains, drainage systems, glaciers, volcanoes etc.

OBJECTIVES

After studying this lesson, you will be able to :

- describe the location of India in terms of latitude and longitude;
- describe with the help of a map and a globe, the importance of the location of India in terms of neighbouring countries, continents, hemispheres and the Indian Ocean; compare India with other countries in terms of area;
- describe the main characteristics of major physiographic divisions;
- show the major relief features and rivers of India on an outline map of the country;
- compare the Himalayan rivers with those of the peninsular India;
- conclude that India's rich and diverse culture is the result of its varied physical features;
- explain how different physiographic divisions are economically complementary to each other.

16.1 LOCATION, EXTENT AND BOUNDARIES OF INDIA

A huge landmass of South Asia is flanked by new fold towering mountains on the northwest, north and northeast. The Arabian sea lies to its southwest, the Bay of Bengal to its southeast and the Indian Ocean to its south. This well defined South Asian landmass is called Indian sub-continent. This sub-continent consists of the countries of India, Pakistan, Bangladesh, Nepal and Bhutan including Sri Lanka, an island narrowly separated by the Palk Strait. India alone covers about three fourths of the area of this sub-continent and has common frontier with each one of them. She along with her five neighbours, forms a clearly identifiable geographical unit, with certain common cultural parameters. Since old times, the country has been known by various names such as *Aryavarta, Bharat, Hindustan* and lately India. The Indian Ocean or *Hind Mahasagar* has also been named after India - the only country to be so. According to the Constitution of India, the country is known as Bharat or India.

India lies wholly in the Northern Hemisphere. The Indian mainland extends between 8°4'N to 37°6' N latitudes and from 68°7' E to 97°25' E longitudes. Thus the latitudinal and longitudinal extent of India is of about 29 degrees. It measures about 3,214 km from north to south, and 2,933 km from east to west. Though the latitudinal and longitudinal extent is almost the same, the actual distances do differ considerably. Why is it so? This is because the east-west distance between two successive meridians of longitude along the equator is at its maximum - 111 km. This, however, goes on decreasing as one moves from the equator to the poles, where it is zero. This is because all the meridians of longitude merge in a single point at the poles - both North and South. On the other hand, the north-south distance between any two successive parallels of latitude along any meridian of longitude remains almost uniform, i.e., 111 km. The following table may further clarify this point:

Degrees of Latitude	0	10	20	30	40	50	60	70	80	90
Distance between two successive longitudes in kms.	111	109.6	104.6	96.4	85.4	71.7	55.8	38.2	19.4	0

A glance at the globe should help to convince this point.

The northern most point of the Indian mainland lies in the state of Jammu and Kashmir and the southern most point is Kanyakumari in Tamilnadu. However, the southern most point of the country as a whole lies further south in Andaman and Nicobar Islands. It is now called Indira Point. It is situated at 6°30'N latitude. The westernmost point of India lies in Gujarat and the eastern most in Arunachal Pradesh.

Let us see the impact of such large latitudinal extent upon the lives of the people of India. The northern parts of the country are quite far off from the equator. Therefore, the rays of the sun strike those parts more obliquely. Consequently, this part of the country receives lesser amount of insolation and has cold climate unlike the southern parts. Secondly, the difference between the length of day and right in southern most part of India is much less only about 45 minutes as they are situated near the equator, This difference between day and night in the northern parts of India steadily goes on increasing till it becomes as much as 5 hours.

The Tropic of Cancer passes almost halfway through the country. Thus half of the country to the south of the Tropic of Cancer is situated in the Tropical or Torrid zone and the other half lying north of the Tropic of Cancer falls in the Sub-tropical zone.

The earth takes 24 hours to complete one rotation on its axis. The Sun rises first in the east and then in the west because the earth rotates from west to east. The earth's longitudinal expanse of 360° is thus covered in 24 hours, at the pace of 15° per hour. As the longitudinal extent of India is nearly 29°, the real time difference in India between its eastern and western extremities is roughly of two hours. While at the eastern extremity of India the day may have just broken out, the western extremity would take nearly another two full hours to do so.

To iron out this big chunk of time difference, India, like all other countries of the world, follows the local time of its relatively central meridian as the standard time for the whole country. For the convenience of all, each country chooses its standard meridian in a multiple of 7°30'. Accordingly, the standard meridian of India has been chosen to be 82°30' E.

The north-central part of India is broad while the southern part tapers down towards the Indian Ocean in the south. Thus, the northern part of the Indian Ocean has been divided into two, by the sheer presence of Indian Peninsula. The western part of northern Indian Ocean is called the Arabian Sea while the eastern part is called the Bay of Bengal. The total length of the coastline of India including the island groups is about 7,516.6 km. The Palk Strait separates Indian mainland from Sri Lanka. Structurally, Sri Lanka is an extension of the peninsular block of India.

16.2 SIZE

India accounts for 2.42 per cent of the world's total land area; whereas it sustains 16 per cent of the world population. You will know more about it in lesson No. 26 on population of India. The land frontiers of India measure 15,200 km. Pakistan, Afghanistan, China, Nepal, Myanmar and Bangladesh share common boundaries with India. The kingdom of Bhutan is situated in the Eastern Himalaya. It is a small country and the responsibility of its defence rests with India. Most of our boundary with Pakistan and Bangladesh is almost man-made. There is no mountain range or river to form a natural boundary. The international boundary of India passes through a variety of landforms - barren desert lands, lush green agricultural fields, gushing rivers, snow clad mountains as well as densely forested mountain ranges. The defence of such an international boundary passing through various kinds of terrains is certainly a difficult job. An Indian soldier is, therefore, exposed to various types of extremely hostile conditions on the course of his duty. Sometime, he is posted on the icy cold glaciers. At times he has to bear the wrath of the burning sun and he has to face in the hot sands of the desert. Often he is posted in the marshy, riverine, rainy and thickly forested tracts of the northeast. Our country has to spend crores of rupees daily for the defence of such a long and inhospitable boundary that passes through various kinds of terrain.

- India stands at the head of the Indian Ocean that spans the continents of Asia, Africa and Oceania providing further links to other continents through the Pacific Ocean and the Atlantic Ocean.
- In the Indian subcontinent, India is the only country to share its land frontiers with every member country of the subcontinent.
- In area India is the seventh largest country in the world but in population it stands next only to China.
- The variation in local time between the eastern and western extremities of India is of two hours. This has been minimised to a certain extent by adopting 82°30' E longitude as the Standard Meridian of India for calculating Indian standard time which we follow through our watches.

INTEXT QUESTIONS 16.1

1. Name the countries which share the common land frontiers with India.

   ____

2. Between which latitudes and longitudes is India situated?

   ____.

3. Which is the southern most point of India? Select the correct alternative.

   (a) Kanyakumari (b) Rameshwaram

   (c) Indira Point (d) Kavaratti

4. Which is the Standard Meridian of India? Select the correct alternative.

   (a) 68°7' E (b) 97°25'E (c) 82°30' E (d) 80^0E

5. Broadly by how many hours does the local time of the eastern most point of India differ from that of the westernmost point? ____________________

16.3 PHYSIOGRAPHIC DIVISIONS OF INDIA

India is a land of physical diversities. Almost all types of picturesque and breath taking landforms are found here. According to one estimate, 29.3 per cent of area of India is occupied by mountains and hills, 27.7 per cent by plateaus and 43 per cent by plains.

From a physiographical point of view, India can be divided into following four regions:

1. Great Northern Mountains
2. Great Northern Plains
3. Great Indian Plateau and
4. Coastal Plains and Islands.

Let us know more about these physiographic divisions.

16.4 THE GREAT NORTHERN MOUNTAINS

They include the mountains and plateaus of northern Kashmir, the Himalayas proper and the hills of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya. They are divided into three groups. They are

(i) The Himalayas

(ii) The Trans-Himalayas

(iii) Purvachal or the hills of the North-East.

(i) The Himalayas

This is the highest mountain range of the world. It extends in the shape of an arc for a distance of about 2500 km from west to east along the northern boundary of India between the Indus gorge in Jammu and Kashmir in the west and Brahmputra gorge in Arunachal Pradesh in the east. The breadth of the Himalayas ranges between 400 km in the west to 150 km in the east. The area covered by this mountain system is about 5 lakh square km. It has three major ranges. These ranges are separated by deep valleys and plateaus. The southern slopes of Himalayas facing India are steeper and those facing the Tibetan side are generally gentler. In the east, Himalayas rise almost abruptly from the plains of West Bengal and Assam. That is why two of the highest peaks of Himalayas, Mt. Everest (in Nepal) and Kanchenjunga are not very far from the plains. On the other hand, the western part of Himalayas rises rather gradually from the plains. Hence, the higher peaks in this part are farther from the plains and a number of ranges lie between the plains and high peak. The high peaks of this part such as Nanga Parbat, Nanda Devi and Badrinath are very far from the plains.

Three parallel ranges can be identified in the Himalayas. These are

(a) Himadri,
(b) Himachal and
(c) Siwalik

(a) **Himadri (Greater Himalaya) :** This is the northern most and the highest range of the Himalayas. This is the only range of the Himalaya which maintains its continuity from west to east. The core of this range is made up of granite rocks and flanked by metamorphic and sedimentary rocks. The extent of this range is between the Nanga Parbat peak (8126 m.) in the west and Namcha Barva peak (7756 m.) in the east. The average height of this range from sea level is about 6100 metres. Over 100 peaks have a height of more than the average height of the range. The highest peak of the world, Mount Everest, (8848 m) is situated in this range. Kanchenjunga, Makalu, Dhaulagiri, Annapurna are some of the other peaks having a height of more than 8000 metres. Kanchenjunga is the highest peak of Himalayas in India.

The Himadri range is snow clad throughout the year. There are a number of large and small glaciers. After melting of snow and ice, their water falls in the rivers of northern India making them perennial throughout the year. Gangotri and Yamunotri are good examples of such glaciers.

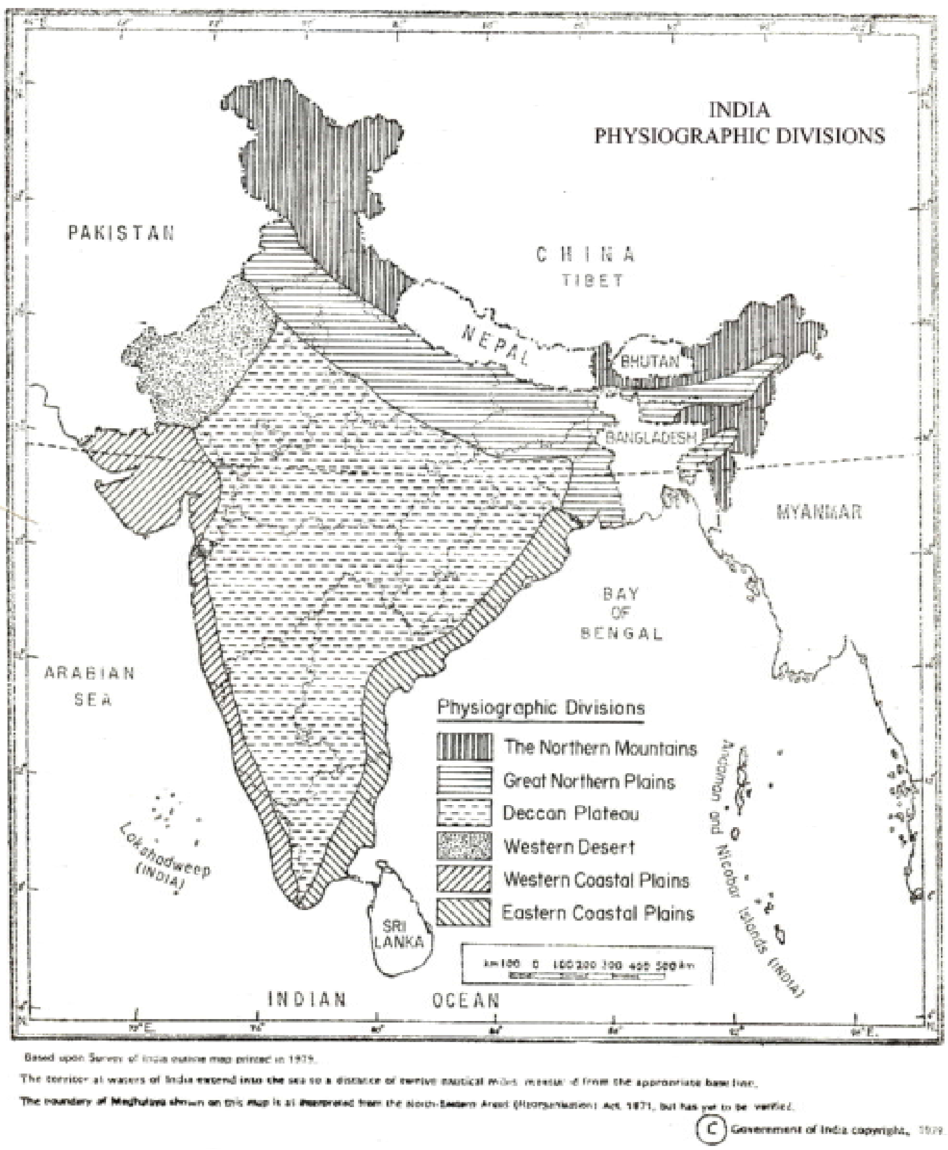


Fig. 16.1 : Physiographic Divisions of India

The Himadri range can be crossed through some passes like Zojila, Shipkila, Niti, Nathula etc.

(b) Himachal (Lesser or Middle Himalaya) : It is located southwards of Himadri. The breadth of Himachal range is 60 to 80 km and the height varies from 1000 metres to 4500 metres. Some of the peaks of this range have a height of more than 5000 metres. This range is highly dissected and uneven. Rocks in this zone have been metamorphosed due to violent thrusts and compression. Therefore, this range mainly consists of metamorphosed rocks. The gentle slopes of the eastern part of this range are covered with dense forests. The south facing slopes of other parts of this range are very steep and generally devoid of any vegetation. The north facing gentle slopes of this range are covered by dense vegetation.

Pir Panjal in Jammu and Kashmir and Dhauladhar in Himachal Pradesh are the local names of this range. The beautiful valley of Kashmir extends between the Pir Panjal and Himadri ranges. The famous valley of Kullu and Kangra are also a part of Himachal ranges.

Most of the hill towns or resort towns are located in the Himachal range. Shimla, Nainital, Mussouri, Almora and Darjeeling are some such famous hill towns. There are a number of beautiful lakes around Nainital.

(c) Siwalik (Outer Himalaya) : The southern most range of Himalayas is known as Siwalik. The Himadri and Himachal ranges of the Himalayas have been formed much before the formation of Siwalik range. The rivers rising in the Himadri and Himachal ranges brought gravel, sand and mud along with them, which was deposited in the rapidly shrinking Tethys Sea. In course of time, the earth movements caused folding of these relatively fresh deposits of sediments, giving rise to the least consolidated Siwalik range. The average height of the Siwalik range is very low, about 600 metres only. There are some broad valleys in between the Himachal and the Siwalik ranges. These valleys are known as 'duns'. Dehradun valley is one of the best examples.

(ii) The Trans-Himalayan ranges

There are some mountain ranges to the north of the Himadri in Jammu and Kashmir. The range extending to the north of the Himadri and running parallel to it is called the Zaskar range. North of Zaskar range is the Ladakh range. The river Indus flows towards northwest between Zaskar and Ladakh range. Many scholars treat Zaskar and Ladakh ranges as parts of the Great Himalayas and include them in Kashmir Himalayas. North of the Ladakh range lie the Karakoram. The name of the Karakoram in Sanskrit literature is Krishnagiri, K2 (8611m) is the highest peak of the Karakoram Mountains. This is the second highest peak of the world, next only to Mt. Everest.

Ladakh plateau is situated in the north eastern part of the state of Jammu and Kashmir. This plateau is a very high and arid. It forms one of the remote areas of our country.

(iii) Purvachal

Purvachal is the name given to all the hills of north east India beyond Brahmaputra gorge. The average height of these hills from sea level is 500 to 3000 metres. These hills are located in Southern Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura and Meghalaya. Mishmi, Patkoi Bum, Naga, Manipur, Mizo(Lushai) and Tripur are the major hilly ranges of this region. Meghalaya Plateau is also part of these hills of the north eastern region. This plateau includes the hills of Garo, Khasi, and Jaintia. Structurally, however, it is a part of Peninsular India.

- The Himadri, the Himachal and the Siwalik are three major ranges of the Himalayas.
- The Zaskar, the Ladakh and the Karakoram along with their eastern extension, Kailash in Tibet are the trans Himalayan ranges.
- Mishmi, Patkoi Bum, Naga, Manipur, Mizo, Tripur etc. are the hill ranges of Purvachal.

INTEXT QUESTIONS 16.2

1. Select the correct alternative.

   (i) Which is the highest mountain peak of the world?
   (a) K^2 (b) Kanchenjunga (c) Mt. Everest (d) Namcha Barva.

   ____

   (ii) Which is the highest peak in India?

   (a) Annapurna (b) Nanga Parbat (c) K^2 (d) Nanda Devi

   ____

2. Name three mountain ranges of the Himalayas

   (1)________________(2)______________(3)__________________

3. Which mountain is referred to as Krishnagiri in Sanskrit literature?

   ____

4. Name the most important Trans-Himalayan mountain range in Jammu & Kashmir along with its eastern extension in Tibet.

   ____

16.5 THE GREAT NORTHERN PLAINS

This plain extends from west to east, between Himalayas in the north and Great Indian Plateau in the south. The plain extends from the arid and semi-arid areas of

Rajasthan in the west to Brahmputra valley in the east. The area of this plain is more than 7 lakh square km. This plain is very fertile and a very sizeable part of the Indian population lives in innumerable villages and several big cities in this region.

This plain is made up of the soils brought down and deposited by the rivers flowing from the Himalayas in the North and the Great Indian plateau in the South. The rivers have been depositing their sediments in this plain over millions of years. Therefore, the alluvium in this plain is quite a few hundred metres deep. In some of the parts, the depth of the sediments is as much as 2000 to 3000 metres.

This plain is almost dead flat. Its average height is 200 metres above the mean se level. Due to a very gentle slope towards the sea, the rivers in this plain flow very leisurely and at times even sluggishly. The slope from Varanasi upto the mouth of Ganga is only 10 cm. per km. The land around Ambala is a bit more elevated. However, it acts as a water divide between the two major river basins - the Satluj in the west and the Ganga in the east. Rivers lying eastwards of this water divide flow into the Bay of Bengal while those west of it flow into the Arabian Sea.

The relatively higher part of the plain is called *bangar*. This area is never covered with flood water of the rivers. Contrary to this, the comparatively lower area is called the *khadar*. This area is flooded by streams almost every year. *Khadar* area is know as bet in Punjab.

There is a strip of plain about 10-15 km broad along the outer slopes of the Siwaliks in Punjab, Haryana and Uttar Pradesh. This region is known as *'bhabar'*. This strip of bhabar is made of gravel and coarse sand. The smaller streams disappear under ground in the 'bhabar' region during the summer season and their water surfaces again after crossing the bhabar. This water accumulates in the strip of plain about 15 to 30 km wide and extends to the south of bhabar. Accumulation of this water makes the land marshy. This marshy land is called the *terai*. Many parts of the terai have been reclaimed, for agricultural purposes.

The great Northern Plain can be divided into four parts: (i) Western plain (ii) North Central plain (iii) Eastern plain and (iv) Brahmputra plain.

(i) **Western Plain :** This region includes the Rajasthan desert and bangar region lying to the west of Aravali ranges. The desert is partly rocky and partly sandy. In the ancient period, the perennial streams - Saraswati and Drishadvati - flowed through this region. This region includes the fertile area of Bikaner. River Luni flows through this bangar region and falls into the Rann of Kutchchh. The famous salt water lake of Sambhar is situated in this part of the plain.

(ii) **North Central Plain:** This plain extends over Punjab, Haryana and Uttar Pradesh. The part of this plain extending into Punjab and Haryana has been formed by the alluvium brought by rivers Satluj, Beas and Ravi. This is a very fertile area. The part of this plain lying in Uttar Pradesh is made up of the deposits laid down, by the rivers like, Ganga, Yamuna, Ramganga, Gomati, Ghagra and Gandak. This part of plain is highly fertile and has been the cradle of Indian civilization and culture.

(iii) **Eastern Plain:** This part of the great plains covers the middle and the lower Ganga valley lying in the states of Bihar and West Bengal. Ganga flows through the middle of this plain in Bihar. Ghagra, Kosi and Gandak join Ganga from the north while Son joins from south. On entering West Bengal the plain widens further extending from the foot hills of the Himalayas upto the Bay of Bengal. The southern part of the plain is delta region. Ganga is divided into several distributaries in the delta region. Hooghly is the best example of a distributary of Ganga. This part of the plain is indeed very fertile and more rainy.

(iv) **Brahmputra Plain:** The northeastern part of the Great Indian Plain extends into Assam. This plain has been formed by deposition of alluvium brought down by river Brahmputra and its tributaries. Brahmputra is highly prone to devastating floods at regular intervals. After the floods, the river generally changes its course. This process has led to the formation of various islands in the river. Majuli (1250 square kilometer) in the Brahmputra river is the world's largest river island. This part is also very fertile. It is surrounded by hills from three sides. Bangladesh is situated on this plain and the delta jointly formed by Ganga and Brahmaputra and their distributaries.

- The great Northern Plains have been formed by alluvium deposits brought by rivers flowing from Himalayas and the Great Indian Plateau.
- This plain is dead flat, with almost negligible slope.
- The plain is of two types bangar and khadar.
- The Great Northern Plain can be divided into four parts - Western Plain, North Central Plain, Eastern Plain and Brahmputra Plain.

INTEXT QUESTIONS 16.3

1. What is the maximum depth of alluvium deposits in the Great Northern Plain?

   ____

2. What is meant by the term 'bangar'?

   ____

3. In which three states does the bhabar region extend?

   (a) ______________(b)______________(c)______________

4. Which two perennial rivers flowed through the Western Plain in ancient times?
   (a) ________________________(b)________________________
5. Name four rivers flowing through the North Central Plain
   (a)____________________________ (b)______________________
   (c)____________________________(d)______________________

16.6 THE GREAT INDIAN PLATEAU

The Great Indian Plateau lies to the South of the Great Northern Plains. This is the largest physiographic division of our country. It covers an area of about 16 lakh square km, i.e., about half of the total area of the country. It is an old rocky plateau region. The topography consists of a series of plateaus and hill ranges interspersed with river valleys. Aravalli hills mark the north-western boundary of the plateau region. Its northern and north-eastern boundary is marked by the northern edge of the Bundelkhand Plateau,Kaimur and Rajmahal Hills. The Western Ghats (Sahyadry) and the Eastern Ghats mark the western and eastern boundaries respectively of this Great Plateau. Most of the area of the plateau has a height of more than 400 metres above sea level. The highest point of plateau region is the Anaimudi peak (2965 m). The general slope of this plateau is towards east.

The Great Plateau is the part of very ancient landmass, called Gondwana land. From the earliest time it has been above the level of the sea. Therefore, it has been subjected to large scale denudation. Its mountains are generally of relic type. They are composed of very hard rocks, which have withstood the ravages of denudation more effectively than the surrounding regions. Because of their old age, all the rivers have almost attained their base level and have built up broad and shallow valleys. The dominant rock formations, especially those in the southern parts, are of metamorphic origin with frequent occurrences of granites.

River Narmada divides the peninsular block of India into two parts. The region lying to the north of the Narmada is called the Central Highlands and the region lying to the south of Narmada is called the penninsular plateau, more commonly referred to as the Deccan Plateau.

A glance at the map would point out that barring Narmada and Tapti all the major rivers lying to the south of the Vindhyas flow eastwards to fall into the Bay of Bengal. The westward flow of Narmada and Tapi is assigned to the fact that they have been flowing through faults or rifts which were probably caused when the Himalayas began to emerge from the Tethys Sea of the olden times.

(i) **The Central Highlands:** It extends between river Narmada and Great Northern Plains. The Aravallis form the west-northwestern edge of the Central Highlands. These hills extend from Gujarat, through Rajasthan to Delhi in the northeasterly direction for a distance of about 700 km. The height of these hills is about 1500 metres in southwest while near Delhi they are hardly 400 metres high. The highest peak of the Aravalli hills is Gurushikhar (1722 m) near Mt. Abu. Mt. Abu on the border of Gujarat and Rajasthan is a beautiful hill station. The region to the east of Aravallis is the highly dissected and uneven. Malwa plateau forms the dominant part of the Central Highlands.

It lies to the southeast of Aravallis and to the north of Vindhyachal Range. River Chambal, Betwa and Ken drain the Malwa Plateau before they join Yamuna. The part of the Central Highlands which extends to the east of Malwa Plateau is known as Bundelkhand and is further followed by Baghelkhand and the well known Chhotanagpur Plateau. Vindhyachal Range forms the southern edge of Malwa Plateau. The Mahadeo Hills, Kaimur Hills and Maikal Range lie towards further east. The slope of Vindhayachal Range towards Narmada valley is absolutely steep and forms escarpments. It only confirms that Narmada flows through a rift valley. This range has very few passes. Due to this fact the Vindhyas acted as a barrier between northern and southern parts of India for a long time in the past.

The valley of Narmada is situated between the Satpuras and the Vindhyas. River Narmada flows from east to west in this valley and falls into the Arabian Sea. This valley has been formed due to the subsidence of the land mass between the Vindhyas and the Satpuras.

(ii) The Peninsular Plateau (Deccan Plateau) : This physiographic division is the largest region of the Great Indian Plateau. The shape of this plateau is triangular. One of the sides of this triangle is marked by the line joining Kanya Kumari with Rajmahal Hills and this line passes through the Eastern Ghats. The second arm is marked by the Satpura Range, Mahadeo Hills, Maikal Range and the Rajmahal Hills. The third arm is marked by the Sahyadris (Western Ghats). The area of this Penninsular Plateau is about 7 lakh square km and the height ranges from 500 to 1000 metres above sea level.

The Sahyadri Range forms the sharp edge of the Penninsular Plateau. Its long escarpments running parallel to the Arabian Sea coast are simply breath taking. Due to its location on the western margin of the Penninsular Plateau, the Sahyadri Range is also called Western Ghats. The word ‘Ghat’ also means a step like mountain. Therefore, this English name of the Sahyadris is meaningful. The height of the Sahyadris increases from north to south. Anaimudi peak (2695 m) situated in Kerala is the highest peak of southern India. Anaimudi is a sort of tri-junction of the Annamalai Range, the Cardamom Hills and the Palani Hills. Kodai Kanal is a beautiful hill resort situated on the Palani Hills.

Eastern Ghats running from southwest to northeast form the eastern edge of the Penninsular Plateau. This range is known as poorvadri also. The Eastern Ghats joins the Sahyadris at the Nilgiri Hills bordering Karnataka and

Tamilnadu. Udagamandalam (Ooty) situated on the Nilgiris is the famous hill station of South India and lies in Tamil Nadu. Once it was the summer resort of the Governor of Madras Presidency. The Eastern Ghats are not continuous like the Sahyadris. Mahanadi, Godavari, Krishna, Pennar and Kaveri rivers have dissected this range at many places.

The plateau region between the Sahyadris and the Eastern Ghats is known by numerous local names in different regions. Telangana which extends in Andhra Pradesh is the name of such a plateau. River Damodar flows through the Chhotanagpur Plateau. The valley of this river is famous for its huge coal deposits. Besides coal, this region is a store house of a number of other minerals.

- The shape of the Great Plateau is triangular.
- It can be divided into two major parts. The Central Higlands and the Peninsular Plateau.
- Aravallis, Vindhyas, Sahyadris, Poorvadris, Annamalai, Cardamom, Palani Mahadeo, Maikal and Satpuras are the major hills of the Great Plateau.
- Chambal, Narmada, Tapi, Mahanadi, Godavari, Krishna and Kaveri are the major rivers of the Great Plateau.

INTEXT QUESTIONS 16.4

1. Select the correct alternative

   (i) Which is the highest peak of southern India?

   (a) Doda Betta (b) Anaimudi (c) Mahabaleshwar (d) Guru Shikhar

   ____

   (ii) Which river flows through a rift valley?

   (a) Narmada (b) Chambal (c) Godavari (d) Pennar

   ____

2. Name two rivers flowing through Malwa plateau.

   (a) ____________________(b)____________________

3. On which hills is Kodaikanal situated?

   ____

4. Name the famous hill station situated on the Aravallis.

   ____

16.7 COASTAL PLAINS

The Great Plateau of India is surrounded by plains on all sides. In the north lies the Great Northern Plain and in south, along the east and west lie the Coastal Plains.

East Coastal Plain extends along the coast of the Bay of Bengal from Ganga Delta in the north to Kanyakumari in the south. This plain is broader than the western coastal Plains. This plain includes the deltas of the rivers Mahanadi, Godavari, Krishna and Kaveri. Chilka, Pulicat and Koluru lakes are the famous lagoons of this plain. These lakes have been formed by enclosing small parts of the Bay of Bengal behind sand bars. Lake Chilka is situated south of the delta of Mahanadi. The lake measures 75 km in length. Lake Pulicut is situated north of Chennai city. Koluru lake is situated between the deltas of the Godavari and Krishna rivers. The east coastal plain is fertile where rice grows in plenty.

West Coastal Plain extends along the Arabian Sea from the Rann of Kutchch in the north to Kanyakumari in the south. Except for the Gujarat plain, the western coastal plains are narrower than the eastern coastal plain. From southern Gujarat upto Mumbai this plain is comparatively broader, but it narrows southwards of Mumbai. Occasionally rocky domes and hills are visible in the plains of Gujarat, the Rann of Kutchch and the plains of Kathiawar. The plains of Gujarat are made up of black soil. The coastal strip extending for about 500 km between Daman in the north and Goa in the south is called Konkan. This region is highly dissected and the coast line is indented or irregular with several natural harbours. A number of small and seasonal rivers flow through this region. The coast from Goa to Mangalore is called the Karnataka coast. The coast from Mangalore upto Kanyakumari is called the Malabar coast. Here the coastal plain is wider. There are a number of long and narrow lagoons. 80 km. long Vembanad is an example of its kind. Kochi port is situated on one of the lagoons.

16.8 INDIAN ISLANDS

There are two small groups of islands. One of these situated in the Bay of Bengal, off the coast of Myanmar is known as the Andaman and Nicobar Islands. The other is known as Lakshadweep and situated in Arabian Sea, off the coast of Kerala. The Andaman Islands consists of (i) North, (ii) Middle, (iii) South and (iv) Little Andaman Islands. Port Blair is the capital city of the entire Union Territory and is located in South Andaman Island. This island group is separated by the Ten Degree Channel. To its south are situated the Nicobar Islands. They include Car Nicobar, Little Nicobar and Great Nicobar Islands from north to south. The southern most point of the Indian Union lies in Great Nicobar Island and has been named after Indira Gandhi. These islands represent a submerged chain of mountains. The Barren Island in the Andamans is India's only active volcano. These islands act as a naval and air outpost of our country in view of its strategic location. This island group faces seven countries - Bangaladesh, Myanmar, Thailand, Malaysia, Singapore, Indonesia and Sri Lanka.

Lakshadweep Islands are situated in the Arabian Sea, off the coast of Kerala. All these islands are of coral origin. They have been built up by corals, the microscopic polyps. All these islands are very small in size. The largest island among these, the Minicoy, has an area of 4.5 square km only. Kavaratti is the capital city of this island group.

- The West Coastal plains extend along the Arabian Sea coast.
- The East Coastal Plains extend along the coast of the Bay of Bengal.
- The East Coastal Plains are broader than the West Coastal Plains.
- Lakshadweep Islands are situated in the Arabian Sea, off the coast of Kerala and the Andaman & Nicobar Islands are situated in the bay of Bengal, off the coast of Myanmar. Their location is highly strategic.

INTEXT QUESTIONS 16.5

1. Which of the coastal plains of India is broader than the other?

   ____

2. Name two lagoons on the Eastern Coastal plain.

   (a) ____________________ (b) ____________________

3. Which lake is situated between the deltas of the Godavari and the Krishna rivers? ____________________________________

4. Name the two places asociated with the northern or southern extremities of the Konkan coast respectively.

   ____

5. Which Indian group of islands is of coral origin? Select the correct alternative. (a) Andaman (b) Nicobar (c) Lakshadweep (d) Barren

   ____

16.9 DRAINAGE SYSTEM

The drainage pattern or system of an area refers to the system of flow of surface water mainly through the rivers and basins forms. The drainage system studies streams and the directions in which they carry the surface water of an area. The drainage system is related to a number of factors, for example slope of land, geological structure, amount of volume of water and velocity of water. The surface run off of India is carried by a number of small and large rivers. The drainage system of country can be studied with reference to two parts Northern India and Southern India.

Notes

(a) Drainage System of North India

Himalayas play an important role in the drainage system of the North India. This is because the rivers of North India have their sources in these mountains and beyond. These rivers differ from those of South India as they are still deepening their valleys rather rapidly. The debris eroded by these rivers are carried to the plains and seas and deposited there. This deposition is caused by the reduced velocity of river waters in the plains and deltas for want of necessary slope.

The Great North Indian plain has been formed by the silt brought down by these rivers. Some of the Himalayan rivers are older than the Himalayas themselves. As the ranges of the Himalayas had been rising upwards, these rivers were equally busy in downward cutting forming deep gorges and valleys. Consequently, parts of the valleys of these rivers are very deep and gorges have been formed. The depth of the Indus gorge near Bunji (Jammu & Kashmir) is 5200 metres. Sutlej and Brahmaputra have also formed such gorges.

The drainage system of Northern India can be further sub-divided into three subsystems Indus System, Ganga System and Brahmaputra System.

The major rivers of Indus basin are the Indus, Jhelum, Chenab, Ravi, Beas and Sutlej. The Ganga basin includes Ramganga, Ghaghra, Gomti, Gandak, Kosi, Yamuna along with its southern tributaries, Son and Damodar rivers. The major rivers of Brahmputra basin are Dibang and Lohit in Arunachal Pradesh and Assam, Tista in Sikkim, West Bengal and Bangladesh and Meghna, draining northeastern part of Bangladesh.

(b) Drainage System of Southern India

The Peninsular India is an ancient landmass. Therefore, the streams flowing through this region are in their old stage. They have almost attained their base level of erosion. Their capacity to erode valleys vertically has almost come to a negligible stage. Now these streams are eroding their sides at a slow pace. This is resulting in broadening of their valleys. Consequently, during flood their waters spread over a large area. It is believed that at the time of Himalayan orogeny, due to the movements associated with the mountain building processes, the Peninsular block had a slight tilt towards east. This is why, barring Narmada and Tapi, all the major rivers of south India flow towards east. Narmada and Tapi, both flow through fault or rift valleys. The major rivers of the drainage system of southern India are Mahanadi, Godavari, Krishna, Pennar, Kaveri and Vaigai.

The slope of the northern part of the southern peninsula is towards north. Consequently, some of the streams originating in the Vindhyas, flow towards north and join Yamuna and Ganga. Among these, Chambal, Ken, Betwa, Sind and Son are more important.

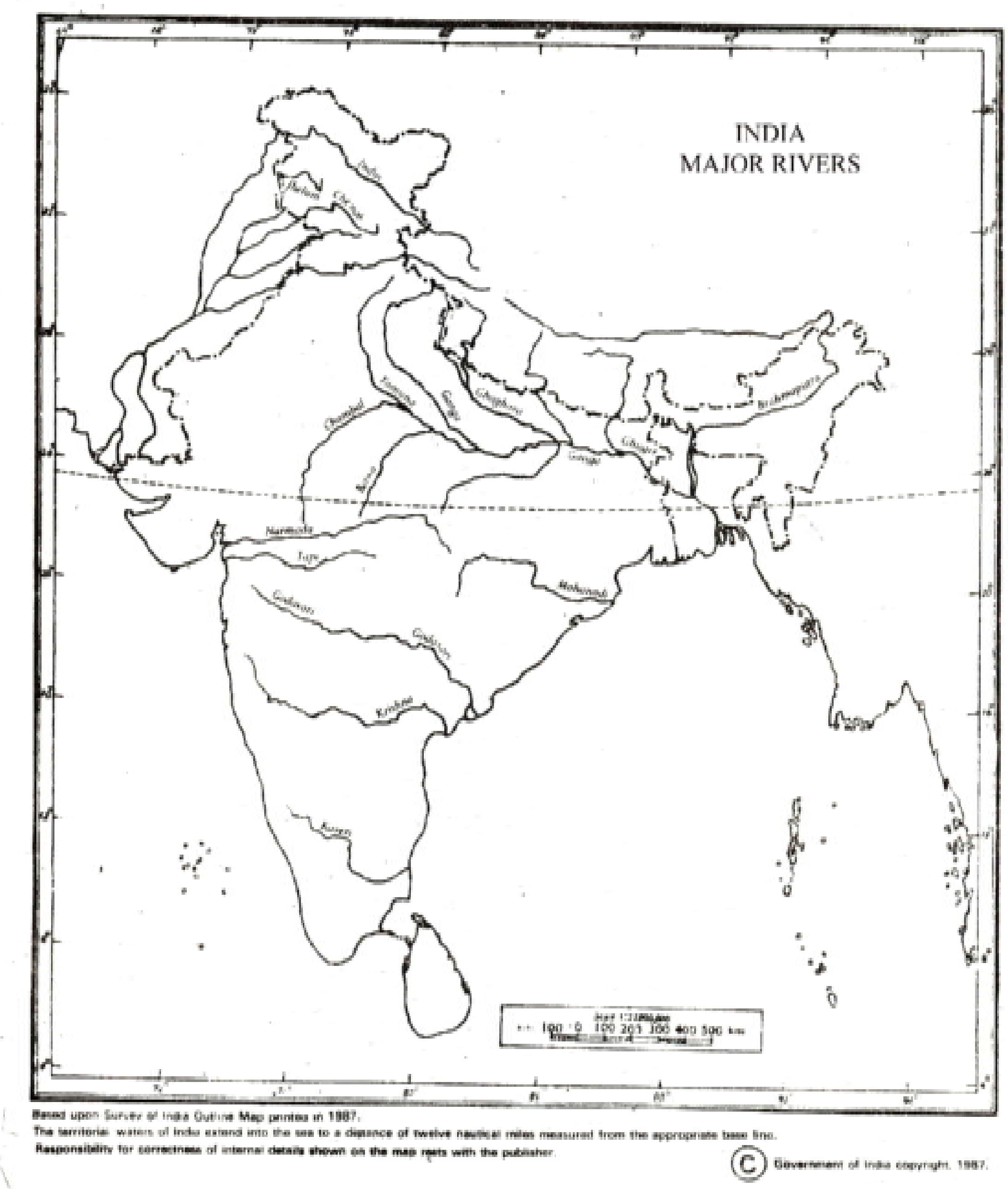


Fig. 16.2: Major Rivers of India

The difference between the Himalayan rivers and Peninsular rivers

The rivers which have their origin in the Himalayas are perennial. These rivers are fed by the melting of ice and snow lying near the tongue of glaciers of the Great Himalayan Range (Himadri).

In the rivers of South India, the flow of water is highly fluctuating. While the rivers are in spate during the monsoons, they are almost dry during the long rainless months. Some of these rivers at many places become totally dry.

16.10 DIVERSITY AND COMPLEMENTARITY OF PHYSIOGRAPHIC DIVISIONS

India possesses a wide variety of landforms and relief features. Its young fold mountains of the north have very bold and sharp features. They include very long as well as tall mountain ranges, towering mountain peaks, high mountain passes and precipitous river valleys. If in one direction lie very steep slopes, on the other there are gentle slopes. If some parts are without thick forests, the others are clad with varied natural vegetation - from tropical rain forests to Alpine grasslands. They rightly boast of large snowfields, glaciers, picturesque water falls along the hanging valleys and glacial lakes like the Dal in Srinagar. The youthful Himalayan rivers prefer to jump, leap and hop forming water falls, rapids and cascades on their way. Equally awe-inspiring are its deep gorges establishing balance between steadily rising mountian ranges on the one hand and silent down cutting action of weighty trans Himalayan rivers like the Indus, Sutlej and Brahamaputra on the other. Not even a handful of countries can boast of such a magestic and maddening beauty of youthful fold mountains. These highest and largest mountain chains of the world have enabled Indian subcontinent to develop its unique culture by acting itself as a physical barrier between the subcontinent and the rest of Asia. Perhaps even more effective is its role as a climatic divide. This physiographic division acts as a store house of snow and water, giving rise to hundreds of perennial rivers to drain and irrigate one of the world's largest and most fertile plains. In fact the plains themselves are a gift of these mountains and rivers flowing from them. It is also a store house of hydel power, fuel wood, timber, various forest products and medicinal herbs, no excluding some strange wildlife species. No wonder, if this region is able to attract tourists from far and near, both in summer and winter.

The Northern Plains are matchless in expanse. These flat or dead level plains are mostly well drained and fairly well irrigated through the use of surface and ground water. The meandering rivers, ox-bow lakes, braided river channels and a maze of distributaries help to break the monotony of these extremely level plains. Once a forest land, it has now been brought under the plough almost fully. The lower parts of the deltas are ribbonned with mangrove or tidal forests. These well watered plains, supported by highly fertile soils, produce varied crops year after year sustaining a very large chunk of the world's population. They have also been supporting equally large bovine population. They are one of the world's largest food baskets producing cereals, pulses, oil seeds, vegetables, fruits besides industrial or cash crops like cotton, jute, sugarcane and the like.

In sharp contrast with the Northern Mountains and Plains stand the hills of moderate attitude and a highly denuded rocky landscape, representing one of the oldest landmasses of the world - the peninsular block of India. Its rounded hills and flat topped ridges have a beauty of their own. The varied metamorphic and old granite rocks have given rise to hills, plateaus and foliated rocks. Further more, the basalt or Deccan Trap of Western India has its typical flat topped hills and ghat or stairlike structures. Its steep wall-like escarpments run for miles and miles without interruption overlooking the Arabian Sea. Their beauty need to be seen and to be believed. This physiographic division is known for millets and various industrial crops such as cotton, sugarcane, coffee and groundnut. More importantly, it is a store house of minerals - specially the ferrous ones and mineral fuels like coal and atomic or radio-active minerals. They have also sizeable hydel power resources. They, thus, provide a sound base to develop both agro-based and mineral-based industries.

The coastal strips are ribonned with a coastline which is partly regular and partly indented. The latter has provided spacious natural harbours like Mumbai and Marmagao. The coastal strips and island groups have ideal conditions to tap deep and shallow water fisheries. The coastal plains in the east have very fertile deltas providing rice-bowls. If it is a coast of emergence in the eastern coast then the major part of the western coast is that of submergence. The plains are rocky and highly eroded. Rice, coconuts, rubber, tobacco and spices are some of the agricultural produce. Off-shore oil and natural gas fields have also been located. If the Lakshadweep are of coral origin, the Andaman and Nicobar Islands are the peaks of emerging mountain chain. These islands are of great strategic significance to the defence of the mainland. They face seven different countries across the seas washing their shores - Bangladesh, Myanmar, Thailand, Malaysia, Singapore, Indonesia and Sri Lanka. The islands are known for fishing, forestry and tourism.

This is how the great diversity of macro and micro relief features and land forms has contributed to enrich our culture, enhanced agricultural potential to grow almost every crop, lay strong foundations of modern industry making all its physiographic divisions totally inter dependent on one another.

INTEXT QUESTION 16.6

1. Name any two factors, which influence the drainage system.

   (a) ______________________ (b) ______________________

2. Fill in the blanks with appropriate words out of those given in the brackets:

   (i) Surface run off from Indian territory flows into the __________ in the west and the ___________ in the east. (Indian ocean, Bay of Bengal, Persian Gulf, Arabian Sea)

   (ii) The two major west flowing rivers of South India are___________ and ___________ (Mahanadi, Kaveri, Narmada, Tapi)

3. Name three rivers of the Great Plateau which flow towards north.

   (a)_______________ (b)__________________(c)________________

4. How deep is the gorge of the Indus river near Bunji?

   ____

WHAT YOU HAVE LEARNT

The Indian subcontinent, flanked by the towering mountains in the north and girdled by the seas and the ocean in the south stands distinct from the rest of Asia. This explains why the subcontinent has been able to develop a distinctive culture of its own. India occupies a dominant position in the subcontinent as it alone claims three fourths of the total population. Also it has fairly long common frontiers with each member of the subcontinent.

Being located at the head of the Indian Ocean it is in a very good position to promote trade with the continents of Asia, Africa and Australia. The construction of Suez Canal has brought Europe and North America in its easy reach. India is only at a relatively short distance from the oil-rich countries surrounding the Persian Gulf.

The latitudinal extent of the country implies marked variations in the climate of the northern and southern parts of the country. The longitudinal extents is responsible for a time lag of almost two hours between its eastern and western extremities. This, however, has been minimised by adopting $82^0 30'$ E longitude as the standard meridian of India whose local time is taken to be the standard time for the entire country.

In terms of area, India stands seventh in the world but in population it ranks second next only to China. It means there is tremendous population pressure on our limited land and water resources.

The physiographic divisions of India are very bold and highly contrasting. In fact, each one of them can be presented as an ideal example of its kind - be it a mountain; a plateau or a plain. Besides adding to the diversity they also stress economic complementarity. They make all these macro regions entirely interdependent on one another, making the whole country a single economic and political entity benefiting each and every part - big or small.

TERMINAL QUESTIONS

1. Give a brief account of the Himadri Range under the following headings.

   (a) Location (b) Their average height and length (c) A few major peaks (d) Few prominent glaciers and (e) Major passes - one each from Jammu & Kashmir, Himachal Pradesh and Sikkim.

2. Differentiate between:

   (a) Eastern coastal plains and western coastal plains.

   (b) Western ghat and Eastern ghat.

   (c) The Himalayan rivers and peninsular rivers.

3. Divide the Great Plateau into two physiographic divisions and describe briefly the Central High Lands under the following heading - (a) Aravalli Hills (b) Malwa plateau and its eastern extensions (c) Vindhyachal Range
4. Write a brief description of Northern Plains, a sub-division of Great Northern Plains of India; under the following headings. (a) Location and extent (b) Major rivers.
5. Define the following - (a) Standard Meridian of India (b) Rift Valley (c) Drainage System.
6. Locate the following in two separate outline maps of India.

   Map I - (a) Himalayas, Karakoram, Zaskar Range, Ladakh Range, Mizo Hills, Sahyadry, Satpura and Vindhyachal Range.

   Map II - (b) Satluj, Ganga, Brahmaputra, Yamuna, Chambal, Mahanadi, Godavari, Krishna, Kaveri, Narmada and Tapi rivers.

ANSWERS TO INTEXT QUESTIONS

16.1

1. Pakistan, Afghanistan, China, Nepal, Myanmar, Bangladesh and Bhutan
2. 8°4' and 37°6' N. Lat., 68°7' and 97°25' E Long.
3. (C)
4. (c) 82°30'
5. About two hours

16.2

1.1 (i) (c)
(ii) (c)

2. (1) Himadri (2) Himachal (3) Siwalik
3. Karakoram
4. Karakoram

16.3

1. 2000 to 3000 metres
2. Comparatively higher part of the plain.
3. (a) Punjab (b) Haryana (c) Uttar Pradesh
4. (a) Saraswati (b) Drishadvati
5. Yamuna, Ganga, Gomati, Ghagara, Gandak, Ramganga (Any four).

16.4

1. (i) (b)
(ii) (a)

2. Chambal, Betwa, Parbati, Kali, Sindh (Any two).
3. Palani Hills
4. Mt. Abu (Peak is Gurushikhar)

16.5

1. The East Coastal Plain
2. (a) Chilka (b) Pulicat
3. Kolleru
4. Daman (North) and Goa (South)
5. (c)

16.6

1. Slope of land, geological structure, amount of water and velocity of water (Any two)
2. (i) Arabian Sea; Bay of Bengal
   (ii) Narmada and Tapi
3. Chambal, Parbati, Sind, Betwa, Ken, Son (Any three).
4. 5200 metres.

HINTS TO TERMINAL QUESTIONS

1. Refer to the description of Himadri Range in 16.4
2.

(a)	East coastal plain	West coastal plain
	1. Extend along the coast of Bay of Bengal	Extend along the coast of Arabian Sea
	2. Comparatively broad	Comparatively narrow
	3. There are deltas here	No deltas of rivers.
(b)	Sahyadry (Pashchimi Ghat)	Poorvi Ghat
	1. Continuous range	Broken by a number of rivers draining into the Bay of Bengal
	2. Comparatively high	Low height
	3. Beautiful hill towns	No hill towns
(c)	Himalayan Rivers	Rivers of Peninsular India
	1. Perennial	Seasonal
	2. Origin from glaciers	Origin from springs

3. Refer to the description of Central High Lands given in 16.6
4. Standard Meridian 82°30' E ; The local time of the standard meridian is considered to be the standard time for the whole country.
6. Rift valley: A valley which has been formed by the sinking of land between roughly parallel faults is called a rift valley.

   Drainage System: The drainage system refers to the system of flow of surface water or runoff in that area. Thus the drainage system studies the streams and the directions in which they carry the surface water of an area.
7. Refer to the maps given at the end of this lesson showing physical features and location of rivers.

17

CLIMATE OF INDIA

In the previous lesson, we have noted the shape and size of our country along with its latitudinal extent. Not only its physiographic divisions are diverse but also far more contrasting in nature. Each one of these factors has an impact on climatic conditions of India, be it temperature, atmospheric pressure, wind system or precipitation.

In this lesson, we will study regional variations in the climatic conditions of India. A search will be made to identify a series of factors responsible for these climatic variations both over space and time. A cycle of seasons would also merit our attention. As our climate is labelled "a monsoon type of climate" we would study the basic concept of monsoons and their typical charateristics. Since, in our country, the climatic variations depends more on rainfall rather than temperature, we would devote some time to study distribution of rainfall.

OBJECTIVES

After studying this lesson, you will be able to:

- explain with suitable examples the climatic variations in India (both seasonal and spatial);
- name various factors which influence the climate of different parts of India;
- explain the concept of monsoon and the way it is caused;
- discuss the typical characteristics of monsoons;
- state the climatic conditions during different seasons;

17.1 CLIMATIC VARIATIONS IN INDIA

You have studied the shape, size, location and latitudinal extent of India. You have also noted the sharply contrasting relief features of India. This has created regional diversities in climatic conditions. The climatic conditions of southern India are a bit different from those of the northern parts with respect to temperature, rainfall and commencement as well as duration of different seasons.

Now, let us have a closer look at these climatic variations. During June, the north western plains experience high temperature around 45°C when areas of Rajasthan desert record day temperatures around 55°C, while the temperatures around Gulmarg or Pahalgam in Kashmir are hardly around 20°C. Similarly, in the month of December, the people of Kargil or Dras(in Jammu & Kashmir) experience biting cold because the night temperatures drop to -40°C, while the inhabitants of Thiruvananthapuram experience temperatures around 27° C (Table 17.1)

The range of temperature increases as one moves away from coastal areas to interior parts of the country. As a result, the people living along Konkan and Malabar coasts do not experience extremes of temperatures or marked change in seasons. On the other hand, people living in north western parts of India, experience sharp seasonal contrasts.

The diversity in rainfall distribution is equally striking. Mausimram, near Cherrapunji in Meghalaya, receives about 1080 cm of rainfall annually, while Jaisalmer in the desert of Rajasthan receives only 20 cm of annual rainfall. The northeastern parts and the coastal plains of Orissa and West Bengal experience spells of heavy rain during July and August while the Coromondel coast of Tamilnadu receive very meager rain during these months (Table 17.1)

Have a close look at Figure17.1 and 17.2 which show the dates of onset and withdrawal of Southwest monsoons respectively. This will help you to understand the difference in the duration of rainy season in different parts of India. You will come to the conclusion that the duration of rainy season is the shortest in North-west India and longest in the South and North eastern parts of the country.

- The shape, size, location, latitudinal extent of the country and its contrasting relief have resulted in diverse climatic conditions in different parts of India.
- Climatic diversity is reflected in regional variations in temperature, amount of rainfall and commencement as well as duration of seasons.

INTEXT QUESTIONS 17.1

1. Name two places in India - one experiencing the highest and the other the lowest temperatures.

   (a) ______________________(b) ______________________

2. Study the Table 17.1 and answer the following questions:

   (i) Name the station which has the most equable climate.

   (ii) Which station has the highest range of temperature ?

   (iii) Which station has the highest temperature in

(a) February (b) April

(c) June (d) August

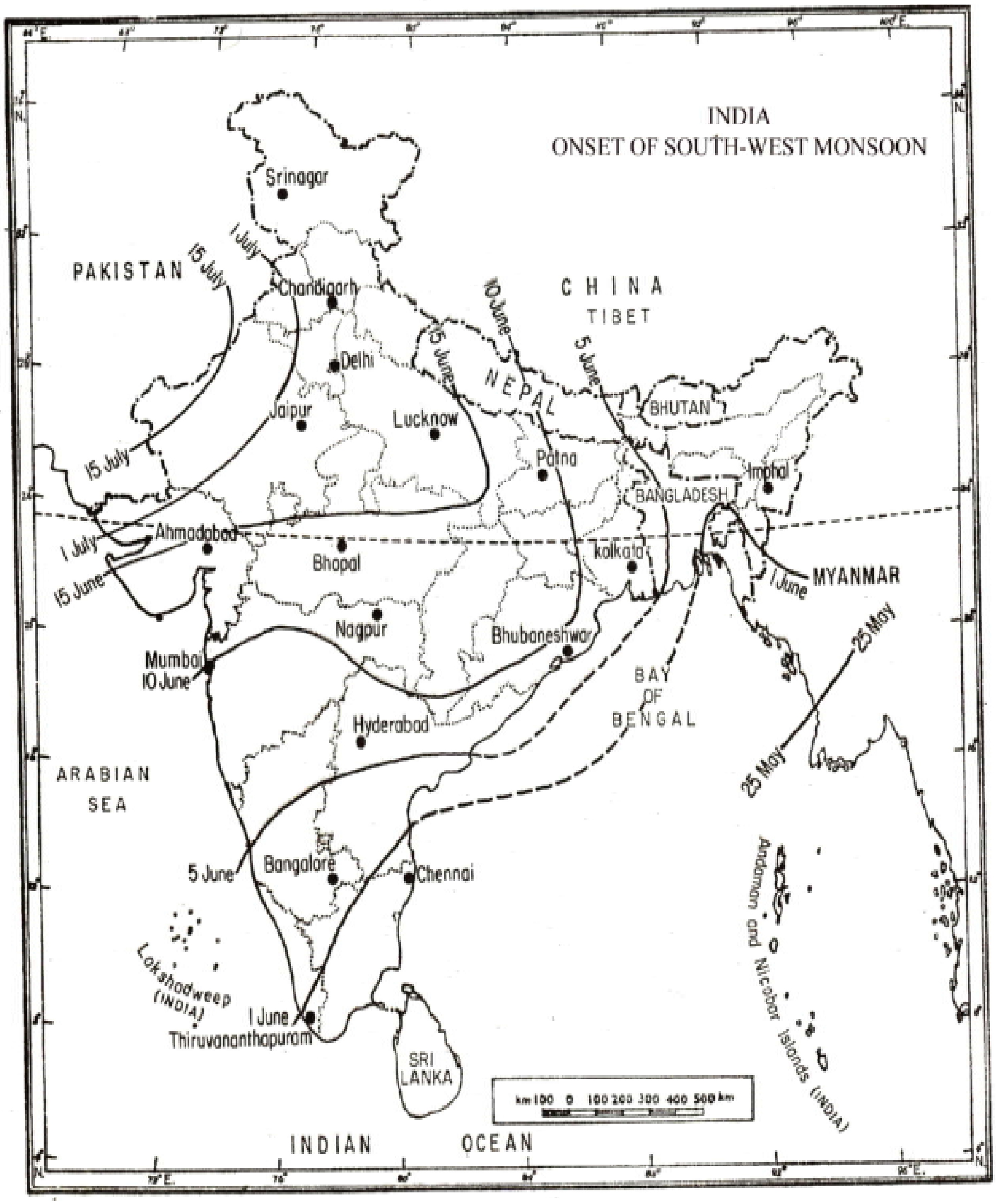
(iv) Name the four most rainy months in India.

(a) __________ (b) __________ (c) __________ (d) __________

(v) Name a place in India which has the lowest rainfall.

Table 17.1: Mean Monthly Temperature and Rainfall in Major Meteriological Centres in India
T=Temperature (in Celsius) and P=Precipitation (in mm)

Station	T/P	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.
Leh	T.	-8	-7	-1	9	10	14	17	17	12	6	0	-6
	P.	10	8	8	5	5	5	13	13	8	5	0	5
Shilong	T.	10	11	16	19	19	21	21	21	20	17	13	10
	P.	14	29	56	146	295	476	359	343	302	188	36	10
Kolkata	T.	20	22	27	30	30	30	29	29	29	28	24	20
	P.	12	28	34	51	134	290	331	334	253	129	27	4
Delhi	T.	14	17	23	29	34	35	31	30	29	21	20	15
	P.	21	24	13	10	10	68	186	170	125	14	2	9
Jodhpur	T.	17	19	25	30	34	34	31	29	29	27	22	18
	P.	5	6	3	3	10	31	108	131	57	3	2	2
Mumbai	T.	24	24	24	28	30	29	27	27	27	28	27	25
	P.	4	2	2	2	18	465	613	329	286	65	18	2
Mahaba-	T.	19	20	23	25	24	19	18	18	18	20	20	19
leshwar	P.	5	4	5	25	27	440	2546	1764	686	154	47	5
Pune	T.	21	23	26	29	30	28	25	25	25	26	23	21
	P.	3	1	2	14	27	107	169	97	130	76	31	4
Nagpur	T.	22	24	28	33	35	32	28	27	28	27	23	21
	P.	11	23	17	16	21	222	376	286	185	55	20	10
Banglore	T.	22	23	26	27	27	25	23	23	23	23	19	20
	P.	9	7	11	45	107	71	111	137	164	53	61	13
Chennai	T.	25	26	28	31	33	33	31	31	30.	28	26	25
	P.	4	13	13	18	38	45	87	113	119	306	350	135
Thiruvana-	T.	27	27	28	29	29	27	26	26	27	27	27	27
nthapurarn	P.	23	21	39	106	208	356	223	146	138	273	206	75

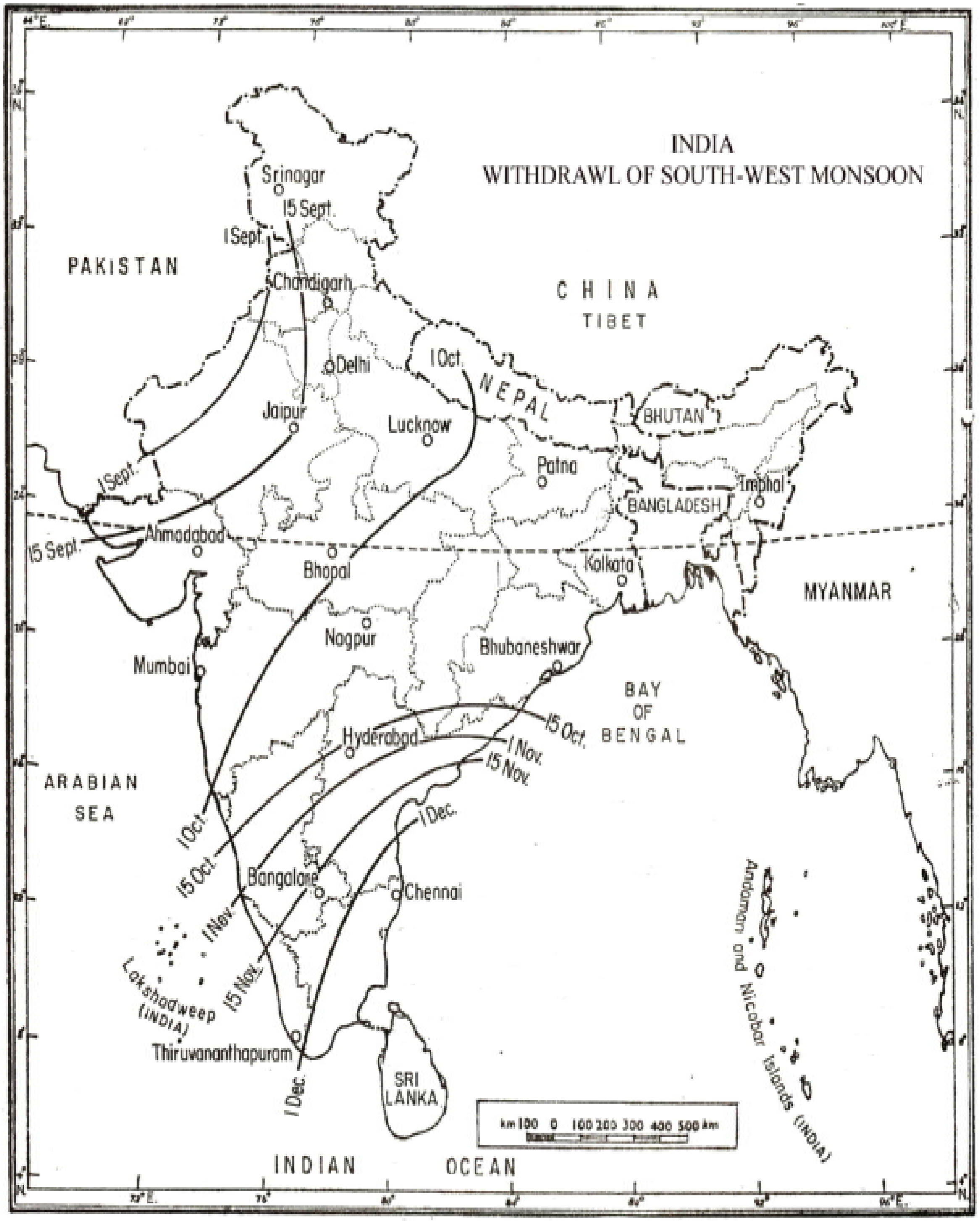


Based upon Survey of India outline map printed in 1979.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified.

Fig. 17.1 Onset of Southwest Monsoon



Based upon Survey of India outline map printed in 1979.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified.

Fig. 17.2 : INDIA : Withdrawl of Southwest Monsoon

17.2 FACTORS INFLUENCING THE CLIMATE OF INDIA

The factors influencing the climate of India are given below:

(i) Location and Latitudinal Extent

India lies roughly between 6°N to 37°N latitudes. The Tropic of Cancer passes through the middle of the country. The southern parts being closer to the Equator, experience high temperatures throughout the year. The northern parts on the other hand lie in the warm temperate zone. Hence they experience low temperatures particularly, in winter. Water bodies surrounding peninsular India make climatic conditions mild along the coastal areas.

(ii) Distance from the Sea

Southern or peninsular India is surrounded by the Arabian Sea, the Indian ocean and the Bay of Bengal, hence the climate of coastal regions of India is equable or maritime. Contrary to this, the climate of the regions located in the interior of the country are cut off from the oceanic influence. As a result, they have an extreme or continental type of climate.

(iii) The Northern Mountain Ranges

The Himalayan and adjoining mountain ranges which extend from Kashmir in the Northwest to Arunachal Pradesh in the Northeast, separate India from the rest of Asia. These ranges protect India from the bitterly cold and dry winds of Central Asia during winter. Further more, they act as an effective physical barrier for the rain bearing southwest monsoons winds to cross the northern frontiers of India. Thus, these ranges act as a climatic divide between Indian Sub-Continent and Central Asia.

(iv) Physiography

The physical features influence the air temperature, atmospheric pressure, direction of winds and the amount of rainfall in different parts of the country. Study the map showing physical features given in the earlier lesson and find out yourself, the relationship between the relief, temperatures, direction of winds and amount of rainfall with the help of climatic maps given in this lesson. This will help you to understand why western ,coastal plains receive more rainfall than the interior parts of Karnataka and Tamil Nadu lying east side of the Western Ghats. You will also understand why Bay of Bengal branch of Southwest monsoon is bifurcated into two parts - one moving along the Ganga Valley to the west and the other along the Brahmaputra Valley to the east. Locate on your Atlas the funnel-shaped Cherrapunji Valley and Mausimram nearby along the steep southern edge of the Meghalaya Plateau. This would give you a clue why Mausimram happens to be the rainiest spot in the world.

(v) Monsoon Winds

The complete reversal in the direction of winds over India brings about a sudden change in seasons - the harsh summer season suddenly giving way to the eagerly awaited monsoon or rainy season. These winds which change their direction completely are called monsoon winds. The word 'monsoon' is derived from the Arabic word 'Mousim' which means 'season'. These winds have such a far reaching influence on India's climate that it is termed as 'monsoon type of climate'. The nature of these winds can be described with reference to the surface distribution of pressure in different regions of India during winter and summer seasons.

(a) **The Northeast Monsoon and its Effect:** During winter, the weather conditions is influenced by high pressure developed over Northwestern part of the subcontinent. This results in the blowing of cold dry winds from this regions towards southern low pressure areas lying over water bodies surrounding peninsular India. Since these winds are cold and dry, they do not cause rainfall and weather conditions under their influence remain cold and dry. However; wherever these Northeast monsoon winds collect moisture while passing over the Bay of Bengal, they bring rain along Coromandel coast. Strictly speaking these winds are planetary winds known as Northeast Trades. In India they are essentially land bearing winds.

(b) **The Southwest Monsoon and its Effect :** During summer, the northwestern parts of India become very hot due to very high temperature. This is ascribed to the apparent shift of the sun in northern hemisphere. This results in the reversal of air pressure conditions not only in northwestern India but also on water bodies surrounding the peninsular. As a result, Northeast Trade winds are replaced by Southwest monsoon winds. Since these winds are sea bearing and blow over warm water bodies before reaching land, they are moisture laden, causing wide spread rain over the most parts of India. This period of southwest monsoon from June to September, is known as the rainy season for most parts of the country.

(vi) Upper Air Circulation

The changes in the upper air circulation over Indian landmass is yet another cause for sudden outbreak of monsoons in India. Jet streams in the upper air system influence the climate of India in the following ways:

(a) **Westerly Jet stream and its Impact:** During Winter, at about 8 km. above sea level, a westerly jet stream blows at a very high speed over the subtropical zone. This jet stream is bifurcated by the Himalayan ranges. The northern branch of this jet stream blows along the northern edge of this barrier. The southern branch blows eastwards south of the Himalayan ranges along 25° N latitude. It is believed by meteorologists that this branch of jet stream exercises a significant influence on the winter weather conditions over India. This jet stream is responsible for bringing western disturbances from the Mediterranean region into Indian sub-continent. Winter rain and hail storms in northwestern plains and occasional heavy snowfall in hilly regions are caused by these disturbances. These are generally followed by cold waves in whole of northern plains.

(b) **Easterly Jet and its Influence:** During summer, due to the apparent shift of the sun in northern hemisphere, the reversal in upper air circulation takes place. The westerly stream is replaced by easterly jet stream which owes its origin to the heating of the Tibetan plateau. This leads to the development of an easterly cold jet stream centered around 15°N latitude and blowing over peninsular India. This helps in the sudden onset of monsoons.

(vii) Western Disturbances and Tropical Cyclones

The inflow of western disturbances moves under the influence of westerly jet streams from the Mediterranean Sea. It influences winter weather conditions over most parts of Northern Plains and Western Himalayan region. It brings little rain in winter months. This rain is considered to be very good for wheat crops in northern plains.

The tropical cyclones also develop in the Bay of Bengal. The frequency and direction of these cyclones influence weather conditions along the eastern coast during October, November and December.

(viii) El - Nino Effect

Weather conditions in India are also influenced by EI-Nino which causes wide spread floods and droughts in tropical regions of the world. El-Nino is a narrow warm current which sometimes appears off the coast of Peru in South America. It is a temporary replacement of the cold Peru current which normally flows along this coast. Sometimes, becoming more intense, it increases the surface water temperatures of the sea by 10° C. This warming of tropical Pacific waters affects the global pattern of pressure and wind systems including the monsoon winds in the Indian Ocean. It is believed that the severest drought of 1987 over India was caused by EI-Nino.

(ix) Southern Oscillation and its Effect

The southern oscillation is a pattern of meteorological changes which are often observed between Indian and Pacific oceans. It has been noticed that whenever the surface level pressure is high over Indian ocean, it is low over Pacific Ocean and vice-versa. When the pressure is high over the Pacific Ocean and low over Indian Ocean, the Southwest monsoons' in India tend to be weaker. In the reverse case, the monsoons are most likely to be stronger.

- The factors affecting the climate of India are: location and latitudinal extent, distance from the sea, the northern mountain ranges, physiography, monsoon winds, upper air circulation, western disturbances and tropical cyclones, formation of El-Nino and southern oscillation.

INTEXT QUESTIONS 17.2

1. Name the mountain range which acts as a climatic divide for the entire Indian subcontinent

2. Why is the climate of Mumbai equable and than of Delhi?

3. Name the Jet Stream which brings Western disturbances in India.

4. Why do Northeast Monsoons cause no rainfall in most parts of India ?

5. Why does reversal of winds take place in India before the onset of southwest monsoons?

17.3 THE CONCEPT AND MECHANISM OF MONSOON

Monsoons refer to a system of winds in the tropical regions under which the direction of winds is reversed completely between the summer and the winter seasons. Under this system, the winds blow from land to sea in winter and from sea to land in summer. Therefore, most of the rainfall in the regions influenced by the monsoons is received in the summer season while winter season is generally dry.

- Monsoon implies the system of tropical winds with complete reversal in their direction between winter and summer seasons.

According to the traditional belief, the monsoon is caused by the differential heating of land and sea. Due to a higher temperature over the land in summer, a low pressure area develops over the continents and the winds blow from neighbouring oceans towards the land. These winds are of maritime origin and hence cause ample rainfall in summer. On the other hand, the continents become colder than the neighboring oceans in winter. As a result a high pressure area is developed over the continents. Therefore, winds blow from land to sea in winter. These winds, being of continental origin, are dry and do not cause rain. This traditional theory of monsoon has been criticized by the German meteorologist Flohn. He argues that the differential heating of land and sea is not enough to cause a seasonal reversal of winds at a global scale. He has explained the origin of the monsoon on the basis of seasonal shift of the pressure and wind belts under the influence of the shift of the vertical rays of the sun.

According to this theory, as the vertical rays of the sun shift northwards over the Tropic of Cancer in summer season, the Inter-Tropical Convergence Zone(ITCZ) also shifts to north. This results in the formation of a low pressure area over the northwestern parts of India. This low pressure is further intensified by the high temperatures in this region. This low pressure area sucks the air from the Indian Ocean towards the Indian landmass in the form of Southwest monsoons. In winter season, the ITCZ shifts southwards and a mild high pressure is produced over northern parts of India. This high pressure is further intensified by the equator ward shift of the sub tropical high pressure belt. Due to high pressure over northern India, the winds start blowing from northeast as retreating monsoons. According to recent observations, the origin of Indian monsoon is influenced by a number of other factors, besides the differential heating of land and sea and the seasonal shifts of pressure and wind belts. One of the most important factors among these is the system of subtropical westerly and tropical easterly jet streams. The subtropical westerly jet streams blowing over India in winter cause a high pressure over northern India. It thus intensifies the northeast monsoons. This jet stream shifts northwards beyond India in summer season and tropical easterly jets develop over India in this season. The behaviour of this jet streams is partly responsible for the variations in the time of onset of southwest monsoons over India.

- According to the traditional belief, monsoon is caused by the differential heating and cooling of land and sea.
- Flohn, a German meteorologist opined that monsoon originates due to the shifting of planetary pressure and wind belts,
- According to modern scientists, the origin of Indian monsoon is influenced by a number of factors, important among them is the system of jet streams.

INTEXT QUESTIONS 17.3

1. Define monsoons.

   ____

2. What is the main cause of the origin of monsoons according to Flohn?

   ____

3. List three important theories explaining the origin of monsoon in India.

   (i) ______________________________

   (ii) ______________________________

   (iii) ______________________________

17.4 CYCLE OF SEASONS IN INDIA

By now, you have understood that the complete reversal of direction of winds is the most striking feature of the monsoons. These changing monsoon winds result in the change of seasons over the year. It is, therefore, important to understand in detail, the prevailing weather conditions throughout India during different seasons.

Climatically, the year is divided into following four seasons in India:

(i) The cold weather season - December to February;

(ii) The hot weather season - March to may in south and upto June in the north;

(iii) The advancing southwest monsoon season - June to September;

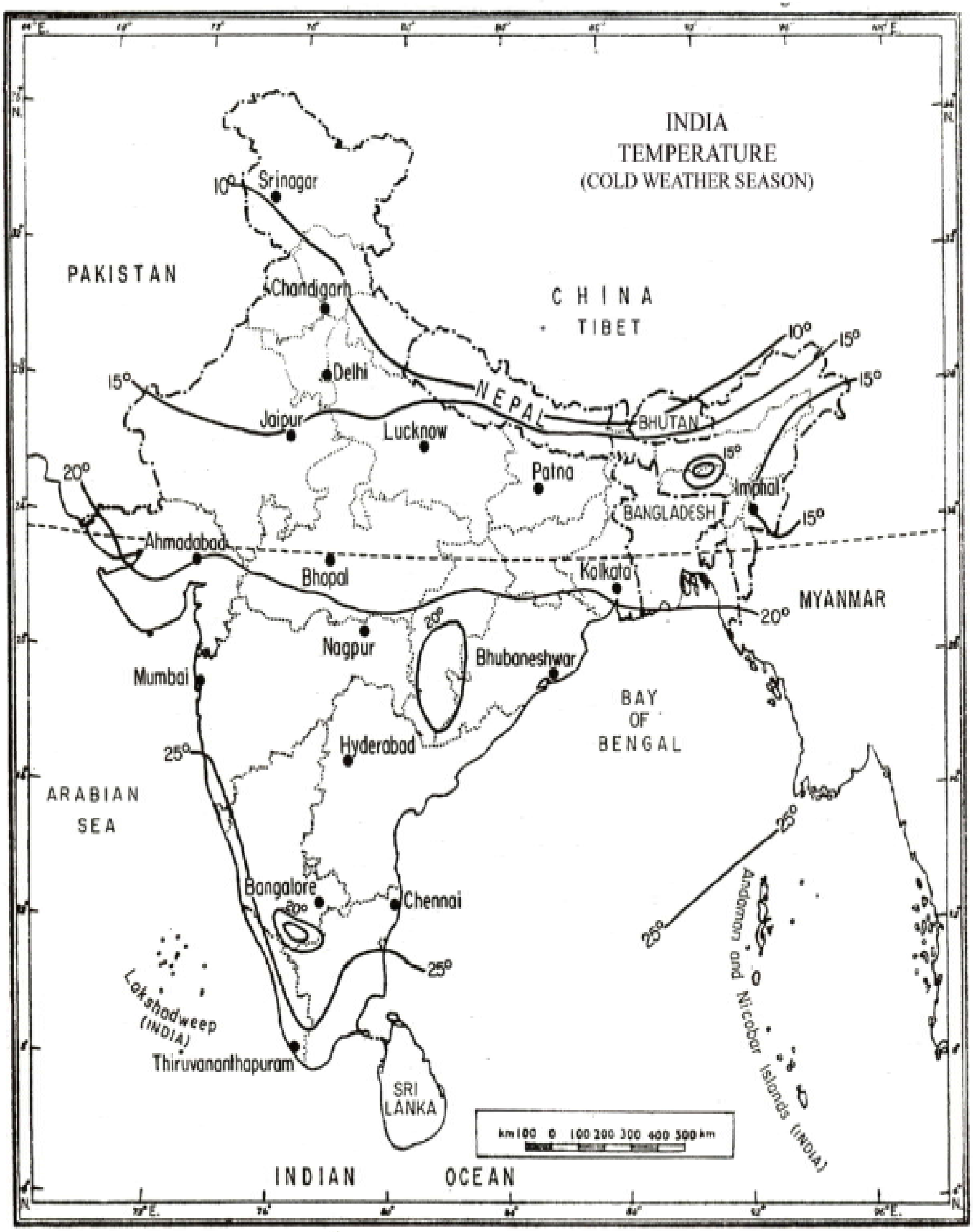
(iv) The retreating southwest monsoons season - October and November.

(i) The Cold Weather Season

This season usually begins with late-November in northern India. January is the coldest month over most parts of the country as sun shines vertically over the Tropic of Capricorn in the southern hemisphere. During these months, the mean daily temperatures remain below 21°C over northern plains and northern mountain regions. The night temperatures sometimes fall below freezing point resulting in wide spread damage to the standing crops due to frost. The temperature increases as one moves from north to south (Fig. 17.3). As a result of low temperatures, a feeble high pressure area develops over northern parts of India (Fig17.4) This mild high pressure causes the off-shore Northeast monsoon winds. Their direction in Northern Plains is westerly owing to the relief. These land bearing winds being cold and dry don't give rain over most parts of the country. However, these winds cause rain along the Coromandel coast since they collect moisture on their way over the Bay of Bengal.

The succession of depressions is another feature of this season. These low pressure systems are called "Western disturbances" as they originate in the Mediterranean region. These depressions move with the westerly jet streams. Covering a long distance over Iraq, Iran and Pakistan, they reach India around mid December. Their arrival results in the increase of temperature and in light rains over northern plains. They cause wide spread snowfall over western Himalayas and the adjoining ranges. At times hailstorms cause widespread damage to the standing rabi crops in northwestern plains. The meager rainfall caused by these disturbances is of great importance to the standing crops, particularly the wheat, in unirrigated areas. These depressions are followed by cold waves which bring down temperatures considerably.

The peninsular India has no well defined winter season. The mean monthly temperatures in the month of January is above 20°C in this part. Moreover, the coastal plains hardly experience any seasonal change as is clear from the mean monthly



Based upon Survey of India outline map printed in 1979.

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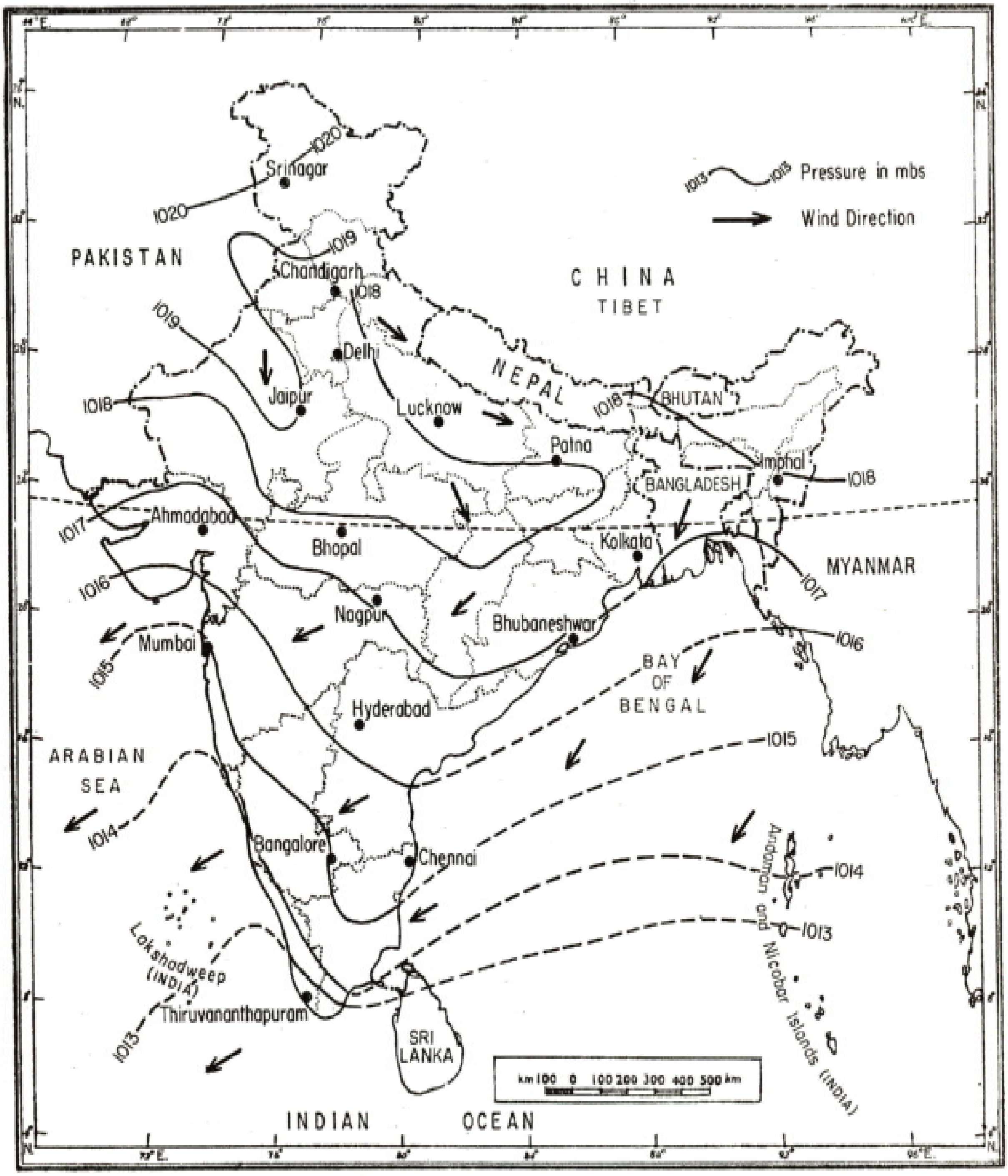
The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified.

Fig. 17.3 INDIA : Temperature (cold weather season)



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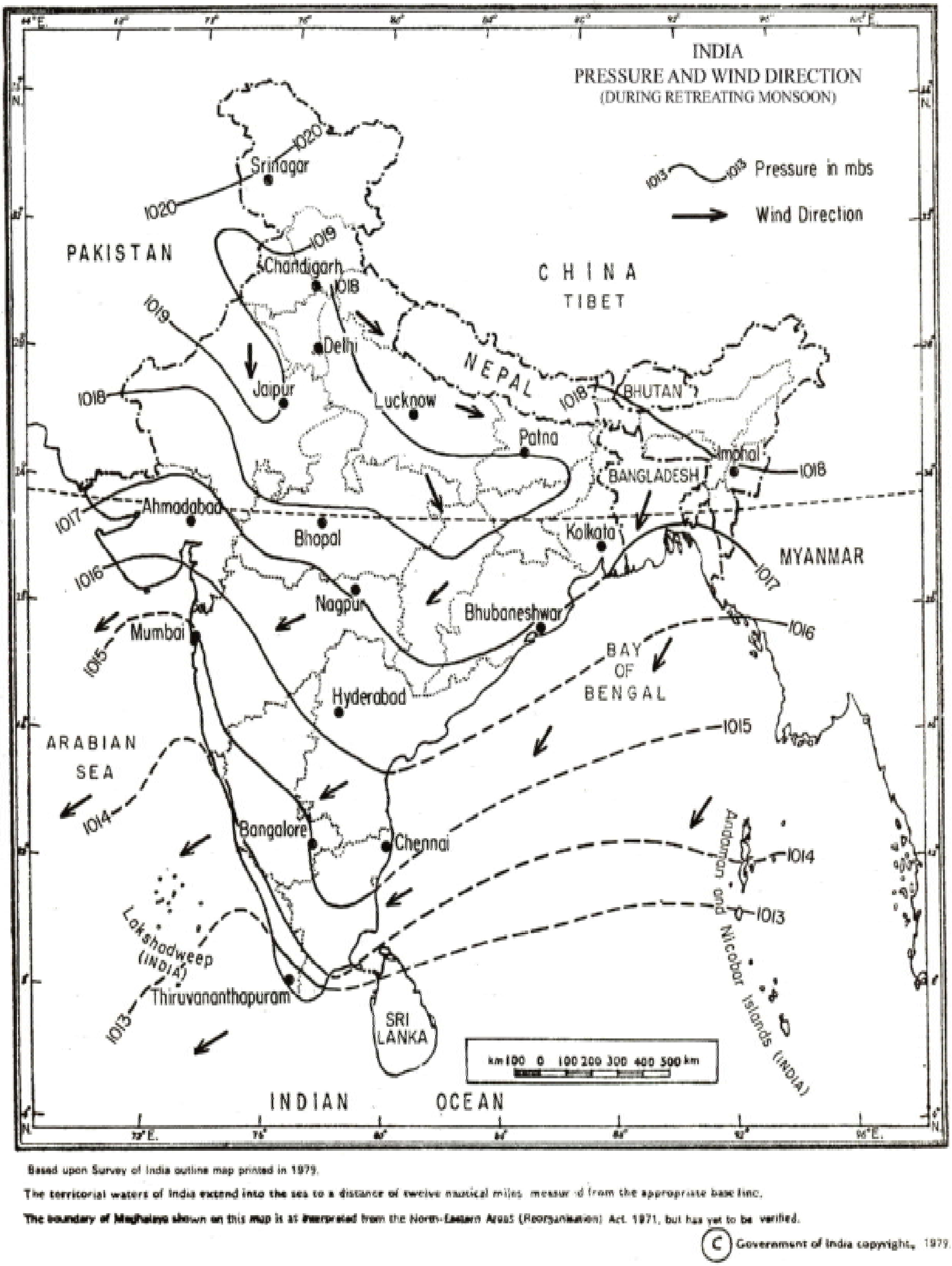

Fig. 17.4 INDIA : Pressure and wind direction

temperature of above 27°C at Thiruvananthapuram. But Chennai records a temperature of 25°C during December and early January owing to the rains caused by Northeast monsoon winds (Table 17.1)

The important characteristics of cold weather season are:

- Low temperatures in the north and their gradual increase towards southern parts of India.
- Blowing of cold and dry northeast monsoon resulting in dry weather conditions in most parts. Coromandel coast receives rainfall during winter.
- Western disturbances cause light rain in northern plains and snowfall over the Himalayan ranges.

(ii) The Hot Weather Season

The apparent movement of the sun towards the north increases the temperatures in the northern plains. As a result, the spring sets in soon giving way to the hot weather season which lasts till end of June in this region. The temperatures increase northwards and reach around 45°C in mid May in most parts of the northern plains. The characteristic features of this season are afternoon dust storms and 'Loo' which is a hot dry wind which blows during May and June mainly over the northern plains. These winds cause heat stroke resulting in deaths of hundreds of people every year. The day temperatures at times rise above 45°C in some northwestern parts of the country.

The wind direction is variable during this season. The weather conditions are generally hot and dry throughout the country. However, dust storms cause drizzle in Northern Plains. Light showers are also experienced in Kerala, West Bengal and Assam. In Kerala, these premonsoon showers are popularly known as "Mango Showers". In West Bengal and Assam, they are called Northwesters or Kal Baisakhi. Sometimes, due to high velocity of winds these Northwesters cause heavy loss of life and property.

- The main characteristic features of hot weather season are hot and dry weather, blowing of Loo - a hot dry wind in northern plains, afternoon dust storms, sometimes causing drizzle and mild showers in Kerala (Mango showers), West Bengal and Assam (Northwesters / Kal Baisakhi).

(iii) The Advancing Southwest Monsoon Season

It is a rainy season for most parts of India. It starts with the inflow of Southwest monsoons which strike the coast of Kerala normally in the first week of June and cover most of India by mid July. This weather continues till September. The arrival of these warm moisture laden winds brings a total change in weather conditions. Their arrival causes sudden rains which bring down the temperatures considerably. The decline in temperature is between 5°C to 10°C. The sudden onset of rain is called break of monsoons or the burst of monsoons. The arrival of these winds may be delayed by a week or two depending upon the pressure conditions over northern plains and over the Indian ocean (Fig.17.1) The peninsular shape of India divides these Southwest monsoons into two branches - Arabian Sea branch and Bay of Bengal branch.

(a) Arabian Sea branch of Southwest monsoons strikes the western coast of India and causes heavy rains on the western slopes of the Western Ghats. After crossing the Western Ghats, these winds cause less rainfall on the eastern slopes as they gain temperature while descending. This area is, therefore, known as rain shadow zone. This explains why interior parts of Maharashtra, Karnataka and Telangana get meagre rains from these winds. Southwest monsoons striking along the coast of Saurastra and Kuchchh and pass over Rajasthan and beyond to meet the Bay of Bengal branch. These winds cause widespread rain in these states and western Himalayan region.

(b) The Bay of Bengal branch is divided into two sub branches after striking eastern Himalayas. One branch moves towards the east northeast direction and causes heavy rains in Brahmaputra valley and northeast hills of India. The other branch moves towards northwest along the Ganga valley and the Himalayan ranges causing heavy and widespread rains over vast areas. In this region, the amount of rainfall decreases from east to west owing to the progressive decrease in humidity of these winds(Fig. 17.8).

(c) The characteristics of Southwest Monsoons

    (i) These winds generally strike the Indian coast in the first week of June. but their arrival and departure may be before time or even it may be delayed.

    (ii) There may be dry spells in between rainy periods. Such long dry spells may even lead to failure of crops.

    (iii) At times, these winds skip over certain regions without any cause.

    (iv) The amount and timing of rainfall and intervening duration of wet and dry spells varies from year to year. This is known as the vagaries of the monsoons.

    (v) The spatial distribution of rainfall is uneven - some regions may receive heavy rains while the others will have to be contented with meagre or scanty rains.

    (vi) Generally, these winds start retreating by the end of September. But, sometimes, their departure may be delayed till October or they may retreat even much earlier.

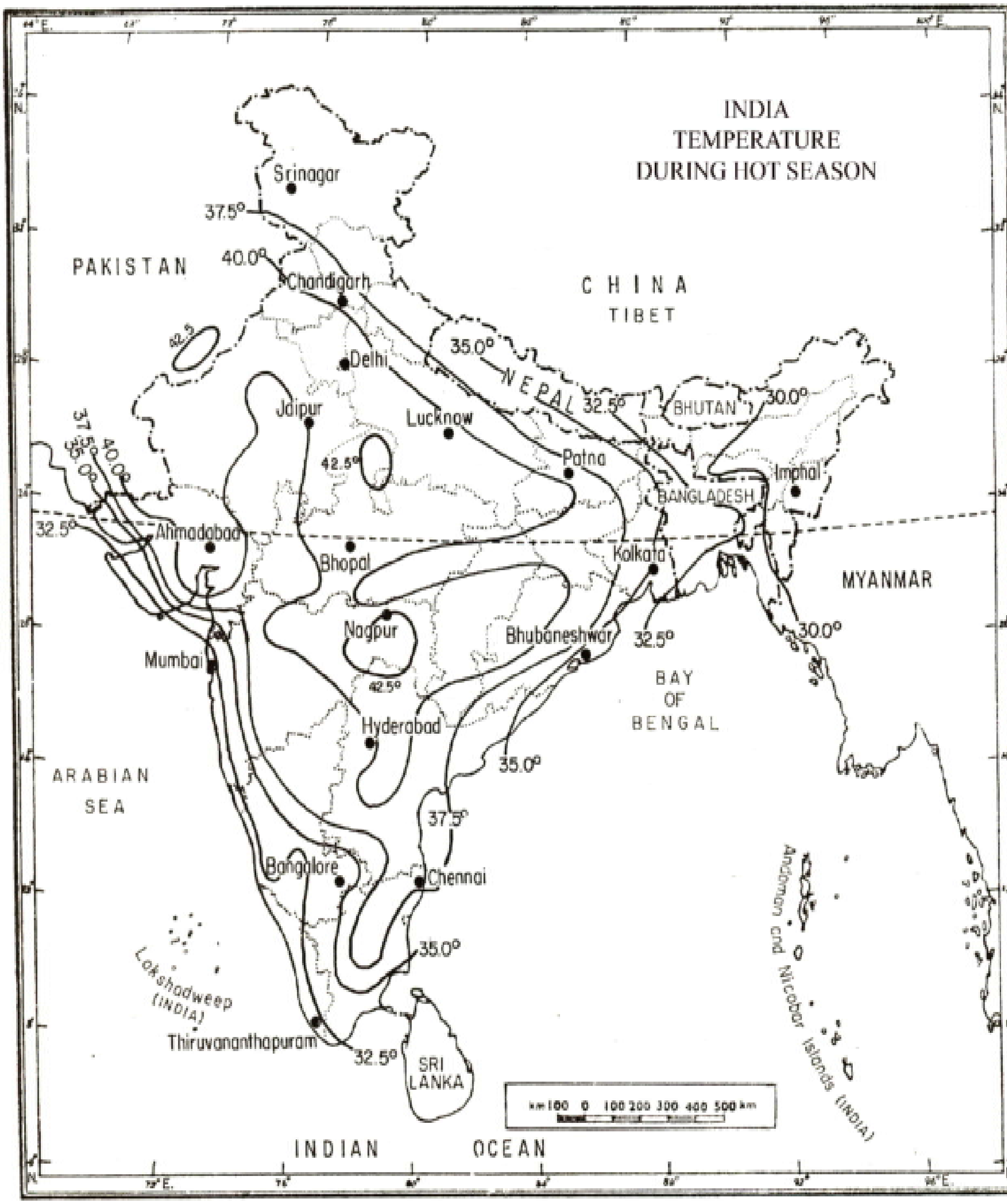

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Fig. 17.6 INDIA : Temperature (during hot season)

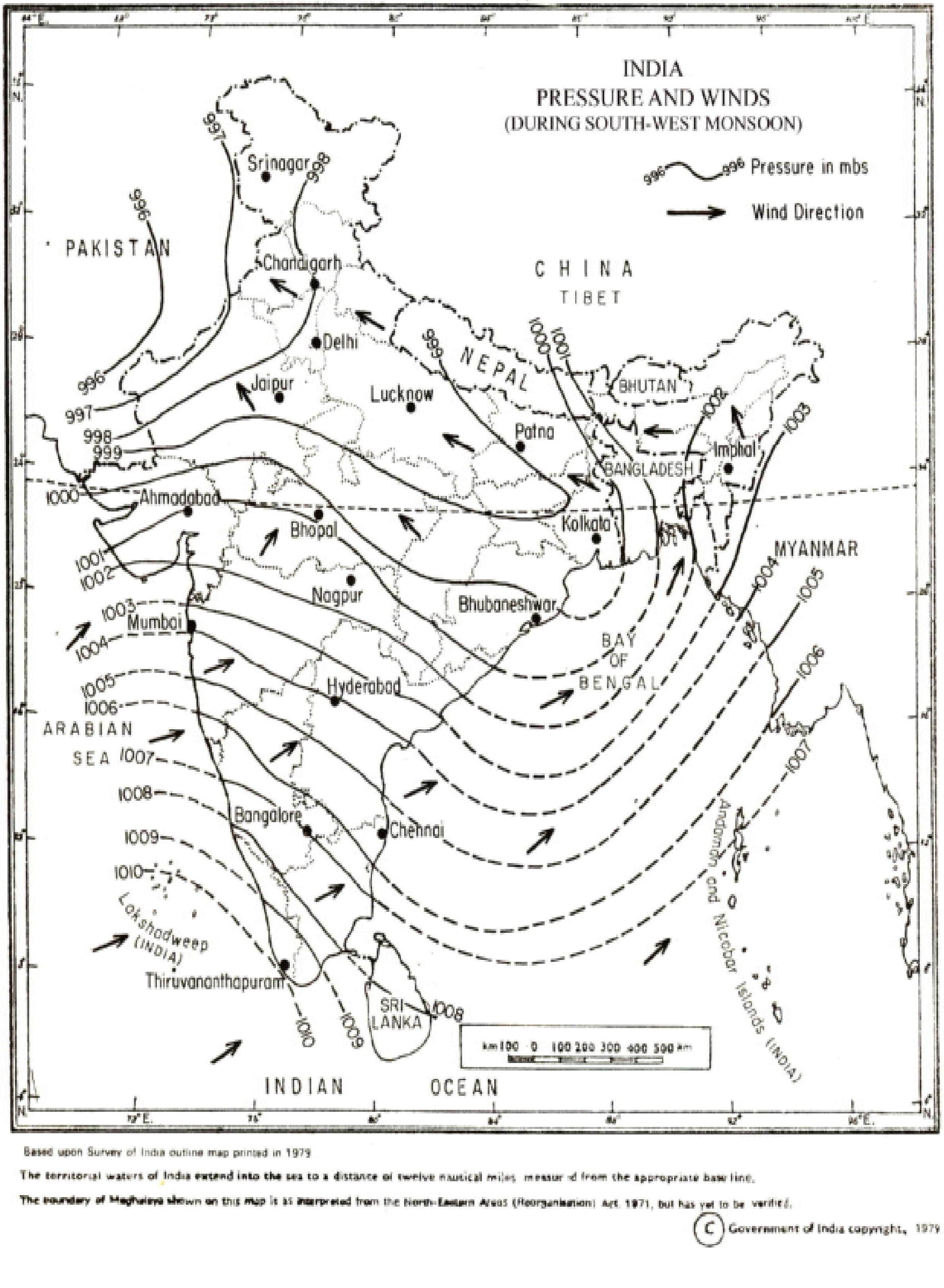

Fig. 17.7 INDIA : Pressure and winds (during southwest monsoon)

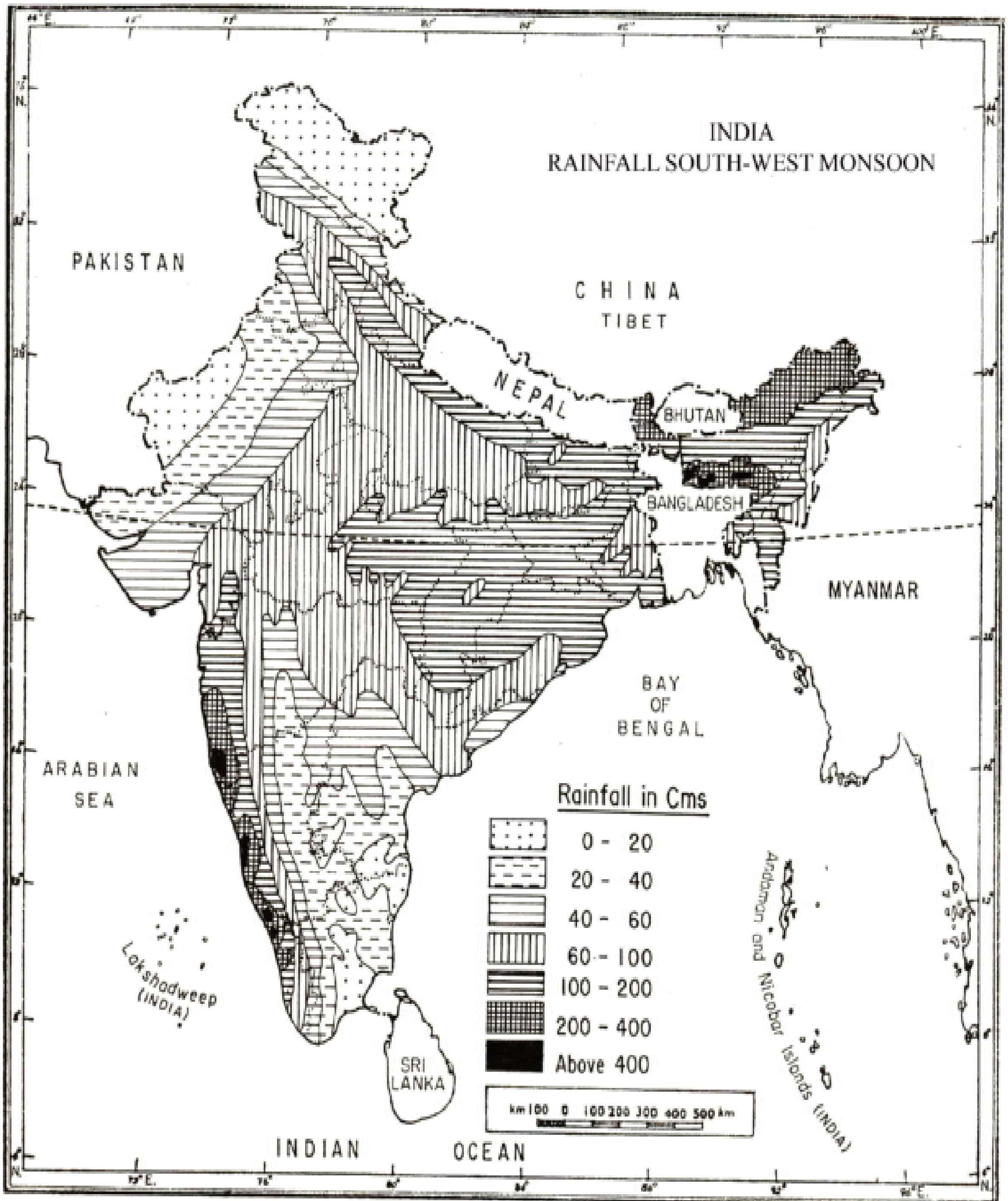

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Fig. 17.8 INDIA : Rainfall

The main features of advancing Southwest monsoon season are:

- Low pressure conditions over northwestern parts of India and high pressure conditions over seas.
- The general wind direction particularly on the Arabian Sea and the Bay of Bengal is southwest to northeast. They cause wide spread rain interspersed with dry spells.
- The onset of monsoons is in the first week of June and withdrawal by the end of September.
- The weather is generally hot and humid during this season.

(iv) The Retreating Southwest Monsoon Season

The Southwest monsoons start retreating in the first week of September from Pakistan border in Northwest India. Thus, these winds withdraw earlier from the regions where they reach the last. The retreat of these winds takes place due to weakening of low pressure area over the northwestern parts. This happens due to low temperatures caused by apparent shift of the sun towards the equator and also owing to the widespread rains bringing down temperatures perceptibly. Consequently, the air pressure starts decreasing. Such changes in the patterns of atmospheric pressure causes Southwest monsoons to withdraw. Hence, this period is known as the season of retreating Southwest monsoons. By the end of October, these winds retreat from most of northern India. As a result, fair weather conditions prevail over this region.

The low pressure area lying over Northwest India is transferred to the middle of the Bay of Bengal by the end of October. As a result of these unstable conditions, severe cyclonic storms originate in the Bay of Bengal. These cyclonic storms strike along the eastern coast of India causing wide spread rain in the coastal regions. Some times very sever storms cause damage to the standing crops, cattle, property, the lines of transports, communication and even electricity. Tamil Nadu coast receives maximum of its rainfall during October and November - the period of retreating monsoons.

The main characteristic features of retreating Southwest monsoon season are:

- weakening of low pressure area over Northwest India;
- fall in temperatures throughout India;
- shifting of low pressure area to the south; and
- origin of cyclonic storms in the Bay of Bengal causing heavy rains and damage to crops and property along the eastern coast of India.

INTEXT QUESTIONS 17.4

1. List four important features of each seasons given below

   (a) Cold Weather Season

(i) ______________________ (ii) ______________________

(iii) ______________________ (iv) ______________________

(b) Hot Weather Season

(i) ______________________ (ii) ______________________

(iii) ______________________ (iv) ______________________

(c) The Advancing Southwest Monsoon Season

(i) ______________________ (ii) ______________________

(iii) ______________________ (iv) ______________________

(d) The Retreating Southwest Monsoon Season

(i) ______________________ (ii) ______________________

(iii) ______________________ (iv) ______________________

17.5 DISTRIBUTION OF ANNUAL RAINFALL

Study the map carefully. You will find that the regional variations in average annual rainfall are well pronounced. The distribution map of rainfall shows that northeastern parts of Jammu and Kashmir and extreme western Rajasthan receive a rainfall of less than 20 cm. On the other hand, the west coastal plains, Sub-Himalayan areas of northeast India including the Shillong plateau receive more than 200 cm. of annual rainfall. Southern slopes of Khasi and Jayantia Hills, particularly the Cherrapunji valley receive the highest rainfall exceeding 1000 cm. Starting from the southern coast of Gujarat, the isohyte of 200 cm. runs somewhat parallel to the coast of Western Ghats upto kanyakumari. To the east of Western Ghats, the rainfall drops abruptly below 60 cm. over interior Maharashtra and Karnataka. Most parts of Punjab, Haryana, central and eastern Rajasthan and western Gujarat also receive rainfall below 60 cm. Starting from the southwestern parts of Jammu and Kashmir, the isohyte of 100 cm. moves eastwards upto east of Allahabad from where it bends to the west and south west, running over western Madhya Pradesh, eastern Maharashtra and northern Andhra Pradesh, it joins eastern coast near Visakhapattnam. To the west and south west of this isohyte, the areas receive less rainfall. Some parts of Coromondel coast receive a rainfall of more than 100 cm. The areas receiving less than 100 cm. of rainfall depend on means of irrigation for agricultural activities

In India, distribution of rainfall particularly of the southwest monsoon has a close relationship with the relief. Hence it is even described as “relief” or “orographic” rainfall. By and large places with higher altitude have greater chance to catch more rainfall than the places with less altitude. The direction of moist winds also matters.

The distribution of annual rainfall in different parts of India shows the following trends:

- The rainfall decreases as one moves from Kolkata to Amritsar.
- It shows declining trend towards interior from the coastal areas on Deccan Plateau.
- Northeastern parts receive more rainfall than north western parts of India.
- Areas lying on the windward side receive more rains than the areas lying on the leeward side.

17.6 THE MONSOONAL UNITY IN INDIA

Despite the regional diversities in climatic conditions, it is obvious from the above description that there exists a climatic unity in India. The 'Climatic Unity' means that weather conditions over different parts of India are more or less the same during different seasons round the year leaving minor variations as exceptions to the rule. Indian climate is called 'monsoon climate'. It explains how much influence the monsoon winds have in bringing climatic unity. This unity in climatic conditions results from the combined influence of regular movements of monsoons (seasonal winds) and the bounding role of the Himalayan mountain system.

The monsoonal unity of India caused by these twin factors is discernible. It reflects upon the life styles and activities of the common masses in India. They are:

(i) **Rhythm of seasons:** The sequence of hot, wet and cold seasons affects the life styles and economic activities of the people throughout India in the following ways:

Firstly, the farmers all over India start their agricultural activities like ploughing of fields, sowing of seeds, transplantation etc. with or just before the onset of monsoons. Kharif crops - rice and millets, cotton and sugarcane in different areas is an expression of amount of rainfall they receive. During winter, wheat is the major rabi crop in cool and irrigated areas; whereas barley, gram and oil seeds are common crops of unirrigated areas in northern and central India.

Secondly, the clothes are also affected by seasons. During summer, the people wear cotton clothes whereas the woollen clothes are used in winter season especially in north and central India.

Thirdly, most parts of India have to bear a long dry season; contrary to it, the season of life giving rains is limited to only a few months. This has a far reaching effect on the life style of the Indian people. When the rain drops the monsoon clouds fall on the thirsty parched land. Their music and fragrance coming out of the land generate similar emotional responses all over India. This is reflected in the Kajari of Bhojpuri and Malhar of Brij and their counter parts in other regions of India. Most of the Indian festivals are closely linked with seasons. In north India, Baisakhi is celebrated when rabi crop is ready for harvesting. During winter, when the sun shines vertically over the Tropic of Capricorn and extreme cold weather conditions prevail over northern plains Lohri and Makar Sakranti are celebrated in the north and west while Pongal distinctly is its southern counterpart. Holi is celebrated in spring after bidding good bye to the prolonged cold winter especially in the north.

Fourthly, the rainfed subsistence farming has been the oldest response of the village community. Its entire economy is based on it, howsoever meagre rain it may be.

Lastly, the seasonal and regional variations in weather conditions have made different regions capable of producing different crops in varying quantities making all regions completely interdependent. This is not a less contribution of the monsoons in promoting underlying unity despite all pervasive diversity.

(ii) Thirst for Water: You know that rain occurs over most parts of India only during four or five months of the year. Thus, India remains dry for seven to eight months in a year. Even during rainy season, spells of dry period are common. Being an agricultural society, the need for water is all pervasive in most parts of India. Even the rainiest parts around Cherrapunji and in Konkan and Kerala have no drinking water during the long and dry summer months. All eyes are focussed on black monsoon clouds in every part of the country.

(iii) The Waiting for Monsoon Rains: The farmers as well as citizens all over India eagerly wait for monsoon rains after a long dry season not only to get rid of summer heat but to start agricultural activities which sustain rural as well as urban economy. So, bursting of monsoon is welcomed with equal joy everywhere in India.

(iv) Incidence of Droughts and Floods: The paradox of Indian monsoons is that no part in India is spared from occasional or even frequent floods or droughts, if not famines. The drought are common even in the areas of heavy rainfall like Kerala and Assam; likewise, dry areas of Northwest India are not free from floods, be it Punjab or Rajasthan. Consequently, there is need to conserve, control and store water for irrigation, drinking and power generation.

INTEXT QUESTIONS 17.5

1. Write True or False against each of the following statements
   (a) The amount of rainfall decreases from east to west in northern plains.
   (b) Gujarat and Rajasthan receive low rainfall as monsoon winds become dry on reaching these states.

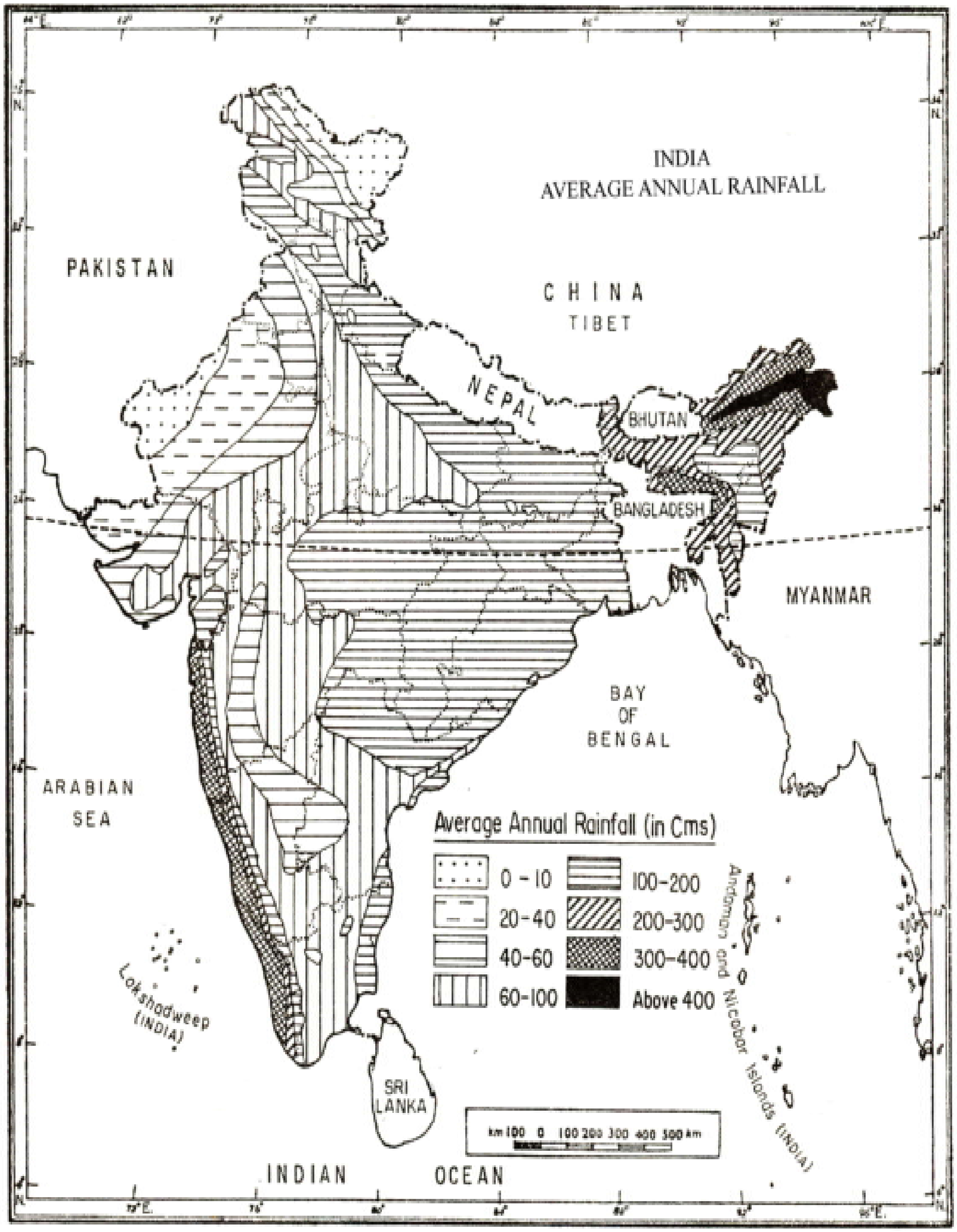

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Fig. 17.9 INDIA : Average Annual Rainfall

(c) The date of arrival of monsoon winds is always definite in different parts of India.

(d) Coromandel coast receives bulk of its rainfall in October-November from Northeast monsoon winds.

(e) Only certain parts of India experience the occurrence of droughts and floods.

2. Name two areas of India which receive less than 20 cm of annual rainfall.

(i)_________________________ (ii)_________________________

WHAT YOU HAVE LEARNT

India is a country of climatic diversities which are expressed in the variations in the distribution of temperature, pressure, winds and amount of precipitation. The factors which are responsible for determining the climate of different regions of India include her location and latitudinal extent, physiography, the role of Himalayan ranges as a climatic divide, the monsoon winds, upper air circulation, western disturbances and cyclonic storms. Derived from Arabic word 'mousim', monsoon implies the rhythm of season and seasonal reversal of winds. Meteorologically, the year in India is divided into four seasons namely the cold weather season, the hot weather season, the advancing southwest monsoon season and the retreating southwest monsoon season. These seasons have different characteristics of weather conditions.

TERMINAL QUESTIONS

1. How do western disturbances influence the weather conditions of north west India?

2. Distinguish between:

   (i) The cold weather season and hot weather season;

   (ii) The southwest and northeast monsoons.

3. Give reasons :

   (i) Dras in Kargil is always colder than Thiruvananthapuram.

   (ii) Winter is dry and cold over greater parts of India.

   (iii) Southwest monsoons start retreating from northern India after September.

   (iv) The western coastal plains receive more rainfall compared to the interior plateau region lying east of the Western Ghats.

4. Describe five major factors which influence the climate of India. Illustrate your answer with examples.
5. Explain with suitable examples the uneven distribution of rainfall in India.
6. Identify the characteristics of monsoons in India.
7. Locate and label the following on the outline maps of India
   (i) Dras and Cherrapunji;
   (ii) Areas receiving rainfall from 'western disturbances';
   (iii) Areas receiving rainfall from northeast monsoons.
   (iv) Areas receiving annual rainfall less than 20 cm.

ANSWER TO INTEXT QUESTIONS

17.1

1. (a) Jaisalmer in Rajasthan desert (b) Dras in Jammu & Kashmir
2. (i) Thiruvananthapuram
   (ii) Delhi
   (iii) (a) Thiruvananthapuram (b) Nagpur (c) Delhi (d) Chennai
   (iv) June, July, August, September
   (v) Leh.

17.2

1. The Himalayas
2. Mumbai lies along the western coast while Delhi is too far away to have any oceanic influence.
3. Westerly jet stream.
4. Because they are cold and dry land bearing winds.
5. Owing to the reversal of air pressure conditions between land and sea at the peak of the summer season.

17.3

1. Monsoon refer to a system of winds in the tropical regions under which the

direction of winds is reversed completely between summer and winter.

2. The shifting of planetary pressure and wind belts. .

3. (i) Differential heating and cooling of land and sea.

   (ii) Shifting of planetary pressure and wind belts.

   (iii) System of jet streams.

17.4

1. (a) (i) cold and dry in most parts of India.

   (ii) direction of winds is generally northeasterly.

   (iii) light rain, hails in northwestern plains and snowfall in Western Himalayan region.

   (iv) rainfall along Coromondal coast from N.E. monsoons.

   (b) (i) generally hot and dry throughout India.

   (ii) variable wind direction.

   (iii) blowing of hot and dry wind called "Loo" in northern plains causing heat strokes.

   (iv) light rain in Kerala, W. Bengal and Assam. (premonsoon showers)

   (c) (i) generally rainy throughout India.

   (ii) general direction of winds is southwesterly.

   (iii) onset and withdrawal of these winds is somewhat certain with marginal variations.

   (iv) amount of rainfall varies from place to place and time to time.

   (d) (i) Weakening of low pressure are over northern parts of India.

   (ii) fall in temperatures throughout India.

   (iii) shifting of low pressure areas to the Indian ocean.

   (iv) origin of cyclonic storms in the Bay of Bengal causing heavy rains on coastal areas.

17.5

1. (a) True; (b) False; (c) False; (d) True; (e) False
2. (a) Ladakh (b) Rajasthan desert

HINTS TO TERMINAL QUESTIONS

1. Refer to 17.2 (vii)
2. (i) Refer to 17.4 (i) and (ii)

   (ii) Refer to 17.4 (iii) and (iv)
3. (i) Because Dras is located in high altitude and latitude in interior parts of Jammu and Kashmir while Thiruvananthapuram has coastal location and is nearer to equator.

   (ii) Refer to 17.4 (i)

   (iii) Refer to 17.5
4. Refer to 17.2
5. Refer to 17.5
6. Refer to 17.6
7. Refer to maps.

18

NATURAL DISASTERS

Humans have been coping with natural disasters since time immemorial. There are so many disaster which can not be controlled by human intervention. They are destined to bring their tragic consequences of human destruction. Due to human intervention in the natural processes, the destructive power and frequency of natural disasters have increased considerably. According to U N statistics, natural disasters kill 1,00,000 persons on an average and cause property damage of Rs 20,000 crores world wide per year. Among the top ten natural disaster-prone countries, India stands second after China.Therefore, there is a need for creating awareness among all sections of the people about it's causes, consequences as well as preventive measures so that they can handle as an individual, and as a members of society.

In this chapter we will study five natural disasters i.e. earthquakes, land slides, droughts, floods and cyclones.

OBJECTIVES

After studying this lesson you will be able to:

- explain the meaning of the words natural 'Hazard' and 'Disaster'.
- differentiate between hazard and disaster
- recognize and describe some disaster-prone areas from each physical division of India.
- describe some adverse effects of natural disasters.
- give example of some other nuturological disasters.
- suggest measures to mitigate or reduce the problems and sufferings arising before, during or after the disaster.

18.1 DISASTERS IN INDIA – A BACKGROUND

India is struggling with disasters from many years. How can we forget the day when killer waves (tsunami) struck the coastal parts of India on 26th December 2004 or the morning of 26th January 2001, when western part of India was badly affected by earthquake. These are just few examples. We always listen such kind of news in print or electronic media that one part of India is affected by flood where as another faces drought.

Due to vulnerability of different kinds of disasters, it is said that India is a disaster prone country, the reasons are:

1. Over 55% of the land area is vulnerable to earthquakes,
2. 12% is flood prone,
3. 8% is vulnerable to cyclones and
4. 70% of the land under cultivation is drought prone.

18.2 NATURAL HAZARDS AND DISASTERS

The vulnerability of enviornment has been increasing continuously due to human activities. But this is not one sided relationship. Humans are also the components of the enviornment. Hence they can't escape from the effects of environmental change processes. When local, regional or global processes of environment pose danger to humans or their property, they are simply natural events. For example, the blizzard blowing in the Antarctica is a natural event. But if this blizzard porses dangers to our lives and property, then it becomes a disaster.

For instance, tsunami was caused by an earthquake that occurred in the sea near Sumatra (Indonesia) on 26 December, 2004. It turned into a disaster for India, Srilanka and some other countries of Southeast Asia. It caused wide spread loss to human life and property in Andaman and Nicobar Islands and on the coasts of Andhra Pradesh and Tamil Nadu.

Table 18.1: Difference between Natural Hazard and Disaster

Hazard	Disaster
1. A hazards is a dangerous physical condition or event.	1. A disaster disrupts the normal function of the society caused by a hazard.
2. Earthquakes, floods, volcanic erruption, land slides, droughts etc are called natural hazards before they cause loss of life and damage to property.	2. It causes damage to property and loss of life but it disrupts the opportunities of employment also.

3. Small number of people are affected.	3. A large number of people are affected by it.
4. It may cause injury, loss of life or damage of property.	4. It causes wide spread loss to life and property.
5. Earthquakes, floods, volcanoes, tsunami, land slide, drought etc. are natural hazards.	5. It affects the society to such an extent that external aid becomes, necessary to compensate the losses.

- Nearly 6 crore people are effected by natural disasters every year.
- Natural events, when pose danger to humans, are called hazards.

INTEXT QUESTIONS 18.1

1. When do natural events become natural hazards?

____

____

2. What is a tsunami?

____

____

18.3 FLOODS

With the arrival of Monsoon, people living in 4 crore hectares area of the country become extremely nervous. No one knows when there will be a flood in the river and their hard earned belongings will be washed away. In comparison to other disasters flood cause more damage to life and property. Twenty percent of deaths caused by floods in the world, occur in India.

What is a flood

The inundation of an area by water is called a flood. In other words, when a river over flows its banks and water spreads in the surrounding areas is a flood. Various causes of flood, losses by flood and flood control measures are described below:

Cause of flood

The causes of flood in India are as follows:

(i) **Heavy rainfall :** Heavy rain in the catchment area of a river causes water to over flow its banks, which results in the flooding of nearby areas.

(ii) **Sediment deposition :** River beds become shallow due to sedimentation. The water carrying capacity of such river is reduced. As a result the heavy rain water over flows the river banks.

(iii) **Deforestation :** Vegetation hampers the flow of water and forces it to percolate in the ground. As a result of deforestation, the land becomes obstruction free and water flows with greater speed into the rivers and causes flood.

(iv) **Cyclone :** Cyclone generated seawaves of abnormal height spreads the water in the adjoining coastal areas. In October 1994 Orissa cyclone generated severe floods and caused unprecedented loss of life and property.

(v) **Interference in drainage system:** Drainage congestion caused by badly planned construction of bridges, roads, railway tracks, canals etc. hampers the flow of water and the result is flood.

(vi) **Change in the course of the river:** Meanders and change in the course of the river cause floods.

(vii) **Tsunami :** Large coastal areas are flooded by rising sea water, when a tsunami strikes the coast.

Losses by flood : Humans and animals both are affected by flood. People are rendered homeless. Houses are damaged or collapse. Industries are crippled. Crops are submerged in flood water. Domestic as well as wild animals die. Boats and fishing nets etc. are lost or damaged in coastal areas. Out break of epidemics like malaria and diarrhoea etc. are common after flood. Potable water is contaminated and sometimes becomes scarce. Food grains are lost or spoiled, their supplies from outside become difficult.

Losses by annual floods, instead of decreasing are increasing every year. In 1953 2.43 crores of people were affected. By 1987 the number of flood affected people rose to 4.83 crore.

According to an estimate on an-average property worth Rs. 210 crores is lost in floods every year. Flood affects about 6 crore people and crops of one crore hectare are damaged.

Flood prone areas : About 4 crore hectare area of our country is flood-prone, which is one eighth of the total area. The most flood prone areas are the Brahmputra, Ganga and Indus basins. As far as states are concerned, Uttar Pradesh, Bihar, West Bengal and Orissa are the most flood affected states followed by Haryana, Punjab and Andhra Pradesh. Now a days Rajasthan and Gujarat also feel the fury of floods. Karnataka and Maharashtra are no-longer immune to floods.

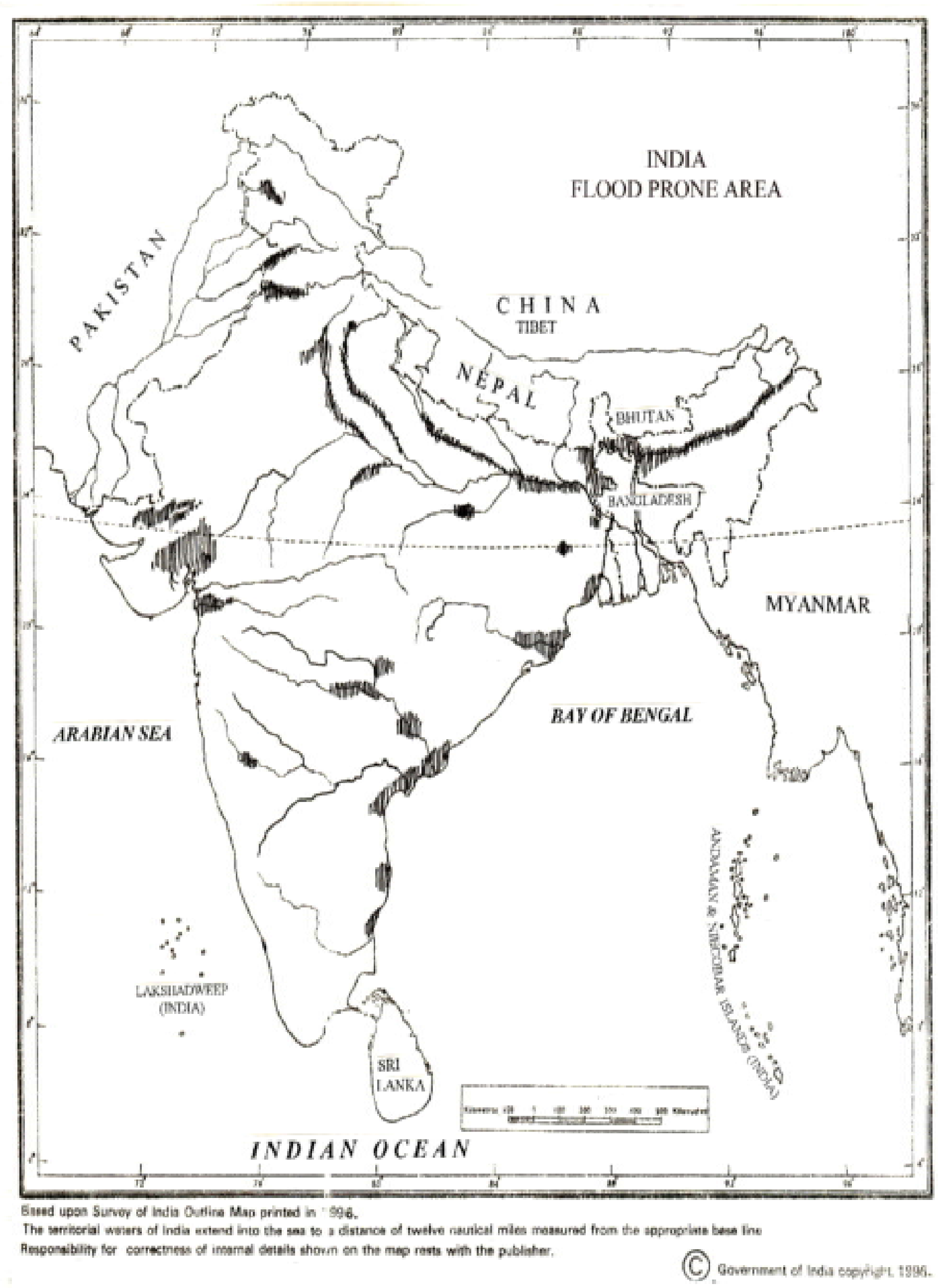

Fig. 18.1 INDIA : Flood Prone Areas

Flood control measures

(i) Reservoirs : By constructing reservoirs in the courses of rivers could stores extra water at the time of flood. Such measures adopted till now however, have not been successful. Dams built to control floods of Damodar could not control the flood.

(ii) Embankments : By building flood protection embankments, floods water can be controlled from overflowing the banks and spreading in near by areas.

Building of embankments on Yamuna, near Delhi, has been successful in controlling the flood.

(iii) Afforestation : The furry of flood could be minimized by planting trees in catchment areas of rivers.

(iv) Restoration of original drainage system : Drainage system is generally choked by the construction of roads, canals railway tracks etc. Floods could be checked if the original form of drainage system is restored.

Flood Management : About 4 crore hectare area is flood prone. Out of this, 1.44 crore hectare areas has been made secure to some extent from the devastation by floods. To achieve this goal, embankments and drainge channels have been constructed. Protection of towns and cities have been adopted. Villages are relocated on comparative by higher ground. By the end of Ninth Plan 8000 crore rupees have been spent on flood management.

Some do's and donts before, during and after the flood

(i) Listen to the radio for advance information and advise.

(ii) Disconnect all electrical appliances, move all valuable household goods and clothing out of reach of flood water. Adopt such measures only when there is a forecast of flood or you suspect that flood water may reach the house.

(iii) Move vehicles, farm animals and moveable goods to the higher ground.

(iv) Prevent dangerous pollution.

(v) Keep all insecticides, pesticides etc. out of the reach of flood water.

(vi) Switch off electricity and gas, in case you have to leave the house.

(vii) Lock all door and windows if you have to leave the house.

(viii) Do not enter flood water on foot or in a vehicle as far as possible.

(ix) Never wander in the flooded area on your own.

- The inundation of an area by rain water is called flood.
- The basins of Indus, Ganga and Brahamaputra rivers are the most flood prone areas.

INTEXT QUESTION 18.2

1. Name any two causes of flood.

   (i) ______________________

   (ii) ______________________

2. How much area of the country is flood prone?

____

3. Name any two measures of flood control.

(i) ____

(ii) ____

18.4 DROUGHT

The tragedy caused by drought affects the people slowly and vastly. This is different type of agony but painful. To see domestic animals to die of hunger and thirst before ones own eyes; to send beloved members of the family in search of employment to far off places in extremely uncertain and exploitative conditions, reduction in diet to reduce the already meager diet, to wander in search of work all day long in relief works and return rejected and empty-handed in the night, these are some of the heart rending scenes from the drought affected areas of India.

What is a drought ? According to meteorologists the rainfall deficiency during a long period over a large area is called a drought. Some times in Hindi language famine *Akal* and *Anavrishty* are also used for drought. Drought can also occur when ground water level is not within reach of agricultural communities. The government also declares on area affected by drought, if more than 50 percent crop loss happens in an area due to meteorological condition.

Causes of drought

Major cause of drought in India is scarcity of rain. But humans have interfered in the environment processes by their activities. People have filled up the natural resources like ponds and lakes. They have destroyed the vegetation cover. Vegetation cover impedes the flow of rainwater and force it to percolate in the ground. Humans have dug lakhs of tube wells and depleted the ground water reservoirs.

Impact of drought : Droughts cause scarcity of food and water. Hungry and thirsty people cry for help. People die of hunger, malnutrition and epidemics. People are forced to migrate from their area of residence. Crops fail due to scarcity of water. Cattle because fodder and water are not easily available.

Farmers are deprived of their employment. People leave their villages with their families for a long, unknown and uncertain journey in the pursuit of food, water, green fodder and employment.

Drought prone areas of India

Study the map carefully given below. There is a major reason that lies between South Rajasthan and Tamilnadu. It includes west south Rajasthan and Tamilnadu. It includes areas of west Madhya Pradesh, central Maharashtra, Andhra Pradesh and Karnataka.

Due to deficiency in Monsoon rainfall and environmental degradation, Rajasthan and Gujrat are generally affected by drought. Out of 593 districts in India, 193 districts are severely drought prone. In 2003 most parts of Rajasthan experienced drought for the fourth consecutive year.

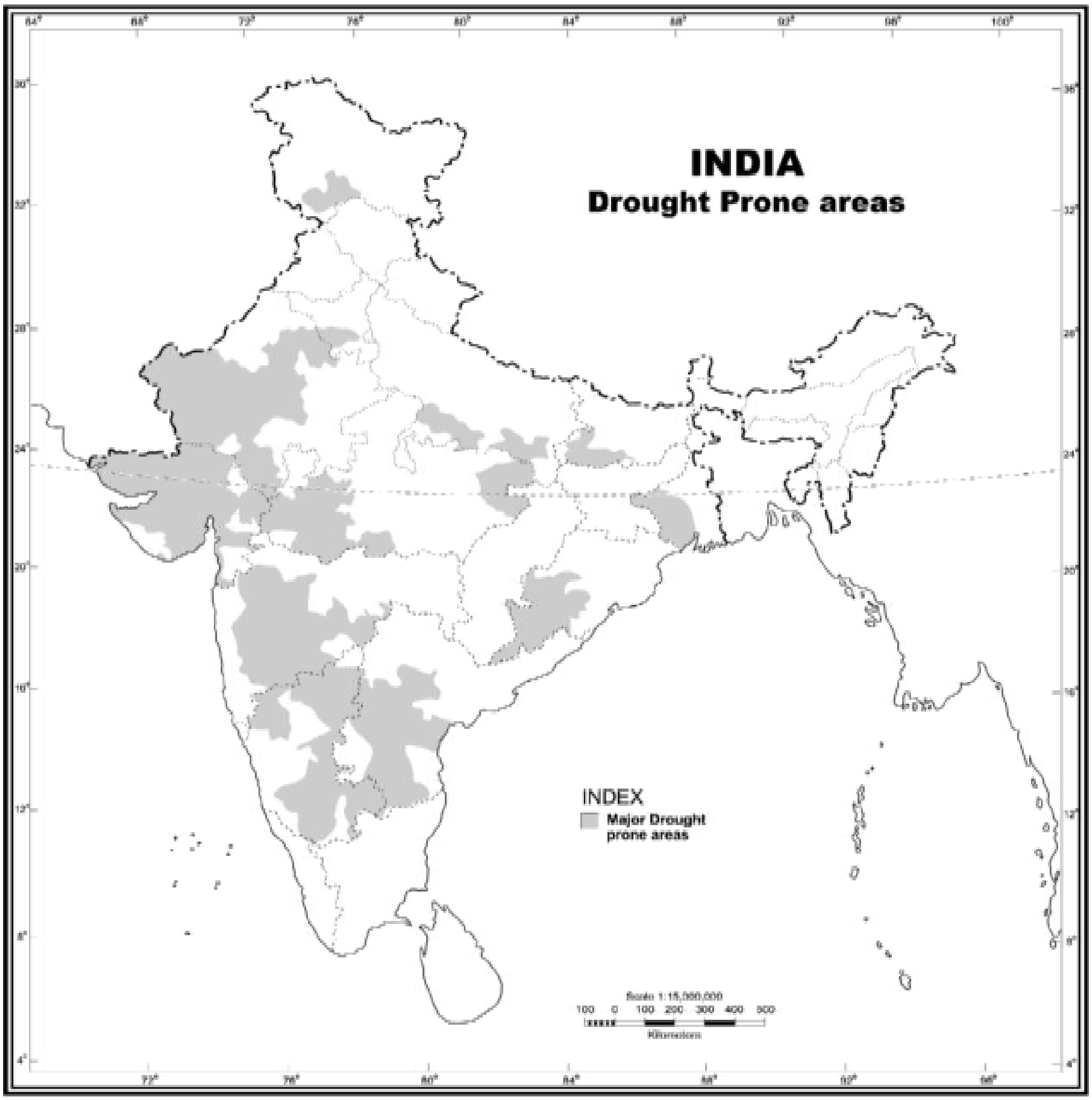

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Fig. 18.2 INDIA: Drought Prone Areas

Measures to cope with Drought

(i) Suitable farming methods for arid areas : By adopting the following methods it is possible to mitigate the intensity of drought. The methods are: Production of coarse and hardy cereals; conservation of soil moisture by deep ploughing, storing water behind small dams, collecting water in ponds and tanks and use of sprinklers for irrigation.

(ii) Sowing drought resistant crops: By sowing drought resistant crops of cotton, Moong, pearl millet, wheat etc, the impact of drought could be mitigated to a certain extent.

(iii) Rain water harvesting : Collection of each and every drop of rain could help in coping with the drought.

(iv) By making high bunds around the fields, adoption of terrace cultivation, planting trees on the bunds of fields, the use of rainwater can be maximised.

(v) Water can also be conserved by taming the irrigation canals with mortar and bricks.

(vi) Small quantity of water can irrigate comparatively larger area by using drip irrigation method.

Drought prone area programme

This programme was initiated in 1973. The objectives of the programme are as follows:

(i) To minimise the adverse impact of drought on crops, domestic animals, productivity of land, water and human resources. This could be done by integrated development by using appropriate technologies as it was done for the natural resources of Gujrat.

(ii) By developing, conserving and suitably using the rainwater, the ecological balance could be maintained for a longer period.

(iii) To improve the economic and social conditions of the section of society who do not have access to resources and facilities.

> - The rainfall deficiency during a long period over a large area is called a drought.
> - States of Rajasthan and Gujrat are comparatively more drought-prone than other states.

INTEXT QUESTIONS 18.3

1. What is a drought?

   ____

2. Fill in the blanks with appropriate words out of these given in the brackets.

   (i) The most drought prone state of India is ______________ (Assam, Rajasthan, Chhatisgarh)

   (ii) In drought prone areas the impact of drought can be minimised by adopting ______________ (Flood irrigation, sprinkler irrigation)

18.5 LANDSLIDES

A major landslide occurred in the midnight in a place called Lamari on the foot path leading to Kailash Mansarover about 60 km away from Dharchula, in August 1998. Lamari is situated between Bendi and Malpa. The debris of this landslide slipped into river Kali and blocked its flow. The water of the river spread over an area of 1½ square km. Thus a lake was created in which the water was flowing. Some pilgrims going to Kailash Mansarovar were resting here in this fateful night. This landslide killed 60 pilgrims.

What is a Landslide

The slipping of masses of rocks, earth or debris downwards on the mountain slopes or banks of the rivers is called a landslide. The occurance of landslides in mountainous areas is increasing day by day. The impact of landslides on the people in the mountains is clearly visible.

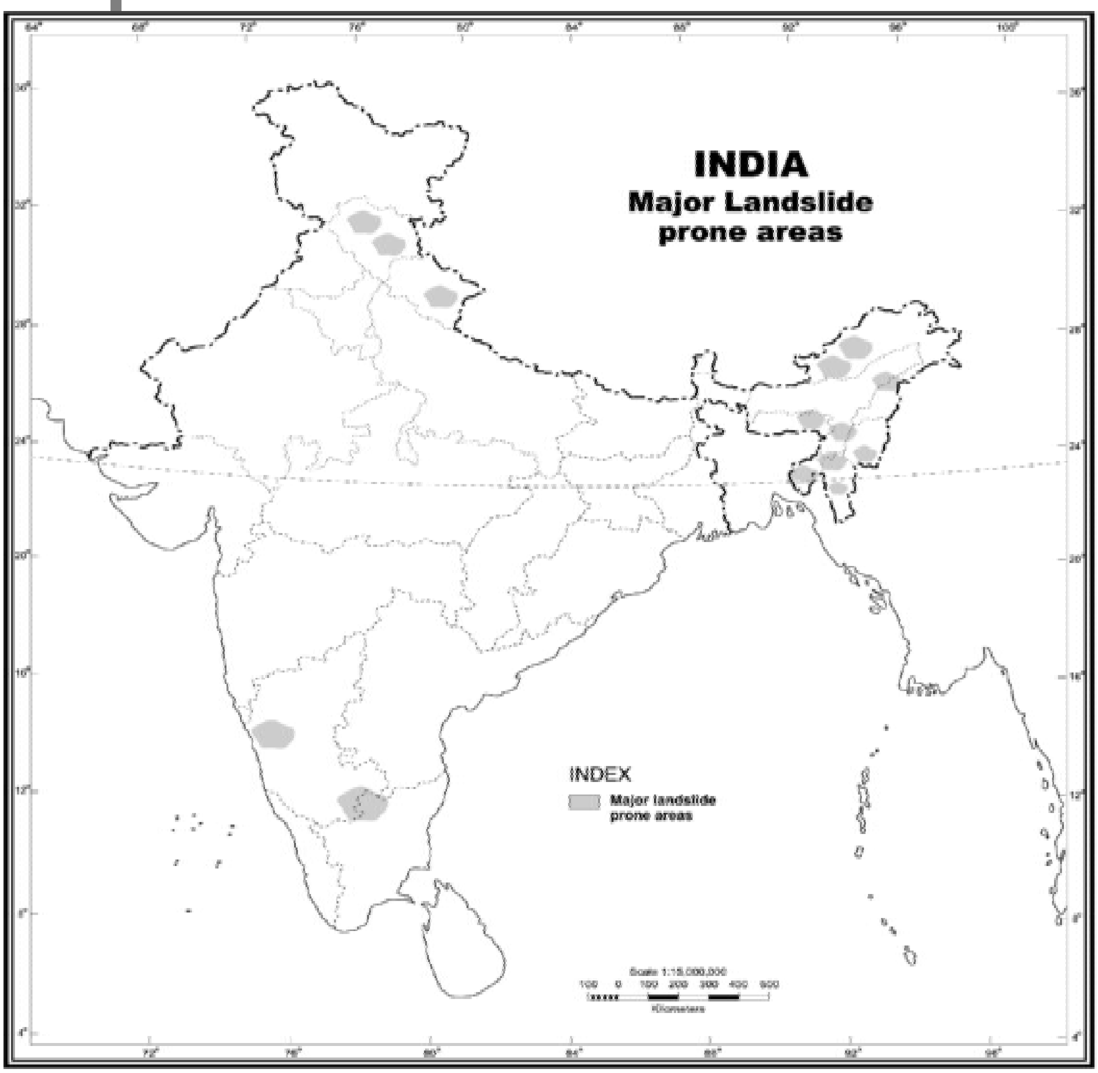

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Fig. 18.3 India : Major landslide prone areas

Landslide prone areas : The landslides are a common feature in Himalaya, Western ghats and in river valleys. The state of Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and all the seven states of North East India, are most vulnerable to landslide. In southern India Mahrastra, Karnataka, Tamil Nadu and Kerala bear the brunt of landslides.

Causes of landslides

1. **Heavy rain :** Heavy rain is the main cause of landslides.
2. **Deforestation :** Deforestation is another major cause of landslides. Tree, brushes and grasses keep the soil particles compact. Mountain slope looses their protective cover by felling of trees. The rain water flows on such slopes with unempeded speed.
3. **Earthquakes and volcanic explosions :** Earthquake is a common feature in the Himalaya. Tremors destabilize the mountains and the rocks tumble downwards. Volcanic explosions also trigger landslides in the mountainous areas.
4. **Building of roads:** Roads are built in mountainous areas for development. During the process of the construction of road, a large amount of rocks and debris has to be removed. This process dislodges the rock structure and changes the angle of slopes. Consequently landslides are triggered.
5. **Shifting agriculture :** In the North Eastern part of India, the number and frequency of landslides has increased due to the practice of shifting agriculture.
6. **Construction of houses and other buildings :** For giving shelter to the ever-increasing population and promotion of tourism more and more house and hotels are being built. In building processes large amount of dibrises created. This causes the landslides.

Impact of landslide

(i) Degrading of environment : Landslides are degrading the environment of mountains. Natural beauty is deminishing slowly and slowly.

(ii) Sources of water are drying up.

(iii) Flooding in rivers is incrasing.

(iv) Roads are blocked.

(v) Life and property are lost

Measures to control landslides and to mitigate their impact

(i) Afforestation : Trees and brushes help in binding the soil particles.

(ii) New technology in road construction : Roads should be constructed in such a way, that lesser amount of debrisses are generated.

(iii) Ban on quarrying of stones and mining of minerals

(iv) Instead of exploitation of forests, they should be used scientifically.

(v) Permanent crops like orchards of fruits should replace the seasonal or annual Drops.

(vi) By controlling the surface flow of water, seepage of water should be minimised.

(vii) Retaining walls can be built of mountain slopes to stop land from slipping.

(viii) Hazard mapping should be done to locate areas commonly prone to landslides. Building and construction activities may be banned in such areas.

- The slipping of masses of rocks, earth or debris downwards on the mountain slopes or banks of rivers is called a landslide.
- During rainy season landslides are a common feature in Himalaya, Western Ghat and deep river valleys.

INTEXT QUESTIONS 18.4

1. Name any two causes of landslide.

   (i) ____________________ (ii) ____________________

2. Name two most landslide prone areas.

   (i) ____________________ (ii) ____________________

3. Choose the correct answers given in the brackets.

   (i) Which state of South India is landslide prone? (Andhra Pradesh, Tamil Nadu)

   (ii) Which measure is adopted to controll landslide (Levelling of slope, construction of strong wall on the slope).

18.6 EARTHQUAKE

In simple words sudden shaking or trembling of the earthsurface is an earthquake. Most earthquake are a minor tremor. Larger earthquakes usually begin with slight tremors but suddenly they turn into violent shocks and after that the intencity of shocks deminishes. Tremors or shocks are felt for a few seconds only.

Earthquake is a hazard that strikes suddenly. A hindi poet described the earthquake in these word. "Earthquakes strikes without pre information but the breathing stops without informing the man."

Earthquake can occur at any time of the year, day or night. Its impact is very sudden. There are no warning signs of earthquakes. Extensive and sincere research has been conducted but success has eluded humans in the forcast or prediction of earthquake.

High risk earthquake prone areas: Bureau of Indian Standard has prepared a map of India, showing earthquake seisnic zones of different intensity. Its revised edition has been published in 2002. India has been divided into four zones. The intensity of each zone, result and losses caused by earthquake are described below:

Zone II - The earthquake is felt by all, some people run outdoor. Heavy furniture may possibly move a little small pieces of plaster fall. Cracks in chimneys.

Zone III - Everyone runs out of doors, slight damage is there even in better designed and strongly built building. More breakage in ordinary bridges houses etc. Considerable damage to poorly designed and sub-standard buildings bridges etc.

Zone IV - Slight damage in specially designed and well built building bridges etc. Heavy damage to poorly designed and badly built structures. Chimneys, poles, memorials, walls etc. fall down.

Zone V - Severe damage to even well built bridges, buildings, foundations are displaced. Cracks and fissures develop in the ground. Practically all structures fall or small are greatly damaged or destroyed.

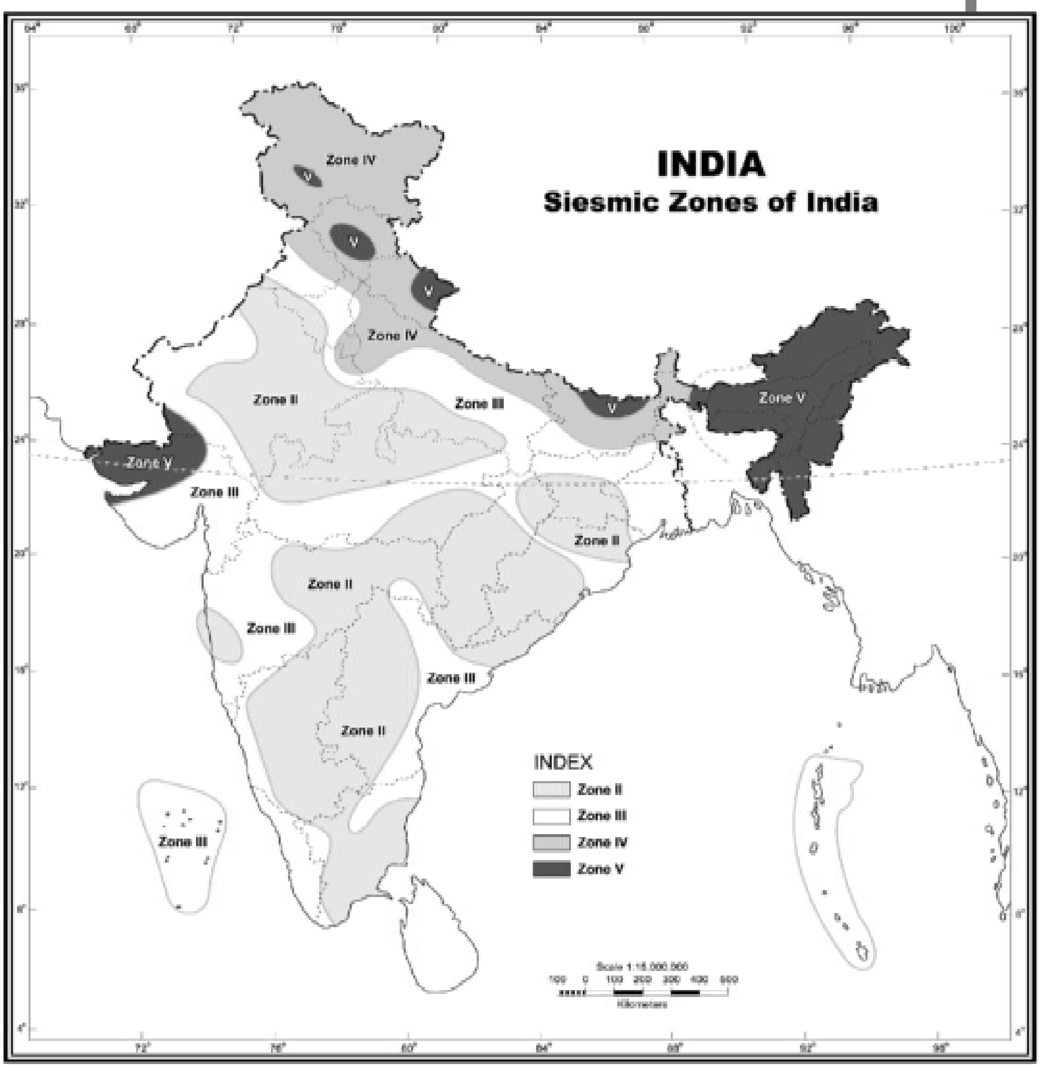

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Fig. 18.4 INDIA Siesmic Zones

Delhi and Mumbai are situated in high risk zone no. IV. The whole of North East India, Kachchh, Gujrat, Uttarakhand, Himachal Pradesh and Jammu & Kashmir are in the very high risk zone no. V. Now peninsular plateau is not safe from earthquakes. Earthquake of Latur (1993, intensity on rich for scale 6.4) and Koyna (1967 intensity 6.5) in Maharashtra testify it.

Impact of Earthquake

(i) **Damage of property :** when earthquake occurs, all buildings from cottage to palaces and stronger skyscrapers are greatly damaged or totally destroyed. Underground pipelines and railway lines are damaged or broken. Dams on river collapse, resultant floods cause havoc. The earthquake in 1967 in Koyna damaged the Dam.

(ii) **Human loss -** Duration of tremors of earthquake is normally of only few seconds, but thousands of people may die in this short period. Five severely devastating earthquakes have occurred in India between 1988 and January 26, 2001. Nearly 31000 people lost their lives prematurely. Bihar earthquake of 1934 and Kangra earthquake of 1905, 10,000 and 20,000 people died respectively. Numerous people lost their shelter and many became orphans. The earthquake that occurred in Gujarat on 26 January, 2001 was devastating and disastrous. More than 25,000 people died due to the impact of this earthquake. The destruction of property was tremendous and could not be estimated properly and exactly.

(iii) **Changes in river courses:** Sometimes river channels are blocked or their courses are changed due to the impact of earthquake.

(iv) **Tsunamis :** are caused by earthquake. This is a Japanese word, meaning extremely high sea wave. It wreaks havoc on settlement of coastal areas. It sinks large ships. Tsunami that occurred on 26-12-2004 near coast of Sumatra (Indonesia) property worth billions of rupee. More than two lakh people lost their lives in Southeast Asia, India and Sri Lanka.

(v) **Fountains of mud :** Due to the intense impact of earthquake hotwater and mud appear on the surface and take a form of fountains. In Bihar earthquake of 1934 some cracks and fissures had developed. The fields of farmer were covered by knee-deep mud and the crops were destroyed.

(vi) **Cracks and fissures :** Sometimes cracks and fissures develop in roads railway tracks, and fields, making them useless. Well known san Andreas fault formed during the earthquake of San Fransisco (California).

(vii) Landslides and avalanches are triggered

Some Do's and Don't during and after the earthquake:

Inside the house

- Don't run outside, set your family into-doorways, under table or if they are bedridden, more them under the beds; keep away from windows and chimneys.

Outside the house

- Don't go near the buildings, high walls, or electric wires.

While driving

If an earthquake occurs stop driving and keep sitting in the vehicle.

To be done immediately

(i) Put off domestic fire, and all electrical switches.

(ii) Leave the house if possible and go to open space.

(iii) Leave the house if a gas leak is detected after the gas is turned off.

(iv) Save water

(v) Untie and free pets and domestic animals (dogs, cats and cattles)

> - Sudden shaking or trembling of the earth surface is an earthquake.
> - The whole North East India, Kachchh area of Gujarat, Himachal Pradesh, Uttaranchal and Jammu and Kashmir are in the very high risk zone No. 5.

INTEXT QUESTION 18.5

1. In which state did the earthquake occur on the occasion of Republic Day of 2001?

____

____

2. What names is given to the high sea-wave triggered by earthquake?

____

____

3. In which earthquake zone Delhi has been included on the basis of the tensity of the earthquakes?

____

____

18.7 CYCLONES

Cyclones are centers of low atmospheric pressure, in which the air pressure increases from the centre to the outer areas. Consequently winds flow from outside to the centres. In cyclones winds blow in an anticlock-wise direction in the northern hemisphere and in clock-wise in the southern hemisphere.

On the basis of their location and physical properties cyclones are of two types; temperate cyclones and tropical cyclones. Here a description of only tropical cyclone is given. The use of word 'cyclone' is implied for tropical cyclone here onwards.

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Fig. 18.5 Way of Cyclones

Cyclone is a violent circular stormy, in which high velocity winds blow from outside to the centre and are associated with torrential rain. Cyclones play an important role in the general circulation of the atmosphere. A fully developed cyclone can transfer 3.5 billion tons of warm humid air within an hour.

When do cyclones occur?

Cyclone is a phenomenon. It is concentrated to certain seasonal cyclic segment. In India, most of the cyclones occur in the post monsoon season, i.e. from October to December or in pre-monsoon season from April to May. The life span of a cyclone is generally from 7 to 14 days.

The Movement of Cyclones

The cyclone, with its whole system, moves forward from east to west (in Bay of Bengal) with a speed of 15 to 30 km per hour. The cyclone that struck orissa, originated near Andaman & Nicobar Islands and reached Orissa on 29-10-1999 after many days. The movement of cyclone in a direction is like the movement of a spinning top. Cyclones originate over the sea surface and dissipate as they reach land.

Where do the cyclones strike in India

The eastern coast of India is the most cyclone affected region. The cyclone prone states are; West Bengal, Orissa, Andhra Pradesh and Tamil Nadu: Western coast is affected by the cyclones which originate in the Arabian Sea. Gujarat on the west coast, is most affected by cyclones. The coastal areas and interior of Maharstra are affected by cyclones too. More cyclones originate in the Bay of Bengal and the Arabain Sea than any other seas of the world.

Devastation by cyclones

The violent winds of a cyclone destroy whatever come in their way from; thatched cottage to the palaces, forts built of concrete, iron and stones. Trees are uprooted. Lines of electricity and communication are destroyed. Torrential rains cause floods. Floods wreak havoc all around. High sea waves are generated in the sea by speedy cyclonic winds. They strike the coastal areas like high wall of water and flood the areas upto 10-15 km from the coast. In these areas houses, crops, roads, buildings, villages and cities one and all are submerged. Landslides triggered by cyclonic rains are more devastating.

Developed countries have evolved measures to mitigate the fury of cyclones. The warning of cyclone is issued. They are broadcasted and telecasted at right time. This saves the life of people. On the contrary the people in developing countries get premature deaths. In USA, a fierce hurricane named Hugho struck in September 1989. Only 21 people lost their lives due to its impact, because a timely warming was issued, but contrary to this 1,39,000 people lost their lives in Bangladesh when a cyclone struck the country in 1991.

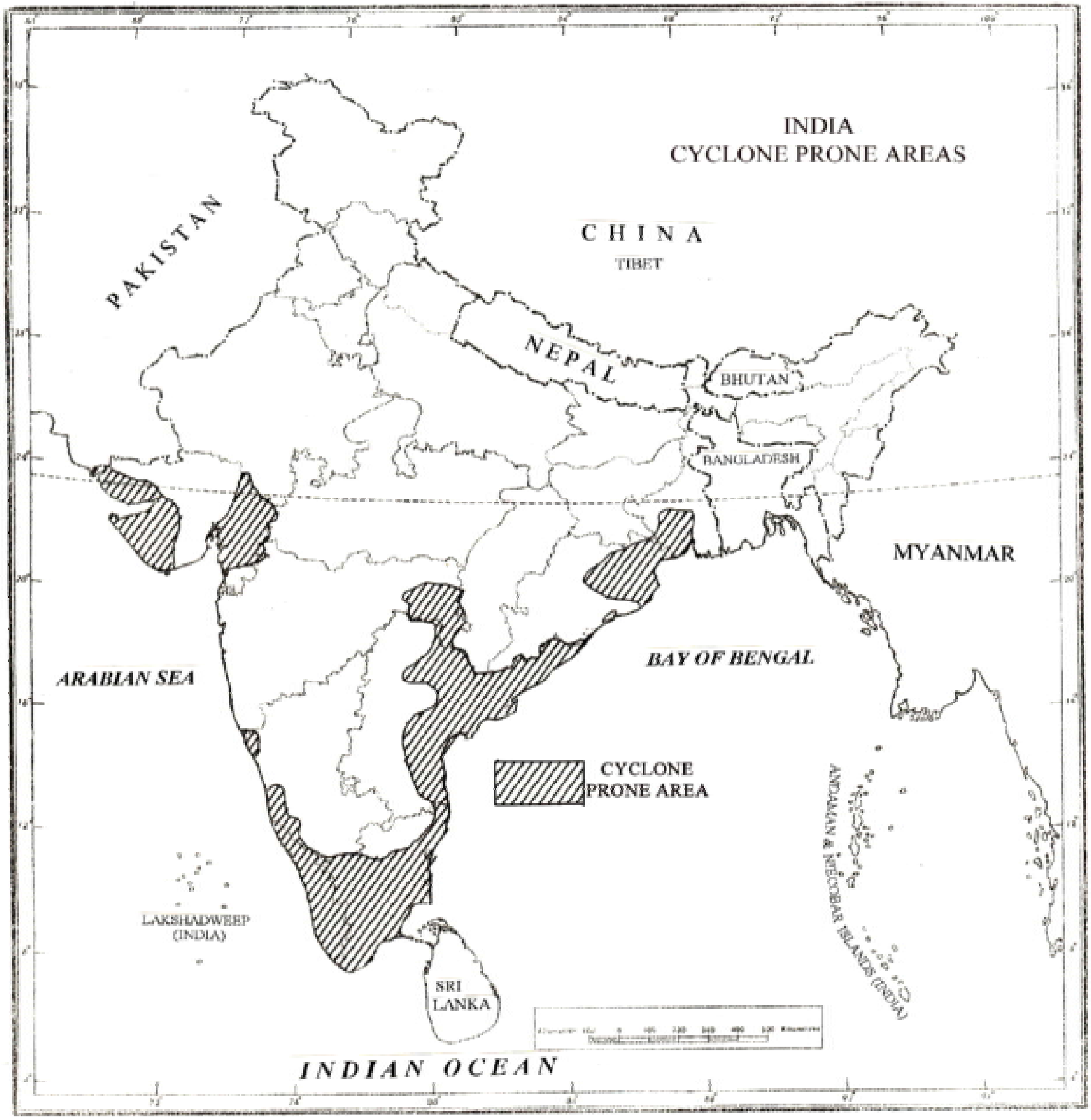

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Fig. 18.6 INDIA: Cyclone prone areas

Some do's and don'ts before, during and after the cyclone

- Listen to the radio for advance information and advice
- Keep considerable margin of time for safety.
- A cyclone may change direction, speed, or intensity within a few hours, so stay tuned to the radio for updated information.

If high velocity winds or severe gales are forecasted for your area:

- Store or secure loose boards, corrugated iron sheets, old tin boxes, anything else that could become dangerous.
- Close the windows tightly to prevent them from breakage.
- Move to the safe shelter built for this purpose, or leave the area on the advice of some authoritative government agency.

When the storm strikes.

- Stay in the house and take shelter in the stronger portion of your house.
- Listen to the radio and follow instructions.
- Open windows of the safe portion of the house if the roof begins to lift.
- Find shelter if you are in open at the hitting time of the cyclone.
- Do not go out of your house or to a beach during or lay down along an elevated footpath in open field the storm. Cyclone often generates large surges in these oceans or lakes.

> - Cyclone is violent circular storm. In its centre the air pressure is extremely low. High velocity winds flow towards the centre.
> - Most cyclone prone states of India are: West Bengal, Orissa, Andhra Pradesh and Tamil Nadu.

INTEXT QUESTIONS 18.6

1. Which are the most cyclone prone months?

____

2. Which state was hit by the seriously devastating cyclone on 29th of October, 1999?

____

3. Which state is most valuable to cyclone on the western coast of India?

____

WHAT YOU HAVE LEARNT

Among the top ten disaster prone countries, India stands second after China. More than 6% of the total population bear the brunt of natural disasters. Natural hazard, which devastates life and property, are called disasters. More than 20%

of the deaths caused by floods in the world, occur in India. Floods are caused by heavy rain, deposition of sediment and tsunami. 65% of cultivated area of India is rain fed. This is the area where droughts are common. Degradation of environment caused by human activities is also responsible for drought. By adopting some measures, the impact of drought could be mitigated. 191 districts, out of the 593 (2001) districts of India, are vulnerable to drought. Landslides cause heavy damage on mountainous slopes in rainy season. Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and all the seven states of North East India are landslide prone. Landslides are caused by deforestation, earthquakes, construction of roads and buildings, and shifting agriculture. A very severe earthquake occurred on 26 January, 2001 in Gujarat. Earthquakes not only destroy life and property, but also changes the courses of rivers. Tsunami, mud fountains, cracks and fissures are also caused by severely devastating earthquakes. The quake prone areas are North East India, Gujarat, Uttarakhand, Himachal Pradesh and Jammu and Kashmir. Cyclones originate in the Bay of Bengal and affects the states of eastern coasts. Cyclones that originate in the Arabian Sea have a devastating impact over Maharashtra and Gujarat coast If some precise precautions are taken, the impact of cyclones could be mininised.

TERMINAL QUESTIONS

1. Differentiate between natural hazard and natural disaster.
2. What is a flood ? Explain the causes of flood and its destruction.
3. Describe the drought prone areas of India.
4. What is a landslide? What activities of human bening have increased the frequency of landslides.
5. What is an earthquake? Describe its impact on humans.
6. When do cyclones occur in India? Describe the measures adopted for protection from the cyclones.

ANSWERS TO INTEXT QUESTIONS

18.1

1. When physical events pose danger to humans and their property, they are called hazards.

2. Tsunami is large sea waves caused by earthquake below sea water.

   It causes heavy destruction to life and property on coastal areas thousands of kilometers away from its place of origin.

18.2

1. Heavy rains, deforestation, cyclones, tsunami (any two).
2. 4 crore hectare.
3. Construction of reservoires and embankments, tree plantation, restoration of natural drainage system.

18.3

1. The rainfall deficiency during a long period, over a large area is called a drought.
2. Rajasthan.
3. Sprinkler irrigation.

18.4

1. Earthquakes, volcanic explosions, heavy rain, deforestation, road construction, shifting agriculture (any two).
2. Himalaya and Western Ghats.
3. (i) Tamil Nadu

   (ii) Cosntruction of strong wall on the slope.

18.5

1. Gujarat
2. Tsunami
3. Zone No. IV

18.6

1. October, Novemer, December, April and May
2. Orissa
3. Gujarat.

HINTS TO TERMINAL QUESTIONS

1. Refer to table No. 18.1
2. Refer to 18.3
3. Refer to 18.4
4. Refer to 18.5
5. Refer to 18.6
6. Refer to 18.7

19

OUR RESOURCES

Natural resources which satisfy the material and spiritual needs of humans are the free gifts of the nature. In other words, any material which is valuable and useful for humans is called a resource. These resources include physical like land, water, soils and minerals; biological living like vegetation, wildlife and fisheries. In fact every material has some utility for human beings but its utilisation is possible on the availability of appropriate technology. For example, for centuries, coal and petroleum were present below the earth's surface, but the technology for their utilisation has been developed recently. These materials turned into resources only when they could be used. It is, therefore, human ability and need which create resource value.

In this lesson we will study importance of resources, their types, extent of utilisation, their distribution and various measures of conservation.

OBJECTIVES

After studying this lesson, you will be able to:

- recall the definition of resources;
- explain the importance of resources;
- describe different types of natural resources with suitable examples;
- identify the distribution of biotic and abiotic resources in India;
- give reasons for unequal utilisation of resources and their availability;
- suggest various methods of conserving resources and;
- assess the methods of managing resources in consonance with our policies and plans.

19.1 MEANING AND SIGNIFICANCE OF RESOURCE

As noted earlier, the term resource generally means the things of utility for the humans. It could be both natural as well as cultural. Humans develop technologies to utilise nature favourably. The popular use of a technology in a natural system turns it into a culture i.e. a way of life or living. As such it attains the status of cultural resource.

1. Resources form the backbone of the economy of a nation. Without land, water, forest, air, mineral one cannot develop agriculture and industry.
2. They constitute natural environment like air, water, forests and various life forms, which are essential for human survival and development.
3. By utilising natural resources, humans created their own world of houses, buildings, means of transport and communication, industries etc. These are also very useful along with natural resources and these human made resources are essential for development.

19.2 CLASSIFICATION OF RESOURCES

Resources can be classified in several ways: one the bases of (i) renewability, (ii) origin and (iii) utility. (see fig. 19.1)

The objective of classification would primarily decide how we put a resource under a particular category.

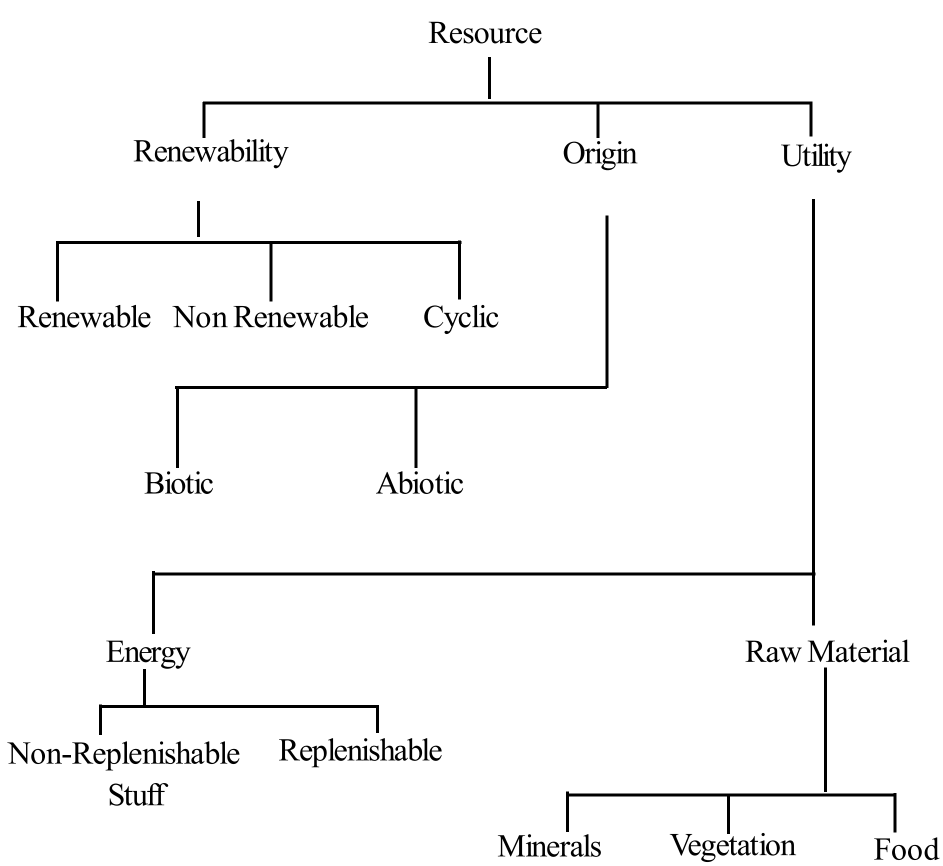


Fig. 19.1 : Classification of Resources

(i) **Biotic resources:-** These resources include all living elements of the environment. Forests and forest products, crops, birds, wildlife, fishes and other marine lives are the examples of biotic resources. These resources reproduce and regenerate themselves, hence, are renewable. Coal and mineral oil are also biotic resources but they are non-renewable.

(ii) **Abiotic resources:-** These resources include all non-living elements of the environment. Land, water, air and minerals e.g., iron, copper, gold, silver etc. are abiotic resources. They are **exhaustible and non-renewable** as they cannot be regenerated or reproduced.

- Natural resources satisfy human wants are the free girts of the nature. For example land, water, soils etc.
- Any material which is valuable and useful for humans is called a resource.
- Resources constitute the natural environment like air, water, forests and various life forms, which are essential for human survival and development.
- Resources can be classified on the basis of origin, renewability and utility.

INTEXT QUESTIONS 19.1

1. Define the term 'resources'.

   ____

2. Classify resources on the basis of their origin.

   (i)__________________________(ii)______________________________

3. Give two examples of biotic resources.

   (i)__________________________(ii)______________________________

4. Give two examples of Abiotic resources.

   (i)__________________________(ii)______________________________

5. Name two biotic resources which are non-renewable.

   (i)__________________________(ii)______________________________

19.3 DISTRIBUTION OF BIOTIC RESOURCES

Forests

When we use the term 'distribution' in the discipline of geography our main concern remain with geographical or spatial distribution of geographical phenomena. Otherwise, distribution for a sociologist primarily mean distribution among different social classes in a society.

From a geographer's point of view understanding of areas differentiations in distribution of geographical phenomena such as forests in the present case and to examine the factors responsible for such differentials is first and most vital task of any geographical study of earth's phenomena.

In India, at present forest areas cover about 76.5 million hectares of land, which is about 23 per cent of the total geographical area. It ranges from about 87 per cent in Andaman & Nicobar Islands to only about 4 percent in Haryana making to range difference of 83 percent. According to our National Forest Policy, 33% of the total geographical area of the country should be under the forest cover to maintain ecological balance. Unfortunately, it is below the norm outlined in our forest policy. The vegetation found in India can be divided into six main types. They are tropical evergreen forests, tropical deciduous forests, thorn forests, tidal forests and mountain forests.

Wildlife

India possesses a great variety of wildlife. Out of a known world total of 1.05 million species of animals about 75,000 species (7.46%) are found in India.

India has over 1200 species of birds. Among the mammals we have the majestic elephant found in the forest of Assam, Kerala and Karnataka. Camel and Wild ass are confined to the arid areas and Runn of Kachchh in Gujarat, respectively. Indian lions are found in the Gir forests of Gujarat. One horned rhinos are found in the swampy and marshy lands of Assam and West Bengal. Among the most handsome animals include four horned antelope *(Chousingha)*, Indian antelope (Black buck) and gazelle. India has several species of monkeys and deers.

The species of deer include Hangul (Kashmir stag) swamp deer, spotted deer, musk deer and mouse deer. The animals belonging to the **cat family** are leopards, clouded leopards and snow leopards. Several interesting animals are found in the Himalayan ranges such as wild sheep, mountain goats, ibex, Shrew and tapir.

Bird life is equally rich and colourful in our country. The gorgeous 'peacock' is India's National Bird. In the forests and wetlands pheasants, geese, ducks, mynahs, parakeets, pigeons, cranes, hornbills and sunbirds are found. There are song birds like the nightangale and the *bulbul.*

Livestocks

India has about three fifths or 57 per cent of the world's buffalo population and about one-sixth or 15 per cent of the cattle population. Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Uttarakhand, Jharkhand, Maharashtra, Orissa, Karnataka and Rajasthan have over two-thirds of the cattle population of India. One-fourth of the total sheep of India is found in Rajasthan and more than half of India's goats are found in Bihar, Jharkhand, Rajasthan, West Bengal and Uttar Pradesh.

Farm animals such as ox, buffalos, cows are the friends of the farming community in India. They are used in various farm operations such as ploughing, sowing, thrashing and transporting of farm products. However, with farm Mechanization especially in Green Revolution areas of north western India, coastal Andhra and Tamil Nadu and other pockets, the importance of dwarf energy for agricultural operations is on decline. Milk is provided by the cows and she-buffalos. Sheep provide us wool, mutton and skin. Goat supplies milk, meat, hair, hides and skin. Chickens, ducks, geese and turkeys are reared for eggs and feathers.

Fisheries

There is a large scope for the development of fisheries in the country because of large continental shelf of 20 lakh square km, availability of sufficient fish food in big lakes and rivers, oceanic currents and skilled fishermen. **Marine fishing** is done in seas and oceans and **Inland fishing** is carried out in lakes, rivers and reservoirs.

More than 1,800 distinct species of fish are known to exist in India. Four forms of fisheries are found in India such as marine fisheries, freshwater or inland fisheries, estuarine fisheries and the peral fisheries. Marine fisheries accounts for about 63 per cent of the annual fish production. **Major fishes are sardines, mackeral, prawns, clupeoids and silver bellies.**

About two fifths or 37 per cent of the country's total fish production comes from inland fisheries. **Major fishes are catla, rohita, kalabasil, mringal and carp etc.** More than nine-tenths or 97 percent of the country's total production of marine fish and more than three-fours or 77 per cent of inland water fish is raised in Kerala, Maharasthra, Tamil Nadu, West Bengal, Andhra Pradesh, Karnataka and Gujarat. Notably, all are coastal states.

- Forest area cover in India is about 23 per cent of the total geographical area which is much below the figure mentioned in national forest policy to maintain ecological balance.
- According to the national forest policy about 33% of total area of the country should be under forest in order to maintain eoclogical balance.
- About 75,000 species of animals and over 1200 species of birds are found in India.
- Nearly three-fifths or 57 per cent of the World's buffalo population and 15 per cent of the cattle population is found in India.
- Four forms of fisheries are found in India such as Marine Freshwater, estuarine and Peral Fisheries.

Notes

INTEXT QUESTIONS 19.2

1. How much area of India is under forests?

   ____

2. Name the state or Union Territory having the highest and the lowest proportional share of forest cover in the country.

   ____

3. Name six types of vegetation found in India.

   ____

4. How many species of animals are found in India?

   ____

5. What are the shares of India in total buffalo and cattle population in the world?

   ____

6. Name four types of fishing done in India.

   ____

19.4 DISTRIBUTION OF ABIOTIC RESOURCES

Land resources: India covers an area of 32,87,263 sq km. According to area size, it is the seventh largest country of the world after Russia, Canada, China, U.S.A., Brazil and Egypt. This vast size itself is the most important resource. About 30 per cent of area is covered by the mountains which are source of scenic beauty, perennial rivers, home of forests and wildlife. About 43 per cent of land area is plain which is highly suitable for agriculture. Remaining about 27 percent under plateaus is the store house of minerals and metals.

Water resources: India is fortunate to have large water resources. Diversity in resources is the result of diversity in land forms in the form of glaciers, surface rivers and underground water, rains and oceans. The average annual rainfall is estimated at 117 cm. Rivers are major source of surface water in India. The Indus, the Ganga, the Brahamputra carry about 60 per cent of the total surface water. Replenishable groundwater potential in India is about 434 billion cubic metres. Today, over 70 per cent of the population uses ground water for its domestic needs and more than half of irrigation is obtained from this source.

Mineral resources: India is very rich in mineral resources and has the potential to become an industrial power. It possesses large reserves of iron ore, extensive deposits of coal, mineral oil, rich deposits of bauxite and mica. Jharkhand, Orissa and Chhattisgarh possess large concentration of mineral deposits, accounting for nearly three–fourths of the country's coal deposits. Other important minerals found in our country are iron ore, manganese, mica, bauxite and radioactive minerals.

- India is the seventh largest area sized country of the world.
- The average annual rainfall is estimated at 117 cm.
- The Indus, the Ganges and the Brahamputra river systems carry 60 per cent of the total surface water available in the country.
- Jharkhand, Chhatisgarh and Orissa posesses large reserves of iron ore, bauxite and mica.

INTEXT QUESTIONS 19.3

1. In terms of area size which is the rank of India in the world?

   ____

2. What is amount of average annual rainfall in India?

   ____

3. Name the three river system which carry, sixty per cent of the total surface water in India?

   ____

4. Which are the three Indian states which have the large reserves of mineral deposits.

   ____

19.5 RESOURCE UTILISTION

To satisfy their needs, Humans have been using resources for time immerged. This process is called 'resource utilisation'. Human skills, technical know how and hard work converts the neutral stuff into a commodity or service to serve material and spiritual needs of the human society. Thus resources are created by man. But he needs the help of culture to convert the neutral stuff into valuable resources. Culture includes all the equipments and machines, means of transport and communication as well as efficient management, group cooperation, recreation, intellectual work, education, training, improved health and sanitation. Without culture, man has only a limited capacity to work and produce.

In the modern age, the application of science and technology has increased the human capacity and capability to use resources in efficient manner for production purposes. For example, United States of America and West European countries have 'high developed economies' for efficient use of their natural wealth with advanced technologies. On the other hand, several countries in Africa, Asia and Latin America are lagging far behind in development level inspite of abundant natural resources there. Since, these countries are lagging behind in terms of advanced technology.

19.6 EXTENT OF RESOURCE UTILISATION IN INDIA

The natural resources have played a significant role in the socio-economic development of our country. India is the second largest agricultural giant in the world today. It is because India has varied climatic conditions and an endless growing seasons to grow different crops. India's large mineral wealth has enabled India to be industrially developed.

In recent decades, in our desire not only to feed the fastly growing population but also to accelerate economic well being to vast Indian populatin, exploitation of resources has increased phenomenally. This has led to environmental and ecological imbalances as resources were used on un-sustainable basis. Production of resources has been motivated by the maximisation of output and profit maximization rather than the optimixation of net social benefits. The precious resource of land is the under the threat of degradation because of soil erosion, deforestation, overgrazing and careless management of forests . Unscientific farming practices like Jhuming in north-east India and an excessive use of chemical fertilizers and pesticides coupled wih over irrigation result in loss of soil nutrients, water logging and salinity.

Under pressure from rapid population growth the available resources of water are being exploited and depleted at a fast rate. Due to lack of technology only 37 per cent of total annual flow of Indian rivers and equal proportion of the available ground water resource is available for use.

After independence, the fisheries Industry, particularly the marine sector, has witnessed a massive transformation from a traditional and subsistonce type enterprise to market driven multicrore industry. Currently, India exports nearly 55 categories of marine products to South Asian, European countries and U.S.A.

- To satisfy their material and spiritual needs humans have been using the resources from the time immurial and this process is called 'resource utilisation'.
- Precious resource of land is under the threat of degradation because of soil erosion, deforestation and overgrazing.

INTEXT QUESTIONS 19.4

1. What do you understand by resource utilization?

____

2. Name the four main causes of land degradation in India.

3. What share of total average annual flow of water in the Indian rivers is available for use?

4. What percentage share of ground water is utilized in India?

19.7 CONSERVATION OF RESOURCES

Conservation of resources mean the judicious and planned use as well as reuse of natural resources by avoiding their wastage, misuse and over use.

Depletion of resources is a matter of great concern today. In order to reach the maximum production limit, we are using all those resources which are in fact the property of future generations. In fact, as the concept of sustainable development, resources are the inheritance which one generation of human society has to pass on to next one. Non-renewable resources may come to an end after some time, therefore, striking a balance between the growth of population and the utilization of resources is absolutely necessary. Of course, such a balance is bound to vary in time and space. Obviously, we have to look at the balance between population and resources in a region or country as dynamic rather than static one. Any imbalance in either of the two may disrupt the continuity of our economic, social and cultural development. So resources should be used in a planned way that imbalance does not take place.

19.8 METHODS OF CONSERVATION OF RESOURCES

(1) It is necessary to **create awareness** about the preservation and conservation of resources among people. They should be made aware of the harmful result of large scale destruction of natural resources.

(2) **Afforestation,** preventing the felling of immature and young trees and creating awareness amongst the local people about planting and nurturing trees may help in conserving forests.

(3) **Terrace farming** in hilly regions, contour ploughing, controlling the shifting cultivation, overgrazing and plugging the Gullies. Some of are the import methods of soil conservation.

(4) Construction of dams to impound rain water, use of sprinklers, drip or trickle irrigation technique, **recycling of water** for industrial and domestic purposes will help in conservation of the invaluable water resource.

(5) Minerals are non-renewable resources so they need to be conserved through efficient utilisation, development of better technology of extraction and purification, **recycling of minerals** and use of substitutes.

(6) **Non conventional sources of energy** e.g. solar, wind or water will have to be developed in order to save conventional sources of energy.

- Conservation of resources means Judicious and planned use of natural resources by avoiding their wastage, misuse and over use.
- It is necessary to create awareness among people about the preservation and conservation of resources.
- Non renewable resources need to be conserved and used with utmost care.

INTEXT QUESTIONS 19.5

1. What do you understand by conservation of resources?

   ____

2. What is a matter of great concern today?

   ____

3. Which irrigation technique should be used to conserve water?

   ____

4. What type of farming is suitable for hilly regions?

   ____

5. Give two methods of conservation of forests.

   ____

6. Name renewable sources of energy.

   ____

19.9 POLICY ON CONSERVATION OF RESOURCES

With growing consciousness of environment conservation, the efficient use of resources has become important for a developing country like India. We have to increase our R & D (Research and Development) efforts to explore for new resources, devise technologies to minimize waste and conserve non-renewable resources. Government of India has formulated several policies and programmes to implement for conservation of our biotic & abiotic resources.

1. A ministry of forests and environment was created at the Union level in 1980 to give high priority to issues relating forest and environment in the country. By now, all the state government have also created independent ministry of forest and environment.

2. National Forest policy of 1950 was revised in 1988 to make an effective tool as per current needs to protection, conservation and development of forest in the country. Under this policy social forestry scheme was launched to increase green coverage, produce and supply of fuelwood etc.

3. National land use and conservation Boards were established in 1983, and restructured in 1985 for land resource conservation and preparation of perspective plan for optimum utilization of land resources.

4. National water policy was adopted in 1987 which accord the highest priority to drinking water, followed by irrigational hydel power generation, nevigational, industrial and other uses of water.

5. A National Mineral Policy framed in 1990 has allowed both domestic and foreign enterprise to invest in mineral extraction and export. It also allowed the authority to permit investment in mineral extraction directly under the Union Ministry of Mines.

6. In new agriculture policy of encouragement is given to use eco-friendly and sustainable agricultural technology, i.e. bio-technology.

- National Forest Policy has been launched for the protection and development of forest.
- National Water Policy was adopted to conserve and preserve water resources.
- New Agriculture Policy places premier use of bio-technology.

INTEXT QUESTIONS 19.6

1. In which year the National Forest Policy was re-framed?

____

2. In which year National Water Policy was adopted?

____

3. What was the main aim of new agricultural policy?

____

WHAT YOU HAVE LEARNT

Natural resources which satisfy material and spiritual needs of humans are the free gifts of the nature. Any material found on the earth becomes a resource only when it has got some utility. It is therefore human ability and need which create resource value. Resources form the backbone of the economy of a nation. They constitute the natural environment like air, water, forests and various life forms, which are essential for human survival. They are the bases for economic strength and prosperity.

There are two types of resources on the basis of their origin - biotic and abiotic. Biotic resources include forests and all forest products, crops, birds, animals, fish and other marine life forms. Abiotic resources include land, water and minerals e.g. iron, copper, gold and silver.

About 23 percent of total area of India is covered by forests. About 75,000 species of animals are found in India. Wide climatic variations and a long crop growing season has put an advantage before India to grow variety of crops. India has nearly three-fifths or about 57 percent of the world's buffalo population and 15 percent of the cattle population. Further, the large continental shelf provides large scope for the development of fisheries in India. Vast size of India in itself is the most important resource. Large water resources are found in form of surface water, ground water, rains and oceans. Mineral wealth of India is equally rich.

Conservation of resources stands for judicious and planned use of natural resources. It is necessary to create awareness among people about the preservation and conservation of resources. Various methods like afforestation, terrace farming in hilly regions, use of advanced irrigation techniques, efficient utilization of minerals and use of alternative sources of energy should be used to conserve natural resources.

Government has adopted various measures to conserve natural resources. Several policies and programmes have been framed and Implemented to conserve the resources. Examples are framing of National forest policy, establishment of National landuse and Conservation Board, National water policy, Mineral policy and Agricultural policy.

TERMINAL QUESTIONS

1. Define resources and state how they are important to us.
2. Differentiate between biotic and abiotic resources.
3. Give a brief description of distribution of biotic resources in India.
4. Briefly explain the distribution of abiotic resources in India.
5. What do you understand by resource utilization? How is it related to culture?
6. Write a brief note on the extent of resource utilization in India.
7. What do you mean by conservation of resources? Explain various methods of resource conservation.

8. Describe major programmes and policies undertaken by Government of India for conservation of natural resources.

ANSWERS TO INTEXT QUESTIONS

19.1

1. Resources which satisfy human wants are the free gifts of the nature.
2. (1) Biotic (2) Abiotic
3. Forests, crops, birds, animals and fish.
4. Land, water, minerals.
5. Coal and mineral oil.

19.2

1. About 23 percent
2. Andaman & Nicobar Islands and Haryana
3. It is because of wide climate variations, ample sunshine and long growing season. Rice, wheat, maize, millets
4. About 75,000 species
5. Buffalo population - 57 per cent

   Cattle population - 15 per cent
6. Marine Fisheries, Freshwater, Estuarine and Pearl fisheries.

19.3

1. Seventh
2. 117cm
3. The indus, the Ganga and the Brahamputra
4. Jharkhand Orrisa and Chhatisgarh

19.4

1. Humans use their natural environment to satisfy their needs. This is called resource utilization.
2. Soil erosion, deforestation, overgrazing and careless management of forests.
3. About 37 percent
4. 37 percent

19.5

1. Judicious and planned use of natural resources.

2. Depletion of resources
3. Sprinklers, drip or trickle irrigation
4. Terrace farming
5. Afforestation, preventing the felling of immature and young trees.
6. Solar, wind or water.

19.6

1. In 1988
2. In 1987
3. To use those agricultural techniques which are eco friendly and sustainable like bio technology.

HINTS TO TERMINAL QUESTIONS

1. Natural resources which satisfy human wants are the gifts of nature.
   (i) Resources form the backbone of the economy of a nation.
   (ii) They constitute the natural environment which is essential for human survival and development.
   (iii) By utilizing natural resources humans created their own world of living like houses, buildings, means of transport & communication etc.
2. Refer section 19.2
3. Refer section 19.3
4. Refer section 19.4
5. Refer section 19.5
6. Refer section 19.6
7. Refer section 19.7 and 19.8
8. Refer section 19.9

20

LAND, SOIL AND VEGETATION RESOURCES IN INDIA

The nation's strength, be it social, economic *or* political depends mostly on the available resources and their proper utilisation. But what is a resource? In simpler terms, resource is the matter or substance which satisfies human wants at a given time and space. Before any element can be designated as resource three basic pre-conditions must be satisfied. They are the knowledge, technical skills and demand for the material or services produced. If one of these conditions is not satisfied the particular substance remains unutilised. Let us explain it through one example. From time immemorial, water is present on the earth. But it becomes a source of energy when people gained the knowledge and technical skills for hydel power generation. It is therefore human ability and need which create resource value and not their sheer physical presence. So the basic concept of resource is also related to human well-being.

India has rich endowment of resources. An integrated effort is now being made by our country to make the best use of the existing resource potential. It helps to meet the demands of growing population and also provide opportunities for employment. Simultaneously, it acts as indicator for the levels of development. In this lesson we will study three vital resources i.e. land, soil and vegetation.

OBJECTIVES

After studying this lesson, you will be able to :

- recognise the significance of land as a resource;
- identify the main uses of land;
- explain some of the problems in land resource and their solutions;
- recognise the significance of soil as a resource; .
- recall the main characteristics of each major soil type in India;

- locate major soil regions on the map of India;
- identify different factors that are responsible for the soil erosion in different parts of India;
- explain the problems created as a result of soil erosion;
- establish the relationship between measures adopted for soil conservation with types of erosion in different parts of India.
- identify major constituents of vegetation;
- recognise major vegetation types;

20.1 LAND RESOURCE

Land is our basic resource. Throughout history, we have drawn most of our sustenance and much of our fuel, clothing and shelter from the land. It is useful to us as a source of food, as a place to live, work and play. It has different roles. It is a productive economic factor in agriculture, forestry, grazing, fishing and mining. It is considered as a foundation for social prestige and is the basis of wealth and political power. It has many physical forms like mountains, hills, plains, lowlands and valleys. It is characterised by climate from hot to cold and from humid to dry. Similarly, land supports many kinds of vegetation. In a wider sense, land includes soil and topography along with the physical features of a given location. It is in this context that land is identified closely with natural environment. However, it is also regarded as space, situation, factor of production in economic processes, consumption goods, property and capital.

Availability of Arable Land

India is well endowed with cultivable land which has long been a key factor in the country's socio-economic development. In terms of area, India ranks seventh in the world, while in terms of population it ranks second. Arable land includes net sown area, current fallow, other fallow and land under tree crops. Arable land covers a total area of 167 million hectares which is 51 % of the total area of the country.

However, the arable land-man ratio is' not as favourable as in many other countries like Australia, Canada, Argentina, the USA, Chile, Denmark and Mexico. Conversely, the land-man ratio is more favourable in India than Japan, the Netherlands, Egypt, United Kingdom, Israel and China. What is the land-man ratio? Land-man ratio is defined as the ratio between the habitable area and the total population of a country.

The physical features in India are diverse and complex. There are mountains, hills, plateaus and plains which produce varied human response to the use of land resources. About 30% of India's surface area is covered by hills and mountains. These are either too steep or too cold for cultivation. About 25% of this land is topographically usable which is scattered across the country. Plateaus constitute 28% of the total surface area but only a quarter of this is fit for cultivation. The plains cover 43% of the total area and nearly 95% of it is suitable for cultivation. Considering the differences in proportion of surface area, this allows us to conclude that taking the country as a whole, about two-third of it is usable. Moreover, soils, topography, moisture and temperature determine the limits of cultivability and the quality of arable land is determined by these factors. As a result of this, half of the surface area is cultivated. This proportion is one of the highest in the world.

- Land includes both soil and topography with the physical features of a given location. It is also regarded as space, factor of production in economic processes, consumption goods, situation, property and capital.
- Land-man ratio is defined as the ratio between the habitable area and the total population of a country.
- Land-man ratio in India is not as favourable as in many countries like Australia, Canada, Argentina, USA, Chile, Denmark and Mexico. Conversely, the land-man ratio is more favourable in India than in Japan, the Netherlands, Egypt, U.K., Israel and China.

INTEXT QUESTIONS 20.1

1. Define land-man ratio.

   ____

2. Name four countries where land-man ratio is much more favourable than in India.

   (i)____________(ii)____________ (iii)__________ (iv)____________

3. Name four countries where land-man ratio is less favourable than in India.

   (i)____________(ii)____________ (iii)__________ (iv)____________

20.2 LAND USE

Out of the total geographical area (328 million hectares), land utilisation statistics are available for 305 million hectares only. The balance 23 million hectares remains unsurveyed and inaccessible. The relevant statistic are given in Table 20.1. The significant features of land utilisation are :

(a) high percentage of area suitable for cultivation;

(b) limited scope for further extension of cultivation and

(c) small area under pastures despite a large bovine population.

Table 20.1 Land Utilisation in India

Category		Area in M. Ha	% of total reporting area
1.	Net sown area	142.40	46.30
2.	Current fallow	13.70	4.20
3.	Other fallow	9.70	3.00
4.	Pastures and groves	15.40	5.00
5.	Cultivable waste	15.00	4.70
6.	Not available for Cultivation		
	(a) Barren and uncultivable land	19.60	6.20
	(b) Land under non-arable use	21.20	8.60
7.	Forest	68.00	22.00
	Total	**305.0**	**100.0**

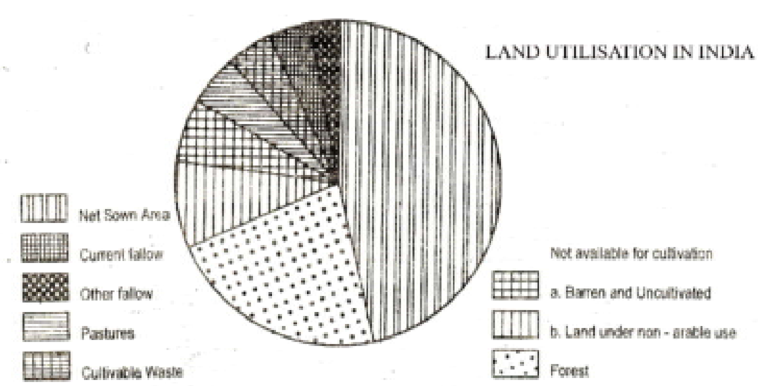


Fig. 20.1 Land utilisation in India

Presently, a little more than 40 million hectares of land is not available for cultivation. Area under this category has shown a decline from 50.7 million hectares in 1960-61 to 40.8 million hectares in 1990-91. There has been a marginal decline in fallow land from 9.9% in 1950-51 to 7.5% in 1990-91. Cultivable wastelands also witnessed an appreciable decline of 34% between 1950-51 and 1990-91. During 1950-51 and 1990-91, the net sown area has witnessed notable increase of about 20%. This area in 1950-51 was 118.7 million hectares which increased to 142.4 million hectares in 1990-91. Only 14% of the net sown area or 41.7 million hectares produced two or more crops in 90-91. Surprisingly, only 5% of the land is under permanent pastures and grazing in a country with the largest bovine population of the world. Land under non-agricultural use has increased with the accelerated growth in economy. The process of industrialisation and urbanisation demands more land under roads, railways, airports, human settlements and industries not excluding huge multi-purpose dams. Essentially, on the limited total area all the cultural uses of land must be accommodated. Obviously, it can be realised mainly at the cost of land under agriculture. In 1950-51, the total area under non-agricultural use was 9.3 million hectares which increased to 21.2 million hectares in 1990-91. Contrary to general belief, the percentage of land under forest is one of the lowest in the world. Forests occupy not more than 22% of the total geographical area of the country, while the world average is 30%. According to land use statistics, area under forests has increased from 40 million hectares in 1950-51 to 68 million hectares in 1990-91. It is much below the desired national goal of one third of the total area.

Thus, land use is a dynamic process. It changes over time due to a number of factors, including increasing population, changes in cropping system and technology. As the various sectors of the economy develop, there may be a shift in the pattern of land use. However, the bulk of the land continues to be used for raising crops. With unabated population growth, the pressure of population on arable land is bound to grow. Indeed, it should be a matter of great national concern.

20.3 LAND PROBLEMS

Out of the total land area, as many as 175 million hectares suffer from degradation. Land degradation is caused largely by soil erosion, but also by water logging and excessive salinity. The most serious threat to the soil is posed by deforestation. Heavy railfall during monsoon damages the soils. Steep slopes encourage rapid runoff leading to soil erosion especially on the southern slopes of the Himalayas and the western slopes of the Western Ghats. Major portions of the Himalayas are prone to landslides and erosion. Wind erosion is prevalent in Rajasthan, gully erosion in Chambal Valley, Chotanagpur, Gujarat, Submontane Punjab Himalaya. Water logging and salinisation which constitute the second major threat to soil have already consumed 13 million hectares and threaten many more. The lands affected are mostly situated in canal irrigated areas. They have suffered because of the absence of adequate drainage. Land is also degraded due to mining operations in many parts of the country. The total land area affected is about 80 thousand hectares by mining. Urban encroachment on good quality agricultural land is another problem by which the amount of land used for agriculture is steadily declining. In other words, there is a tough competition between agriculture, urban and industrial development. There are social conflicts that are arising out of the rights to occupy and transfer of land. The tenant cultivators face major disincentives such as the fear of eviction, the insecurity of tenure, high rents and inadequate surplus to invest. Land ceiling laws have not been implemented with adequate strictness.

20.4 SOLUTION OF LAND PROBLEMS

To deal with these problems, the country has adopted a two-fold approach; physical and social. Physical reclamation of land is achieved through chemical treatment of water-logged soils and is followed with scientific rotation of crops. Similarly, land rendered useless by river action and river floods are also reclaimed after necessary treatment to restore their fertility and texture. Physical reclamation of desert lands calls for more sustained efforts. It requires introduction of suitable natural vegetation and canal or well irrigation or even both. It helps to raise water table. Social approach on the other hand is reflected through state legislation aiming at overall rural reconstruction, promoting agriculture and its productivity in particular. Consolidation of land holdings is one measure among many. It provides necessary motivation and empowerment of a tiller by confirming on him the rights of land tenure/ownership. Elements of social exploitation are promptly. removed e.g. absentee landlords. Thus legislation is used to ensure social justice.

Remote sensing data have shown that about 200 square kilometres of the Gulf of Kuchchh have been covered by sedimentation. The National Remote Sensing Agency has estimated 53 million hactares (16%) as wasteland in the country. Among the states, the highest incidence of wastelands is recorded in Jammu and Kashmir (60%) followed by Rajasthan (38%), Sikkim and Himachal Pradesh (37% each) and Gujarat (17%). The Government of India constituted the National Wasteland Development Board in 1985 with a view to enhancing productivity of wastelands. It includes the programe of afforestation of 5 million hectares per year.

India does not have shortage of land. But, land reform policies need to be reoreinted for further increase in food production.

- Land use is a dynamic process. It changes over time due to a number of factors including increasing population, changes in cropping system and technology. As various sectors of the economy develop, there may be a shift in the pattern of land use.
- The major land problems include land degradation due to soil erosion, water logging, salinisation, mining operations and urban encroachment on good quality agricultural land.
- India has adopted two ways to develop land:

  (a) physical (reclamation of land) and (b) social (land reforms)

INTEXT QUESTIONS 20.2

1. Name three areas where gully erosion is much more prominent.

   (i)________________ (ii)________________ (iii)________________

2. What is the most serious threat posed to the soil?

   ____

3. Name two methods adopted to develop land.
   (i)________________________ (ii)____________________________
4. Which is the area where wind erosion is more prominent?
   ____

20.5 SOIL RESOURCES

Soil is defined as upper layer of the earth composed of loose surface material. It is a mixture of many substances including endless variety of minerals, remnants of plants and animals, water and air. It is the end product of continuing interaction between the parent material, local climate, plant and animal organisms and elevation of land. Since each of the elements varies over space, soils also differ from place to place. Soil is an important segment of our ecosystem, as it serves an anchorage for plants and source of nutrients. Thus, soil is the seat, the medium and fundamental raw material for plant growth. Through its relative fertility, it affects man's economic activities and shapes the destiny of our country. When the soil is lost, property and culture are also lost. Therefore, it is a valuable national and fundamental earth resources of the country.

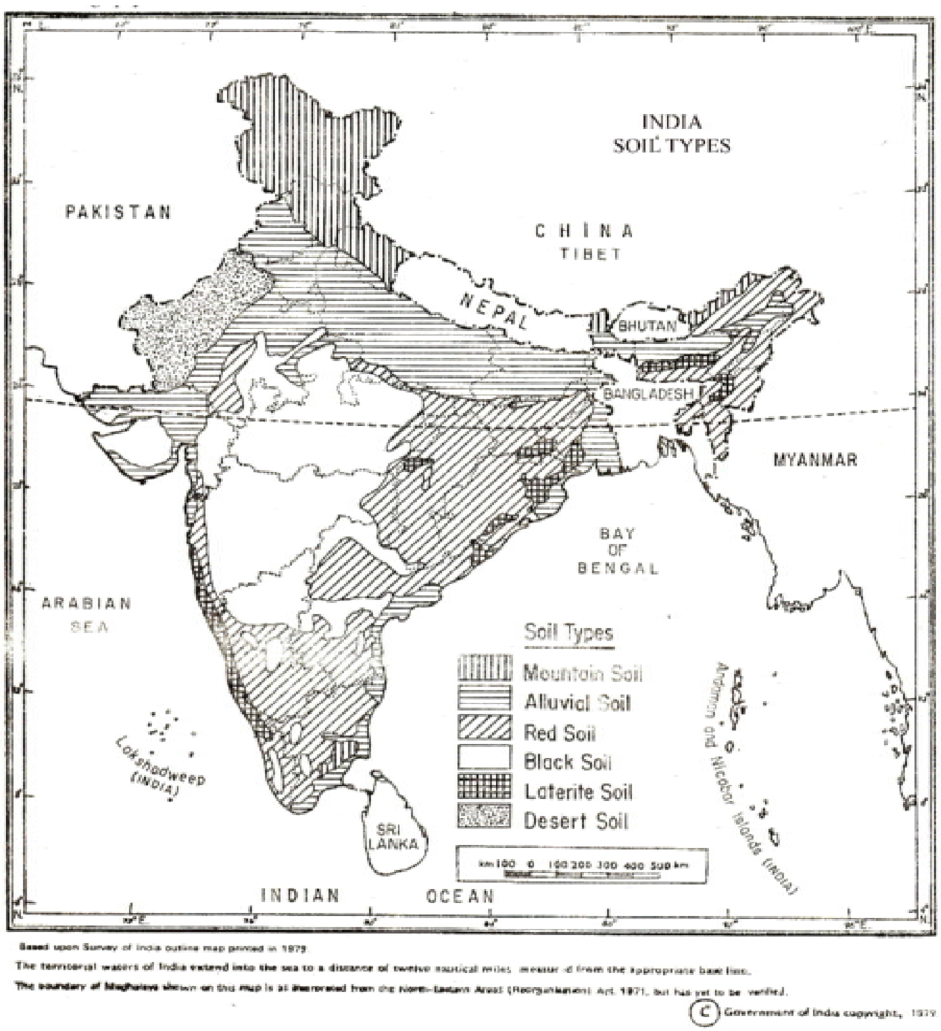


Fig. 20.2 : Soil types

20.6 MAJOR SOIL TYPES

The soils of India are broadly divided into following six types:

1. Alluvial Soils

Alluvial soil is the most important soil type of India. It covers the vast valley areas of the Sutlej, Ganga and Brahmaputra and the fringes of the southern peninsula. It is thin near the fringe of the plateau. The alluvial soils occupy 64 million hectares of the most fertile land. The soils vary from sandy loam to clay in texture and are rich in potash but deficient in nitrogen and organic matter. Generally, the colour varies from grey to reddish brown. These soil are formed of deposits of silt and sand brought down by the rivers flowing from the Himalayas and the Great Indian plateau. Being young, the soils lack profile development. Being extremely productive, these soils are most important from the point of view of Indian agriculture. Based on geographical considerations, this soil can be subdivided into two divisions: newer alluvium (khadar) and older alluvium (bangar). Both are different in texture, chemical composition, drainage capacity and fertility. The newer alluvium is a light friable loam with a mixture of sand and silt. It is found in river valley, the floodplains and deltas. On the other hand, the older alluvium lies on the inter fluves. The higher proportion of clay makes the soil sticky and drainage is often poor. Almost all crops are grown on these soils.

2. Black Soils (Regur)

The black soils are found mainly on the Deccan lava region covering large parts of Maharashtra, some parts of Gujarat and Madhya Pradesh and small parts of Karnataka, Andhra Pradesh and Tamil Nadu. The soils are formed by disintegration of volcanic basaltic lava. The colour of the soil is generally black due to presence of compounds of aluminium and iron. The soil is locally known as regur which extends roughly to 64 million hectares. It is generally clayey deep and has low permeability and impregnable. But it's depth varies from place to place. It is very thick in lowlands but very thin on highlands. The most important characteristics of this soil are its ability to retain moisture even during the dry season. The soils form wide cracks during summer due to moisture loss and swell and become sticky when saturated. Thus, the soil is aerated and oxidised to deep levels which contribute to maintain its fertility. This continued fertility is favourable in the area of low rainfall for cotton cultivation even without irrigation. Other than cotton, this soil is favourable for the cultivation of crops like sugarcane, wheat, onion and fruits.

3. Red Soils

Red soils cover large part of the Peninsular upland in Tamil Nadu, Karnataka, Goa, South east Maharashtra, Andhra Pradesh, Orissa, Chotanagpur Plateau and Meghalaya Plateau. They encircle the black cotton soil zone. They have developed on the crystalline rocks like granite, gneisses and cover roughly

72 million hectares of the arable land. Iron compounds are abundant making the soil reddish in colour but they are deficient in organic matter. The red soils are generally less fertile and are not as important agriculturally as the black and alluvial soils. But the productive capacity can be raised through irrigation and use of fertilizers. This soil is suitable for rice, millet, maize, groundnut, tobacco and fruits.

4. Laterite Soils

The laterite soils are commonly found in area of high altitude and heavy rainfall in Karnataka, Tamil Nadu, Madhya Pradesh, Jharkhand, Orissa, Assam and Meghalaya extending over 13 million hectares. They generally form under hot and humid climatic conditions. The lateritic soils are particularly found on high flat erosion surfaces in areas of high and seasonal rainfall. Loss of nutrients by accelerated leaching is the most common feature which renders the soil infertile. The pebbly crust is the important feature of laterites which is formed due to alteration of wet and dry periods. As a result of weathering, laterite becomes extremely hard. Thus, their characteristics include complete chemical decomposition of the parent rock, complete leaching of silica, a reddish brown colour given by the oxides of aluminium and iron and lack of humus. The crops which are generally grown are rice, millets, sugarcane on lowland and tropical plantation such as rubber, coffee and tea on uplands.

5. Desert Soils

The desert soils occur in western Rajasthan, Saurashtra, Kutchchh, western Haryana and southern Punjab. The occurance of these soils is related to desert and semi-desertic conditions and is defined by the absence of water availability for six months. The soil is sandy to gravelly with poor organic matter, low humus contents, infrequent rainfall, low moisture and long drought season. The soils exhibit poorly developed horizons. Plants are widely spaced. Chemical weathering is limited. The colour of the soil is either red or light brown. Generally, these soils lack the basic requirements for agriculture, but when water is available, variety of crops like cotton, rice, wheat etc. can be grown with proper dose of fertilizers.

6. Mountain Soils

The mountain soils are complex and extremely varied. The soils vary from deep alluvium in the river basins and lower slopes to highly immature residual gravelly on higher altitudes. Because of complex topographic, geologic, vegetation and climatic conditions, no large areas of homogenous soil groups are found. Areas of steep relief are mostly devoid of soil. Various types of crops are grown in different regions like rice in valley, orchards on slopes and potato in almost all areas.

20.7 SOIL EROSION

Soil erosion is described as the carrying away of soil. It is the theft of the soil by natural elements like water, wind, glacier and wave. Gravity tends to move soil down slope either very slowly as in soil creep or very rapidly as in landslides. The present shape of land has been carved through thousands of years. Soil erosion has become now one of the major environmental problems and a serious constraint for agricultural production. There are many physical and social factors which determine the extent and severity of soil erosion. The principal physical factors are erosivity of rainfall, erodibility of soil, severity of periodic floods, length and steepness of the slope. The important social factors are deforestation, overgrazing, nature of land use and methods of cultivation. Ravines, gullies and landslides are most serious and highly visible forms of land erosion. On the other hand, sheet erosion caused by rains and erosion due to winds are least visible but equally serious as they too take a heavy toll of our precious top soils. Soil erosion by ravines and gullies is widespread in India, It has been estimated that 3.67 million hectares of soil surface is damaged. There are four major areas of ravines and gullies in India. They are (1) Yumuna-Chambal ravine zone, (2) Gujarat ravine zone, (3) The Punjab Siwalik foothills zone and (4) Chhotanagpur zone. There are other areas of substantial ravine erosion in the Mahanadi valley, upper Son valley, upper Narmada and Tapi valleys, Siwalik and Bhabar tract of the western Himalayan foothills and edges of Ganga Khadar in western Uttar Pradesh. The relatively less affected areas are whole of Deccan south of the Godavari, the Ganga-Brahmputra plains, east of Varanasi, Kutchchh and western Rajasthan. Sheet erosion is widespread over sloping deforested terrain, unterraced uplands of Peninsular region, Sutlej-Ganga plains, Coastal plains, Western Ghats and North-Eastern hills.

The occurrence of landslides is common in earthquake sensitive belts, particularly the Siwaliks. Heavy rainfall and cutting of slopes for roads, buildings and mining activities trigger landslides. In the last 50 years, the Rajasthan desert has encroached upon 13000 hectares of land in Rajasthan, Gujarat, Haryana and Uttar Pradesh. Glacial erosion is limited to high Himalayas and sea erosion is confined to coasal areas only. Soil erosion and soil exhaustion due to loss of soil nutrients pose serious threats to our efforts of increasing the productivity of soil faster than the population growth.

20.8 SOIL CONSERVATION

Methods by which soil is prevented from being eroded consitute soil conservation. If the soil is wasted or blown away, it is not easy to replenish it. Therefore, the most important step of soil convservation is to hold the soil in place. This is possible by improved agricultural practices in different regions. Contour ploughing and terracing are generally practised on the hill slopes. They are the simplest conservation methods. Rows of trees or shelter belts are planted to protect the fields in desert regions from wind erosion. Afforestation of the catchment areas and slopes in the Himalayas, the Upper Damodar valley in Jharkhand and the Nilgiri hills in the south has been implemented. It reduces the surface runoff and binds the soil. Ravines are noted for their enormous size and depth with vertical sides. The Central

Soil Conservation Board has established 3 research stations: (1) Kota in Rajasthan, (2) Agra in Uttar Pradesh and (3) Valsad in Gujarat to suggest methods of reclamation of ravine lands. Overgrazing by sheep, goat and other livestock has been partly responsible for soil erosion. Erosion due to these factor has been reported from Jammu & Kashmir, Himachal Pradesh, Rajasthan and Karnataka. Soil exhaustion can be prevented by the application of manure and fertilisers.

- The six major types of soil found in India are alluvial, black, red, laterite, desert and mountain soil.
- Both physical and social factors cause soil erosion. The physical factors are erosivity of rainfall, erodibility of soil, severity of periodic floods and length and steepness of the slope. The social factors are deforestation, overgrazing, nature of land use and methods of cultivation.
- Major forms of soil erosion are ravines, gullies, landslides and sheet erosion.
- Contour ploughing, terracing, planting of shelter belt afforestation checking of overgrazing and application of manures and fertilizers are the methods of soil conservation.

INTEXT QUESTION 20.3

1. (a) Name the two important regions of alluvial soils.

   (i)__________________ (ii)__________________

   (b) Which element are responsible for red colour in red soils?

   ____

2. (a) Name three major types of soil erosion:

   (i) ____________ (ii) ____________ (iii) ____________

   (b) Name four methods of soil conservation adopted for preventing soil erosion.

   (i) ________ (ii) ________ (iii) ________ (iv) ________

20.9 NATURAL VEGETATION IN INDIA

The assemblage of plant species, e.g. trees, shrubs, grasses, creepers and climbers and the like living in association with one another in a given environment is known as natural vegetation. Contrary to this, a forest denotes a large tract covered by trees and shrubs which has an economic significance for us. Thus, a forest has a different connotation than what the Natural Vegetation has.

The variations in climatic conditions in India have resulted in having various types of natural vegetation in different parts of the country. It is so because each plant needs a definite range of temperature and precipitation for its growth. This justifies the growth of tropical evergreen vegetation confined mainly to the Western Ghats, on account of hot and wet climatic conditions. The same is true for temperate evergreen vegetation of northeast India and thorny or arid or semi-arid vegetation of Rajasthan desert and adjoining areas. Deciduous vegetation grows in central parts of India owing to moderate climatic conditions prevailing over there.

MAJOR VEGETATION TYPES

Natural vegetation cover in India is generally divided under the following heads:

i) Moist Tropical Evergreen and Semi–evergreen Vegetation

ii) Moist Tropical Deciduous Vegetation

iii) Dry Tropical Vegetation

iv) Tidal Vegetation and

v) Mountain Vegetation.

1. Moist Tropical Evergreen Vegetation

These are the tropical rain forests which are further divided into two sub-types on the basis of their characteristics as under:

(a) **The Wet Tropical Evergreen Vegetation** is found in regions of very high annual rainfall exceeding 300 cms. with a very brief dry season. Southern parts of Western Ghat of Kerala and Karnataka are very wet. Northeastern Hills are known for this type of vegetation. It resembles the equatorial vegetation. This type of vegetal cover has been badly depleted due to over cutting of trees. The major characteristics of this type of vegetation are:

(i) These forests are dense and have lofty evergreen trees, often as high as 60 metres and above.

(ii) The number of vegetal species per unit area is too large to exploit them commercially.

(iii) Mahogony, cinchona, bamboos and palms are typical species of plants found in these forests. Undergrowth is very dense and thick. Grass is almost absent.

(iv) The wood of these trees is very hard and heavy to work with.

(b) **Moist Tropical Semi-evergreen Vegetation** is found between wet evergreen vegetation and moist temperate deciduous vegetation. This type of vegetation is found on the Meghalaya plateau, Sahyadris and Andaman and

Nicobar Islands. This vegetation is confined to areas receiving an annual rainfall of about 250 to 300 cms. Its important characteristics are:

(i) The vegetation cover is less dense than the wet evergreen forests.

(ii) Timber of these forests is fine textured and of good quality.

(iii) Rosewood, aini and telsur are important trees in Sahyadris, champa. joon and gurjan in Assam and Meghalaya and ironwood, ebony and laurel grew in other regions.

(iv) Shifting agriculture and over exploitation of forests have depleted this vegetal cover to a great extent.

2. Moist Tropical Deciduous Vegetation

This is the most wide spread vegetal cover of India. This type of vegetation is found in areas receiving annual rainfall of 100 to 200 cms. These include the Sahyadris, the northeastern plateau of the peninsula, the Himalayan foot hills in the Siwaliks, the bhabars and terai. The important characteristics of this vegetation are:

(i) The trees shed their leaves once in a year in dry season.

(ii) This is a typical monsoon vegetation consisting of larger number of commercially important species than the evergreen forests.

(iii) Teak, sal, sandalwood, shisham, cane and bamboo are important trees of these forests.

(iv) Large scale cutting of trees for timber has depleted these forests hopelessly.

3. Dry Tropical Vegetation

This type of vegetation is divided into two groups as under:

(a) **Dry Tropical Deciduous Vegetation** is found in regions receiving annual rainfall between 70 to 100 cms. These regions include parts of Uttar Pradesh, northern and western Madhya Pradesh, parts of Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu. These areas experience a long dry season and a moderate rainfall limited at best to four months. The important characteristics of this vegetation are :

(i) Stretches of open grass are most common between group of trees. Teak is the dominant tree of this type of vegetation. .

(ii) The trees shed their leaves during the long dry season.

(b) **Dry Tropical Thorny Vegetation** is found in areas receiving annual rainfall less than 70 cms. These areas include north and northwestern parts of

India and leeward side of the Sahyadris. The important characteristics of this type of vegetation are:

(i) Vast, poor and coarse grasslands are interspersed with widely spaced trees and bushes.

(ii) Acacia, euphorbias, cactus etc. are true representatives of this type of vegetation. Wild palm and spiny and thorny varieties are also found here and there.

4. Tidal Vegetation

This type of vegetation grows mainly in the deltaic regions of the Ganga, Mahanadi, Godavari and Krishna which are flooded by tides and high sea waves. Mangrove is the representative of this type of vegetation. Sundari is the typical tree of tidal forests. It is found in abundance in the lower Ganga delta of West Bengal. This is the reason why it is popularly known as Sunderban. It is known for its hard and durable timber.

5. The Mountain Vegetation

Due to the difference in temperature and other weather conditions of northern and peninsular mountain ranges, there exists difference in the vegetal cover of these two groups of mountain ranges. Hence, the mountain vegetation can be classified as the mountain vegetation of Peninsular plateau and the mountain vegetation of the Himalayan ranges.

(a) The Mountain Vegetation of Peninsular Plateau: The high altitude area of the plateau region include Nilgiri, Annamalai and Palni hills, Mahabaleshwar in Western Ghats, Satpura and Maikal hills. The important characteristics of vegetation of this region are:

(i) Stretches of open rolling grass plains with undeveloped forests or bushes are found.

(ii) The wet temperate forests below 1500 metres are less dense than those found above this height.

(iii) The forests have thick undergrowth, epiphytes, mosses and ferns.

(iv) Magnolia, laurel, elm are common trees.

(v) Cinchona and eucalyptus have been introduced from outside the country.

(b) The Mountain Vegetation of the Himalayan Ranges: In the Himalayan mountain region, the vegetation is different at increasing altitudes. This can be divided into following types:

1. Moist Tropical Deciduous forests are found along the foot hills in the Siwaliks, upto the height of 1000 metres. We have already learnt about these forests.

2. The Wet Temperate Evergreen forests are found in the areas lying between 1000 to 3000 metres. The important characteristics of these forests are:

(i) These are very thick forests of lofty trees.

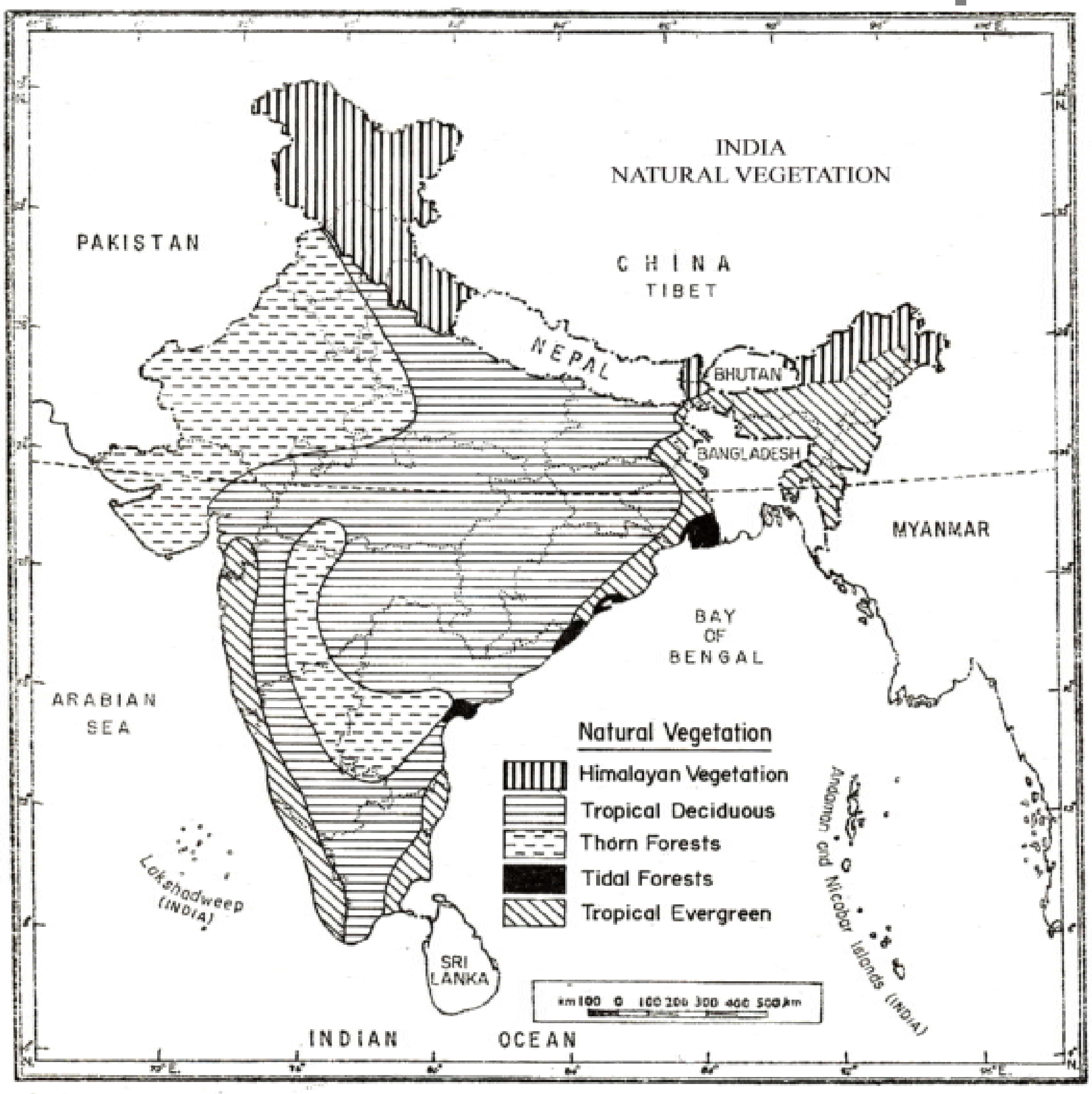
(ii) Oak and chestnut are the predominant trees of the eastern Himalayan region while chir and pine are in the western part.

(iii) Sal is the important tree in lower altitudes.

(iv) Deodar, silver fir and spruce are predominant trees between the height of 2000 and 3000 metres. These forests are less dense as compared to the forests at lesser elevations.

(v) These forests are of great economic importance to the local population.

3. Dry Temperate Vegetation is found on the higher hilly slopes of this mountain region which has moderate temperatures and rainfall between 70 cms and 100 cms. Important characteristics of this type of vegetation are:



Based upon Survey of India outline map printed in 1979.

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Areas (Reorganisation) Act. 1971, but has yet to be verified.

Fig. 20.3 Natural Vegetation in India

(i) This vegetation resembles the Mediterranean vegetation.

(ii) Wild olives, acacia are important trees along with hard, coarse and thick savanna grass.

(iii) Oak and deodar are found here and there.

4. Alpine Vegetation is found between the altitude 3000 and 4000 metres. The important characteristics of these forests are:

(i) These are far less dense,

(ii) Silver fir, juniper, birch, pine and rhododendron are important trees of these forests. However, all of them have only a stunted growth.

(iii) Alpine pastures are found at still higher altitudes.

(iv) The trees get progressively stunted as they approach the snow line.

- Natural vegetation is the assemblage of plant species living in association with one another in a given environment.
- Variations in temperature and rainfall conditions have a clear impact on vegetation of different regions.
- The major vegetation belts include the moist tropical evergreen, the moist tropical deciduous, dry deciduous, the tidal and the mountain vegetation. Mountain vegetation spans almost from the tropical to Alpin types.

INTEXT QUESTIONS 20.4

1. Give suitable technical terms for the following statements:

(a) The assemblage of plant species living in association with one another in a given environment______________________.

(b) A large area densly covered by trees and shrubs generally with a common crown or canopy______________________.

2. Classify the following species of trees into the types of vegetation given below :Mahogony, Ebony, Shisham, Cinchona, Sal, Palm, Rosewood

(i) Moist Tropical Evergreen______________________.

(ii) Moist Tropical Deciduous______________________.

(iii) Moist Tropical Semi-evergreen______________________.

3. Name the type of vegetation found in the regions of annual rainfall

(i) exceeding 300 cms.______________________.

(ii) between 200 and 300 cms.______________________.

(iii) between 100 and 200 cms. ______________________.

4. Give two most important characteristics of the moist tropical deciduous vegetation.

(a) ___________________________ (b)___________________________

WHAT YOU HAVE LEARNT

Land is our basic resource. It has different roles like productive economic factor, foundation for social prestige and is the basis of wealth and political power. India is well endowed with cultivable land. It has favourable land-man ratio than Japan, and Netherlands, whereas it is not as favourable as it is in Australia, Canada and the U.S.A. Land use is a dynamic process. It changes over time due to a number of factors including increasing population and changes in cropping pattern and technology. However, bulk of land continues to be used for raising crops. India faces a lot of problems related to land. They are land degradation, tenure or ownership of land and deforestation. India has adopted two broad measures, land reclamation and land reforms to solve these problems. Soil is defined as upper layer of the earth composed of loose surface material. The soils of India are broadly divided into six groups. They are alluvial, regur or black, red, laterite, desert and mountain soils. Like land, soil also has problems such as soil erosion and soil exhaustion. Various soil conservation methods like contour ploughing terracing, shelter belt formation and afforestation are adopted in India. Natural vegetation implies the assemblage of plant species living in association with one another in a given environment. Diversity in climatic conditions has resulted into a marked diversity in natural vegetation. The important vegetation types in India include the moist tropical evergreen, the moist tropical deciduous, the dry deciduous, the tidal forests and the mountain vegetation.

TERMINAL QUESTIONS

1. What are the significant features of land utilization in India?
2. Give a brief description of various types of land use in India.
3. Write two main characteristics of each soil type of India.
4. Describe various measures undertaken for conservation of soils.
5. Differentiate between these:
   (a) Laterite soil and red soil
   (b) Soil erosion and soil conservation
   (c) New alluvium and old alluvium
6. Define natural vegetation. How is a forest different from it?
7. Distinguish between Tidal vegetation and Mountain vegetation.
8. Give reasons:
   (i) The Himalayan vegetation belt are defined altitudinally and not horizontally.
   (ii) The dry regions are covered with thorny frees and bushes.
9. Locate and label the following on an outline map of India::
   (i) Alluvial soil.
   (ii) Laterite soil.
   (iii) Desert soil.
   (iv) Tidal forests and tropical thorn forest.

ANSWER TO INTEXT QUESTIONS

20.1

1. Land-man ratio is defined as the ratio between the habitable area and the total population of a country.
2. Australia, Canada, Argentina, USA, Chile, Denmark and Mexico (Any four)
3. Japan, Netherland, Egypt, U.K., Israel and China. (Any four)

20.2

1. Chambal valley, Chotanagpur, Gujarat, Submountane Punjab Himalaya (Any four)
2. Deforestation
3. (i) Physical (land reclamation), (ii) Social (land reforms)
4. Rajasthan

20.3

1. (i) Valley areas of Sutlej, Ganga, Brahmaputra, (ii) Fringes of the southern peninsula.
   (b) Compounds of Iron
2. (a) gully erosion, sheet erosion, landslides, ravine erosion (any three)
   (b) contour ploughing, terracing, shelter belt formation, afforestation.

20.4

1. (a) Natural vegetation, (b) Forest
2. (i) Mahogony, cinochona and plam
   (ii) Sal and Shisham
   (iii) Ebony and Rosewood
3. (i) Moist Tropical Evergreen
   (ii) Moist Tropical semi-evergreen
   (iii) Moist Tropical Deciduous
4. (i) The trees shed their leaves once in a year in dry season
   (ii) This belt consists of a number of commercially important species of trees such as teak, sal, shisham, bamboos and sandalwood.

HINTS OF TERMINAL QUESTIONS

1. Refer to 20.1
2. Refer to 20.2
3. Refer to 20.6
4. Refer to 20.8
5. (i) Refer to 20.6
   (ii) Refer to 20.7 and 20.8
   (iii) Refer to 20.6
6. Refer to 20.9
7. Refer to 20.9
8. (i) Refer to 20.9 (5)
   (ii) Refer to 20.9 (3)
9. With the helps of maps given in the book as well as with the help of atlas locate the given soils and forests on the outline map of India.

21

OUR WATER RESOURCES

Water is so important for life that we can not imagine life without it. The evolution of life itself took place in the water. In the evolution of all kinds of life, water has played an important role. The amount of water found in the living beings is 65 per cent and 65 to 99 percent in plants. This clearly shows the need and utility of water. Water which is a precious gift of the nature has several uses. Water is very essential for the development.

From the point of view of availability and suitability, the potable water is limited in India. Morever, it has highly unown geographical distribution. Another disturbing issue is day by day deteriorating quality of water. It is a matter of great concern for all of us. Besides coordinating the demand and supply of the water, there is a need to keep the balance among different sources of water. Hence conservation of water resources is an essential requirement.

OBJECTIVES

After studying this lesson, you will be able to

- know different sources of water;
- explain the meaning of water budget;
- explain the uneven distribution of water;
- know the utility of water;
- understand the utility and distribution of different sources of irrigation;
- locate important river valley projects on the map;
- explain the need of the water management;
- explain the impact of flood and draught on the life of the people;
- explain the meaning of watershed development;
- explain the methods of conservation of water resources.

21.1 WATER RESOURCES

Water is the most valuable resources of nature. This is renewable and inexhaustible resource but is in trouble these days. Demand of water has been increasing continuously its supply decreasing. If we look at the water resources of India in the global contect, India has 4 percent water whereas she is housing 16 percent of the world's population. It means the per capita availability of water is quite low in our country. India ranks first in the world in irrigated area. One-eighth area of the country is flood prone and one-sixth area is under the grip of drought. Nature of monsoon is mostly responsible for this. Food grains and other agricultural products are required in large quantity for the growing population. For this reason the use of water for irrigation of crops has been increasing. The demand for water has increased in the cities due to rapid urbanization, industrialization, and modernization. In addition, the demand for water has been increasing for sewerage and for removing all kinds of wastes.

21.2 SOURCES OF WATER

There are four main sources of water: (i) Surface water (ii) Underground water (iii) Atmospheric water, and (iv) Oceanic water. In our daily life we use only surface water and underground water. Let us study them in detail.

(A) Surface water – The main source of surface water is precipitation. About 20 percent part of the precipitation evaporates and mixes with the environment. A part of the running water goes underground. The large part of surface water is found in rivers, riverlets, ponds and lakes. Remaining water flows into the seas, oceans. Water found on the surface is called surface water.

About two – third of the total surface water flows into three major rivers of the country – Indus, Ganges and Brahmaputras. The water storage capacity of reservoirs constructed in India so far is about 17400 billion cubic metres. At the time of independence, the water storage capacity was only 180 billion cubic metres. Hence water storage capacity has increased about ten times.

Table 21.1 INDIA : Distribution of surface and underground water according to river basins

(Figures in billion Cubic metre)

River basin	Surface water flow		Underground water	
	Annual flow	Usable capacity	Renewable	Usable Capacity
1. Indus	71.3	46.0	26.5	24.3
2. Ganga	525.0	250.0	171.0	157.0
3. Brahmaputra	629.0	24.0	27.0	24.0
4. Godavary	110.5	76.3	40.7	37.0
5. Krishna	70.0	58.0	26.4	24.0
6. Kaveri	21.4	19.0	12.3	11.3

7.	Mahanadi	68.9	50.0	16.5	15.0
8.	Narmada	45.7	34.5	10.8	9.9
9.	Tapi	14.9	14.5	8.3	7.6
10.	Other rivers	365.4	11.82	74.0	68.2
Total		**1952.1**	**690.3**	**431.32**	**395.6**

The storage capacity of usable water in the Ganges basin is the maximum, but in spite of maximum annual flow, the storage capacity of usable water is the least in Brahmaputras basin. The storage capacity in Godavary, Krishna, Mahanadi and Indus is sufficient. If storage capacity of usable water is seen in terms of ratio, then Tapi river basin is 97 percent. Annual water flow in the three major rivers of India – Indus, Ganga and Brahmaputras is more. Hence water storage capacity of these rivers can be increased.

(B) Underground water

Rain water percolates into the earth's surface and becomes underground water. The process of percolation also take place from the surface water. Large amount of water gets collected under the Earth's surface by these two methods. This is called underground water. According to Central Underground Water Board renewable underground water capacity in India (1994-95) was about 4310 billion cubic metre per year. Out of this about 3960 billion cubic metre water is available for use.

The distribution of undergrounds water is not the same everywhere. Availability of underground water depends upon the amount of rainfall, nature of rainfall, nature of land and its slope. In the areas of high rainfall where the land is almost plain and has porous rocks, the water easily percolates there. Therefore underground water is available in plenty at shallow depths in these areas. In the areas like Rajasthan where the land is plain and has porous sandy soil, the underground water is available in lesser amount at greater depths due to lack of rainfall. In the north-eastern areas of the country, where the land is sloppy, the conditions are not suitable for percolation of water inspite of more rainfall. With the result underground water is available in less quantity at greater depths in these areas also. There are large resources of underground water in the plains of Ganga – Brahmaputra and in coastal plains. The availability of underground water is less in peninsular plateau, Himalayan region and desert areas.

Use of underground water capacity

Underground water is used on a large scale in the areas where the rainfall is comparatively less. Underground water is used on a large scale in Punjab, Haryana, Rajasthan, Tamil Nadu, Gujarat and Uttar Pradesh whereas Andhra Pradesh, Madhya Pradesh, Maharashtra, Karnatake and Chhattisgarh are such states where inspite of less rainfall, the use of underground water is less. There is a great need to develop underground water resources here.

INTEXT QUESTIONS 21.1

1. What is the main source of surface water?

____

2. In which river basin is usable underground water available?

____

3. How much part of the country comes under floods and drought every year?

____

21.3 WATER BUDGET

Water Budget means – the balance between the available water in the country and the water under use. There is a great variation in the distribution of water resources in space and time. Water is available in sufficient quantity during rainy season. As the dry season sets in, there is a shortage of water. The reserves of our surface and underground water are about 23840 billion cubic metres. Out of this only 10860 billion cubic metre water is required for use.

The unit of measurement of amount of water is cubic metre or hectare metre. If water standing one metre deep on a perfectly level area of one square metre, then the total volume of whole of that water would be one cubic metre. In the same way, if water standing one metre deep on a perfectly level area of one hectare then the total volume of water would be one hectare metre.

You have already studied about the nature and distribution of rainfall in chapter 17. In India, 90 percent rainfall take place during the short period of three months from june to August. There is a great variation in the number of rainy days in India. Average number of rainy days on the western coast is 137. In Rajasthan average number of rainy days is reduced to less than 10. There is a variation in the nature of rainfall also. The rainfall may be heavy and continuous in the areas of more rainfall where as the rainfall may be low and intermittent in the areas of less rainfall. Hence, there is a great variation in the regional distribution of rainfall. About 8 percent areas of the country receive more than 200 cm rainfall, 20 percent areas receive rainfall between 125 to 200 cm. and remaining 30 percent areas, receive less than 75 cm, rainfall. Uneven distribution of rainfall is responsible for the uneven distribution of surface and underground water.

INTEXT QUESTIONS 21.2

1. Define the water budget.

____

2. State the two units of measurement of water?

   (i) ______________________ (ii) ______________________

3. In which part of the country is the duration of rainfall longest?

   ____

4. What is the proportional share of land area in the country which receive more than 200 cm rainfall?

   ____

5. Mention the main component responsible for the uneven distribution of water.

   ____

21.4 UTILITY OF WATER

Population in India has been increasing continuously. Population of the country has increased about three times since independence. Due to this increase in population demand for water has increased in all the spheres. Demand for water has increased comparatively more for drinking, irrigation and industries. On the other hand, per capita annual availability of water has been decreasing continuously. In 1951 per capita annual availability of water was 5177 cubic metre per person which has decreased to 1829 cubic metre per person annually in 2001. In the coming years by 2025 per capita availability of water is expected to become 1342 cubic metres annually. It is to be noted that the water crisis arises when the per capita availability of water falls 1000 cubic metres annually. Today many countries have started facing the water crisis. They have to import water.

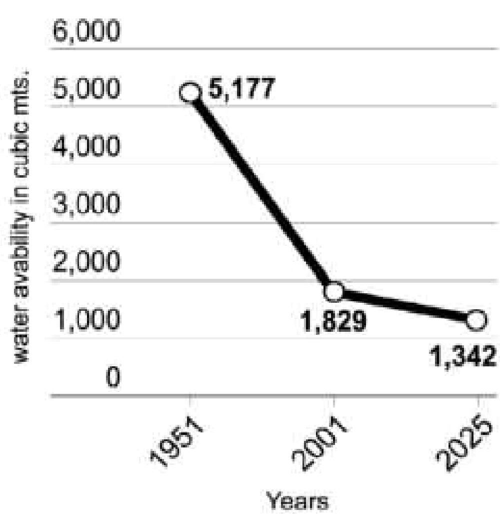


Fig 21.1 Decreasing availability of water annually

There are various uses of water. We need water for drinking, domestic use, irrigation, industries, public health, cleanliness and for flushing or draining sewage or human waste. Water is continuously needed for generation of hydro-electricity. You can not imagine fishing, forestry and water sports without great amount of water. In this way, water is essential for all kinds of developmental work. Its use is essential in all spheres of life. Due to rapid growth of urban population, the demand for water in urban areas has increased tremendously.

Table 21.2 INDIA : Changing pattern of use of water 1990-2050
(figures in billion cubic metre)

Use	1990	2000	2010*	2025*	2050*
Domestic	25	33	42	52	60
Irrigation	460	536	653	770	800
Industry	15	30	79	120	130
Energy	19	27	44	71	120
Others	30	33	35	37	40
Total	**549**	**659**	**853**	**1050**	**1150**

* *Estimated*

India is an agricultural country. Hence plenty of water is needed for irrigation. 536 billion cubic metre water was used for irrigation in the year 2000. It is 81 percent of the total water used. The remaining percentage of water was used for domestic, industrial and other purposes.

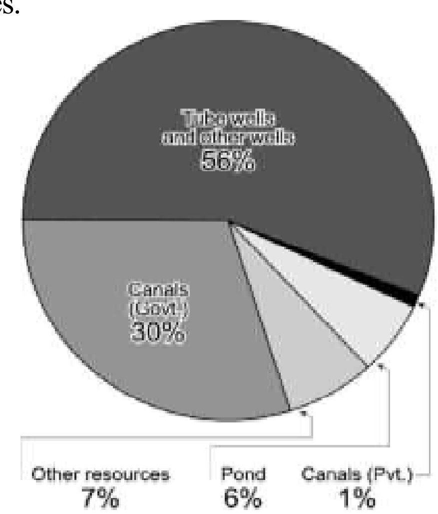


Fig. 21.2 Use of water

There has been a rapid increase in the irrigated area in India since independence. Total irrigated areas in 1999-2000 was 8.47 crore hectare. The maximum capacity of the use of water for irrigation in India is 11.35 crore hectare metre. But about three-fourth water of this capacity is being used.

The demand for irrigation in India has been increasing continuously. The reasons for the increasing demand of irrigation are as follow-

1. Regional and seasonal variations in the distribution of rainfall.
2. Wide and uncertain gaps in rainfall season.
3. Growing demand of water for commercial crops.
4. Changing cropping pattern.

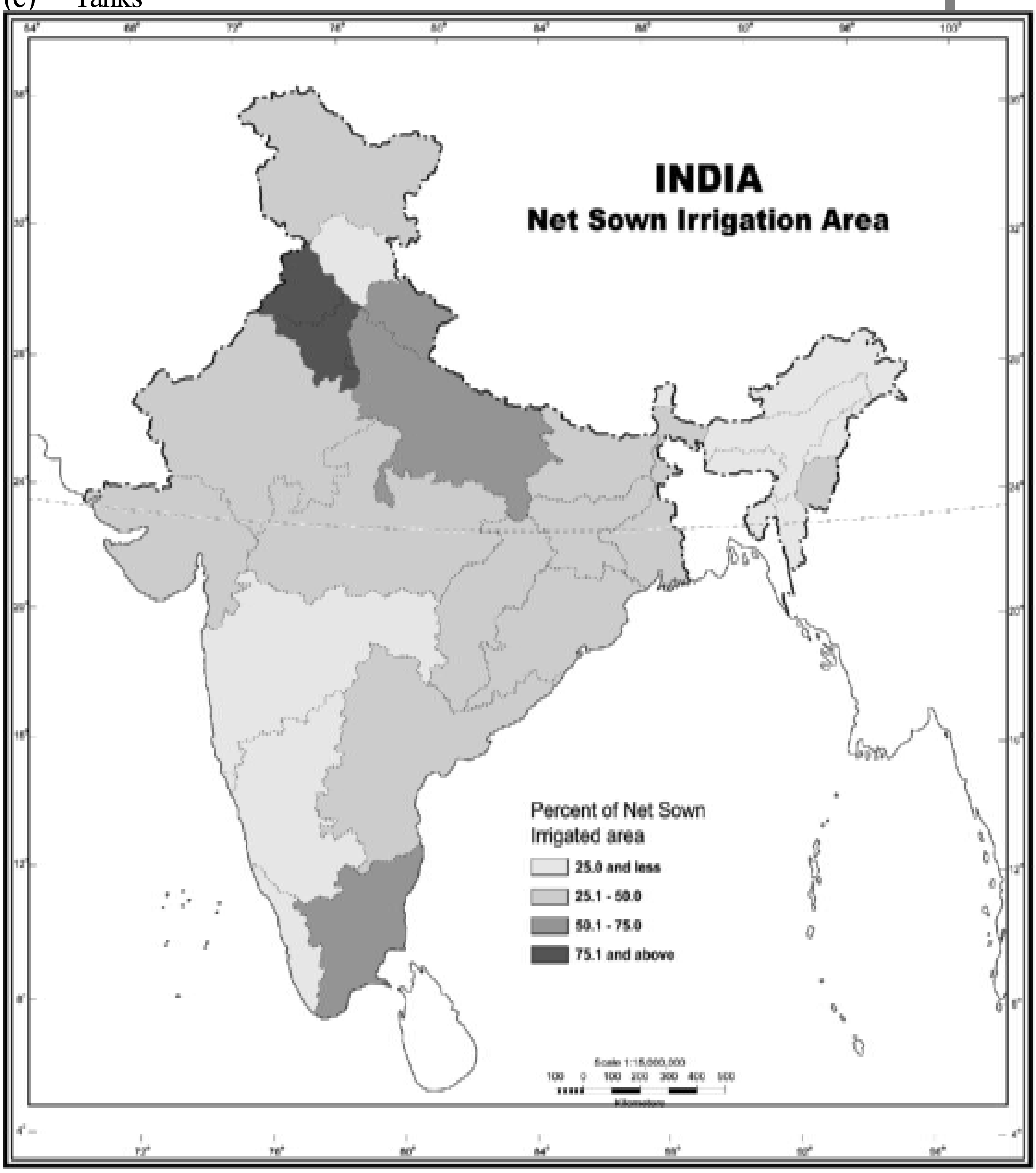
21.5 MEANS OF IRRIGAION

There are three main means of irrigation in India:

(a) wells and tubewells

(b) canals, and

(c) Tanks



Based upon Survey of India Outline Map printed in 1990

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified

Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 21.3 Net sown irrigated area

(A) WELLS AND TUBE-WELLS

Irrigation by wells is an old practice in India. It has greatly increased with the use of diesel and electric pumping sets. Irrigated area by wells and tubewells in 1950-51 was only 59 lakh hectares which has increased to 30 million hectares in 1997-98. During this period total irrigated area has increased from 30 percent to 57 percent.

There are large reserves of underground water in the alluvial plains of north India. Digging and constructing wells and tubewells is easy and cost of their construction is also comparatively less. Therefore irrigation by wells and tubewells here is popular. On the other hand, Gujarat, Goa, Rajasthan and Maharashtra are such states where only about 60 percent irrigation is carried on by wells and tubewells.

(B) CANALS

Canals were the main means of irrigation upto 1960. Canals contributed about 40 percent in the total irrigated area of the country. In 1996-97 it came down to about 31 percent. About 1.74 crore hectare area was irrigated by canals in 1996-97. Half of this area (52.5 percent) is limited to the states of north-India. Haryana, Orissa, Karnataka, West Bengal, Andhra Pradesh and Punjab are worth mentioning for canal irrigation. Jammu-Kashmir, Mizoram, Assam and Tripura are such states which are greatly depend upon canal irrigation because there is lack of other means of irrigation in these states. Mizoram which has the least irrigated area completely dependent upon canals for irrigation.

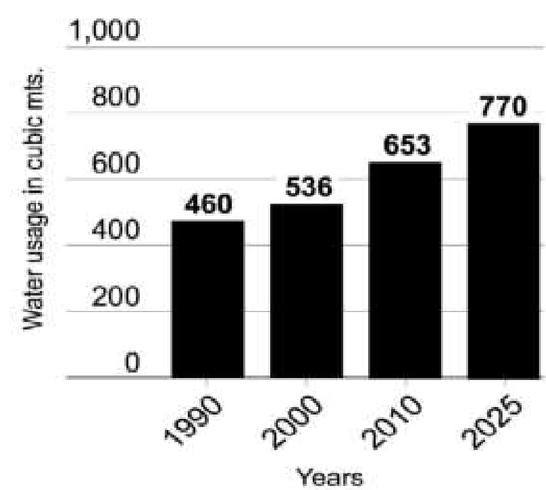


Fig. 21.4 Water availability

(c) TANKS

The contributions of tanks in irrigation has reduced. About 6 percent of the irrigated area is irrigated by tanks. Irrigation by tanks is popular in peninsular plateau area. Tamil Nadu is the leading state in the irrigation by tanks. About 22 percent area is irrigated by tanks here. In the states of Orissa, Maharashtra, Karnataka, Kerala and West Bengal tanks are used for irrigation.

INTEXT QUESTIONS 21.3

1. How much is the per capita average annum availability of water in India?

2. When arises the water crisis?

3. Which is the main means of irrigation in India? How much percent of land is irrigated by this?

4. In which part of the country is the irrigation done mainly by tanks?

21.6 RIVER VALLEY PROJECTS

To make India economically self sufficient and to improve the standard of living of the people, development efforts were initiated soon after the independence. Among these activities special emphasis was laid on the development of river valley projects. River valley projects were multipurpose projects. The main objectives of these projects are flood control, prevention of soil erosion, provision of water for irrigation, drinking and for industries, genration of electricity, transport, entertainment, conservation of wild life and development of fisheries.

Table No. 21.3 Major River Valley Projects of India

Name of the Project	River	Constructed dam/reservoir	Beneficiary states
1	2	3	4
1. Damodar Valley	Damodar	Dames:- 1. Tilaiya 2. Konar 3. Maitlhon 4. Panchet hill	1. Jharkhand 2. W. Bengal
2. Bhakra Nangal	Satluj	1. Bhakra 2. Nangal 3. Pong Reservoir – Gobind sagar	1. Punjab 2. Himachal 3. Haryana 4. Delhi
3. Hirakud	Mahanadi	1. Hirakud 2. Tikkarpara 3. Naraj	1. Madhya Pradesh 2. Orissa 3. Chhattisgarh
4. Tunghadra	Tungbhadra	Canals with dams Tungbhadra dam	1. Karnataka 2. Andhra Pradesh
5. Nagarjuna Sagar	Krishna	Nagarjuna Sagar Dam	Andhra Pradesh
6. Narmada Valley	Narmada	Proposed dams	1. Madhya Pradesh 2. Maharashtra

		1. Sardar Sarovar 2. Narmada Sagar 3. Burgi	3. Gujarat 4. Rajasthan
7. Kosi	Kosi	Three units – 1. Kosi Barrage 2. Kosi Shaktigrah 3. Hanuman Nagar	1. Bihar 2. Jharkhand 3. Nepal
8. Chambal Valley	Chambal	Dams:- 1. Gandhi Sagar 2. Rana Pratap Sagar 3. Jawahar Sagar 4. Kota Barrage	1. Rajasthan 2. Madhya Pradesh
9. Indira Gandhi Canal	Beas-Satluj	Dam on Ravi Beas and Satluj Pong	Rajasthan

21.7 RAIN WATER HARVESTING

Rain water harvesting generally means collection of rain water. Its special meaning is a technique of recharging of underground water. In this technique water is made to go underground after collecting rain water locally, without polluting the same. With this, water during the time of scarcity local domestic demand can be met.

Now the question arises – After all why do we need water harvesting? Three main reasons are responsible for this:-

1. Scarcity of surface water
2. Growing dependence on underground water.
3. Increasing urbanization.

(A) Urban Scenario – Total amount of rain water recovered in an area is called 'rain water reserve'. Effective management of rain water reserve is called 'potential water harvesting'. Think for a while the area of the roof of your house is 100 square metres and the 'average rainfall' of this area is 60 cms. Suppose the water on the roof has neither flowed, percolated nor evaporated then there will be 60 cms, high water on the roof.

Volume of water = Area of the roof X Amount of annual rainfall
= 100 x 60 cms = 100 x .6 = 60 cubic metres

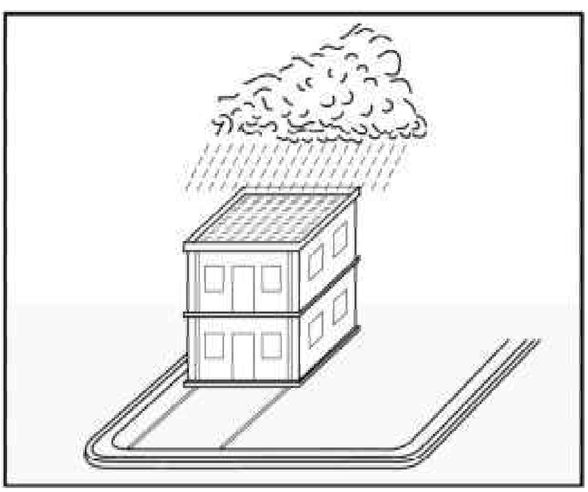
In other words, a family can collect 60,000 litre water in a year. All water related needs of this family can be met with this. On an average a person needs 10 litre water for drinking daily. If your family consists of 6 members, then you need 6x10x365 = 21900 litres water. Remaining (60,000 – 21,900) = 38,100 litre water can be used in dry weather when there is a scarcity of water.

(B) Rural Scenario – The tradition of water harvesting is very old in India. But the utility of water harvesting has never been felt so much as it is today. Even today the people living in the areas of water scarcity try to do their domestic work by adopting old methods. Deepening and dredging of wells, tanks and ponds are included in these methods. Water harvesting in the small channels (locally known as bawli) is an important traditional method in the areas of water scarcity. Now we can be in a better and secure situation by adopting new technique of water harvesting. Think for a while. If the people living in 5,87,000 village engage themselves for harvesting rain water of their 2000 lakh hectare area, there will be lot of water available for use. On an average a village comes under the radius of 37,500 lakh cubic metre rain water reserve. By this calculation we come to know that there is great potential of rain water harvesting.

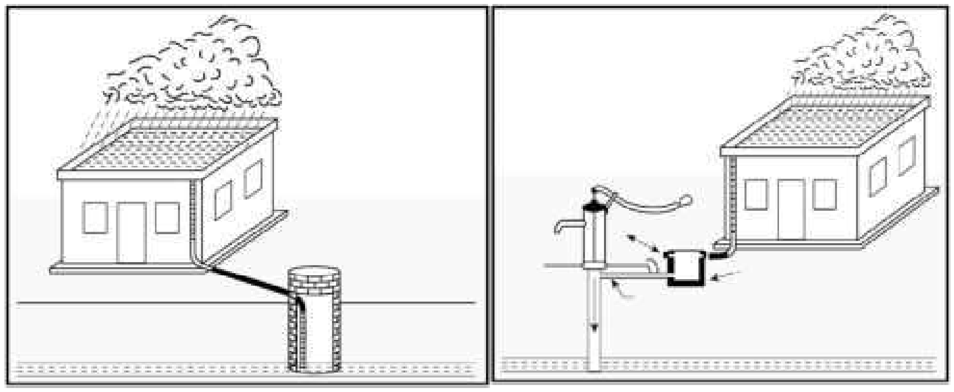
21.8 METHODS OF RAIN WATER HARVESTING

We can adopt different methods for rain water harvesting according to need, available facilities and environmental conditions. The following methods are worth mentioning–

1. **Construction of potholes** – We can harvest water in small ditches constructed in those areas where there is not much underground water. These ditches may be constructed 1-2 metre wide and 2-3 metres deep. Their shape could be anything. These ditches are filled with roubbles and sand. Rainwater can easily percolate through these.
2. **Construction of trenches** – In the lower regions where porous rocks are found after making trenches of 0.5 to 1 metre width, 1 to 1.5 metre depth and 10 to 15 metre length, these are filled with roubbles. These trenches should be made parallel to the slope of the land.
3. **Use of wells** – The wells which have become dry and are not being used at present can be used for water harvesting.
4. **Handpump -** Stored rainwater can be made underground with the help of filter by running handpumps in the areas of lack of underground water.



(a) Recharge through Trench



(b) Recharge through abandoned Dug Well (c) Recharge through Hand Pump

Fig. 21.5 : Methods of water harvesting

INTEXT QUESTIONS 21.4

1. What is called rain water reserve?

   ____

2. Name any two methods of rain water harnesting.

   (i)__________________________(ii)__________________________

3. Which are the main objectives of river valley projects?

   ____

21.9 NATIONAL WATER POLICY

Water is national valuable reserve. It is essential for the Govt. to evolve policy for the development and management of water resources so that surface and underground water is not only properly used but also served for the future. Nature of rainfall has also compelled us to think in this direction. 'National Water Policy' was formulated and accepted in September 1987. It was revised in 2002 and presented as 'National Water Policy' 2002 when many problems arose in the previous policy during the course of time. Water is an important constituent of ecosystem. It should be considered essential for all kinds of life. It should be developed, conserved and managed in a planned manner. It is essential to think about its social and economic aspects of water as large areas of the country suffer due to drought and floods every year. It causes not only the loss of property and human life but the wheel of development is also stopped.

The problems of floods and drought are not limited to the boundaries of a particular state. This requires thinking at the national level. Several problems arise in planning and working on water resources. Among these continued nutrition of atmosphere, proper transfer and rehabililation of men and animal, health security of dams are such problems which can be tackled in a specific period. The problem of standing water and salinity in the soil arise in some areas. More exploitation of underground water in many areas of the country have posed serious challenge. It is essential to think about all these problems under a general policy.

The production of food grains in the decade of 1950 was 500 lakh tons which rose to 2080 lakh tons in 1999-2000. We have to increase the amount of food grains to 3500 lakh tons in 2025. The demand of water would increase in domestic, industries, energy production sectors etc. Water resources are already less, those will become further less in future. Quality of water is also an important aspect. Pollution of surface and underground water, has been increasing. Main sources of water pollution due to human activities include domestic waste water, industrial effluents and chemicals used in agricultural. Sometimes water pollution is also caused by natural factors. Erosion, landslides, decomposition of plants and animals are the main nature sources of water pollution. Three fourths of the total surface water in our country is polluted.

21.10 WATERSHED DEVELOPMENT

The meaning of watershed refers to an area whose water flows towards a point. The planned use of this water can deliver better results. Related area may be a village or a group of villages in the form of a unit. All kinds of land like agricultural, waste lands and forests may be included in this area. Maximum use of the land is possible by adopting watershed programme; The overall development with proper utilization of water in the area is considered to be watershed development.

(A) Benefits of watershed development – The following benefits can be achieved by water-shed development-

1. Supply of water for drinking and irrigation.
2. Increase in bio-diversity.
3. Loss of acidity in the soil and free for standing water.
4. Increase in the agricultural production and productivity.
5. Decrease in the cutting of forests.
6. Increase in the standard of living.
7. Increase in employment.
8. Increase in personal get together by participation of local people.

(B) The results of water shed development – Notwithstanding a huge amount of expenditure made by the Govt, (20 billions dollars by 2000) on watershed development,we have not been able to achieve desired results so far. The following factors are responsible for this:-

a. lack of scientific thinking

b. imperfect techniques

Notes

c. indifferent attitude of local population

d. lack of coordination among various departmental agencies, and

e. absence of independent ministry.

(c) **River linkages** – Large areas of the country suffer from droughts and floods. Droughts and floods are two sides of the same coin. 'National water Development Authority' was constituted in 1982 to solve this problem. The main objects of its constitution was to identify only the national water network. Finally National water Development Authority identified linkage of 30 rivers. Large rivers have mainly been included in this programme. Authority has recommended starting of work on 6 places of river linkages and their completion has to be carried out in three stages.

Ist STAGE - In the first stage, main peninsular rivers – Mahanadi, Godavary, Krishna and Kavery have been included.

IInd STAGE - In the second stage, linking of small river basins of peninsular India have been recommended. Ken, Betwa and Par-Tapi reivers are included in this.

IIIrd STAGE – In the third stage there is a provision for linking tributaries of Ganga and Brahmputras with one-another.

(D) **Benefits of rivers linkages** – All round development of an area is possible by joining basins. The irrigation of about 250 lakh hectare additional agricultural area is possible by surface water after the success of this programme. Underground water will be available to irrigate additional agricultural area of about 100 lakh hectares. With the result, irrigated area will increase from 1130 lakh hectares to 1500 lakh hectares. Additional hydro-electricity of about 340 lakh kilowatt will be generated. Besides these benefits, many other benefits like flood control, water transport, water supply, fishing, removal of acidity from the soil and control on water pollution will also be achieved. But these benefits can not easily be achieved. Much money and time has to be spent on these projects. According to an estimate a large sum of Rs 560 thousand crore are required to complete these projects.

21.11 METHODS OF WATER CONSERVATION

If there is no water, there is no life. Hence water conservation is essential. Future generation may be in difficulty due to scarcity of water. The participation of an individual, society and the Govt. is essential for water conservation. The following methods can be adopted for water conservation –

1. Dams and reserveors should be constructed on rivers so that river water does not go waste into the seas and oceans.

2. The water of rivers should be saved from pollution by urban waste at all costs.

3. Serious efforts should be made to control floods.
4. Water should be used properly.
5. Mass awakening should be around for water conservation.
6. Solicit active participation of the people in all the activities related to water conservation and efficient management.
7. Potable water should not be used for gardening, washing of vehicles and cleaning of household.
8. Saving of reservoirs from pollution
9. Broken pipelines of water should immediately be repaired.
10. Every drop of water is precious, this should be popularized among the masses.
11. Such crops should not be grown in rain fed areas which require more water.
12. There should be stress on afforestation.

21.12 A CASE STUDY : EFFORTS OF TARUN BHARAT SANGH TOWARDS WATER CONSERVATION

Tarun Bharat Sangh was established in 1985 under the guidance of Shri Rajendra Singh. It started with Hamirpur village of Thanagazi Tehsil in Alwar district of Rajasthan. The residents of Thanagazi area under the guidance of Tarun Bharat Sangh achieved such a miracle which could not be achieved by Central Water Authority while searching of the Sarswati in Wester Rajasthan and Bhabha Atomic Research Centre together. Tarun Bharat Sangh is a Non-Governmental Organization (NGO). Arvari river was reborn with a bhargirath efforts of this organization spanning over 15 years. Previously the river was dry and barren. There are two branches of Arvari river. The total length of these is 45 kilometres. Its watershed area is spread in 503 square kms.Parts of Jaipur, Dausa and Alwar districts are included in this.

Previously, there used to be agricultural in an unirrigated area here. There were no means of irrigation. Agriculture used to be done only on 10 percent of the land. Agriculture was entirely dependent upon rain. *There was one cropped agriculture. To remove the water searcity in the area,* Tarun Bharat Sangh with the help of villagers cleaned and deepend the tanks and ponds. Besides this, they also vowed to construct ponds on the sloppy parts of the hilly region. A village was chosen for this work in 1985-86. The results were very encouraging. Seeing this other villagers started competing in getting and making ponds constructed in their areas 'Save water' and **'Johar Andolan'** were started in 1996. 3500 ponds have so far been constructed in this area. The villagers themselves have constructed more than 70 ponds. Water level of underground water has risen after construction of these ponds. Water is available throughout the year in wells, tanks, ponds and rivers. Agricultural has also changed. Greenery dominates everywhere. Animals have become healthy and smart. Cows and buffaloes have started giving more milk.

The standard of living of the people has improved. The families below poverty line are also able to earn 40-50 thousand rupees per annum. Migration of people from villages to cities has stopped. Even migrated families have now started coming back to their villages.

The residents of 70 villages in Arvari river basin have constituted a unique 'parliament' of 150 members. This 'parliament' has been named as 'Arvari Sansad' after the name of Arvari river. The members of 'Arvari Sansad' took oath on the banks of the river in Hamipur on 26th January 1999. The constitution of Arvari Sansad came into effect from this day. This is such a **sansad** which not only frame the rules and laws but follow them also. All residents of the area follow these rules and laws strictly and also got them followed by others.

Arvari sansad has framed some rules and laws keeping the need of the people. Ecological balance and land in mind. The following are worth mentoring among them:-

1. Ban on growing crops such as sugarcane, rice and chillies which require more water.
2. No one will use the river water for agriculture after **Holi** and before end of rainy season.
3. No industrial unit will be established in watershed area.
4. Recommended growing of millets, Jwar-Bajra and Maize.
5. Allowed to grow vegetables in the lower parts of the river.
6. Ban on hunting and cutting of green trees.
7. No person with an axe will enter into recently developed 'Bhairon Dev Manas' sanctuary.
8. The whole region has been declared as an area of bio-diversity
9. Ban on sending food grains and vegetables outside the region
10. Ban on grazing of animals by the people living outside the watershed area.

Today Arvari river has become very useful for the residents of the area. The people of the area worship this river also. Fair and festivals are celebrates. Arvari Sansad has established 'Arvari temple', Arvari treasury' and 'Arvari Sectariate'. Such programmes are being carried on in other areas also. In this connection very encouraging programmes are going on in Gujarat, Madhya Pradesh and Chhatisgarh. The Govts. should give protection and encouragement to such concepts. Such programmes should specially be carried on in rainfed areas.

INTEXT QUESTIONS 21.5

1. Mention any four problems related to the planning and practice of water resources.

   a.____________ b.____________ c.____________ d.____________

2. Which are the three factors of water pollution?

   a._____________ b._____________ c._____________ d._____________

3. How much amount was spent by 2000 on watershed development by the government of India in our country?

   ____

4. Why and when was constituted the National Water Development Authority?

   ____

5. How many river linkages have been identified by the National water Development Authority?

   ____

WHAT YOU HAVE LEARNT

Water in the most important and precious resources of nature. This is the basis of life. There are various uses of water. It is used for drinking, domestic work, irrigation, industries and energy sectors. India is an agricultural country. It has a long growing season. Hence there is maximum use of water in irrigation, wells, tubewells, canals, and tanks are the important sources of irrigation. There is maximum use of wells and tubewells in irrigation.

The distribution of water in India is very uneven. Duration of rainfall, nature of rainfall nature of level and slope of land are responsible factors for uneven distribution of water. River valley projects have played an important role in the development of water resourced, flood control and appropriate use of water. These have contributed greatly in the economic development of the country and in the conservation of resources. The conservation of water resources has become necessary due to scarcity of water, diversity in temporal and terrestrial distribution of water, increasing demand for water by a large growing population and changing atmospheric conditions. Special emphasis has been given on rain water harvesting and water-shed development programmes for this. If these programmes are carried out honestly. Then water crisis can never arise in India. Among there rain water harvesting programmes can be completed in low budget with the active cooperation of the people. There is a great need to change out thinking about water resources. Many social organization, councils and individuals have done commendable work in this field. Barren and backward areas have adopted on the path of development with their cooperation.

Water-shed development and linking rivers together is very expensive time consuming and complex. But this work can be completed by cooperation among different state govts, strong will power of the centre and cooperation of the people.

TERMINAL QUESTIONS

1. Answers the following questions in brief-
   (i) What is the meaning of water resources?
   (ii) Mention the main sources of surface water.
   (iii) Why is more underground water available in the northern great plains of the country?
   (iv) Explain the objective of river valley projects.
   (v) State the meaning of rain water harvesting.
   (vi) Explain the meaning of water shed.
   (vii) Mention three stages of river linkages.
2. Differentiate among the following –
   (a) Surface water and underground water.
   (b) Rain water harvesting and water shed development.
3. Why is distribution of water uneven in India? Explain with examples.
4. “Underground water is a reliable and continued resource of water supply”. Prove the logic of this statement.
5. Describe main methods of rain water harvesting.
6. Which benefits can be achieved by water shed development? Mention them.
7. Why are desired results not achieved by watershed development projects? Give reasons.
8. Why is water conservation essential? Explain different methods of water conservation.
9. Evaluate the utility and applicability of water-shed development programmes in India.
10. Show the location of the following in the map –
   (i) Satluj (ii) Mahanadi (iii) Krishna
   (iv) Tungbhadra (v) Rana Pratap Sagar dam
   (vi) Sardar Sarovar dam (vii) Narmada Sagar dam.

II. PROJECT WORK

Adopt any suitable method of rain water harvesting for your village / town / city. Prepare a brief report on the basis of its following and results.

ANSWERS TO INTEXT QUESTIONS

21.1

1. Precipitation
2. Plains of Ganga - Brahmaputra
3. One - eighth area of the country is flood prove and one-sixth area is under the grip of drought.

21.2

1. Water Budget means - the balance between the available water is the country and the water under use.
2. Cubic metre or hectare metre
3. The western coast.
4. 8 percent
5. Uneven distribution of rainfall is responsible for the uneven distribution of surface and underground water.

21.3

1. 1829 cubic metre person (2001)
2. The water crisis arises when the per capita availability of water falls 1,00,000 metres annually.
3. Wells and tube-wells are the mains means of irrigation in India. 57 percent (1997-98) of land is irrigated by this.
4. Peninsular plateau.

21.4

1. Total amount of rain water recovered is an area is called ‘rain water reserve’.
2. Construction pot holes, construction of trenches, use of wells, handpump (any two)
3. Flood control, control on soil erosion, water for irrigation and drinking, water for industries etc.

21.5

1. Continued neutrition of atmosphere, proper transpher and rehabilitation of men and animal, health, security of dams (any four)
2. a. domestic waste water, b. industrial effluents,

   c. Chamicals used in agriculture.

3. 20 billions.

4. 'National Water Development Authority' was constituted in 1982 to solve the problem of drought and flood.

5. 30

HINTS TO TERMINAL QUESTIONS

1. (i) Refer to section 21.1

   (ii) Refer to section 21.2

   (iii) Refer to section 21.2 (B)

   (iv) Refer to section 21.6

   (v) Refer to section 21.7

   (vi) Refer to section 21.10

   (vii) Refer to section 21.10 (c)

2. (a) Refer to section 21.2 A and B

   (b) Refer to section 21.7, 21.8 and 21.10

3. Refer to section 21.3

4. Refer to section 21.2 (B)

5. Refer to section 21.8

6. Refer to section 21.10 (A)

7. Refer to section 21.10 (B)

8. Refer to section 21.11

9. Refer to section 21.10

10. Refer to maps

22

LAND USE AND AGRICULTURE

In the previous lessons, we studied climate, soils, various types of resources and human activities. In this chapter, we will study agriculture. For agriculture, land is a very important resource. For its large area size, and physical and socio-cultural diversities, India has different types of landuses. Agriculture is predominant economic activity in India, engaging nearly three-fifths of its working population. Though the share of agricultural sector in gross domestic product has considerably declined to about one-fourth yet the importance of agriculture as employment provider to workforce especially in the countryside is very high. Obviously, agriculture forms the hub of Indian economy as a large number of industries are also heavily dependent on agriculture for supply of raw materials. Agriculture involves not only crops raising but also animal ranching and fishing.

OBJECTIVES

After studying this lesson, you will be able to:

- know the availability of land in India and its different uses;
- appreciate the significance of studying land use and agriculture;
- examine various factors responsible for the development of agriculture in India;
- describe the different types of crops grown in various parts of India;
- locate and identify the areas under different crops on a map of India;
- infer changing pattern of crop cultivation;
- explain the concept and significance of Agro-climatic Regions;
- identify the different strategies adopted for the agricultural development in India, during five year plans and
- explain the impact of economic liberalisation on agriculture in India.

22.1 GENERAL LAND USE

Land is the most vital resource of a country. It is a fixed asset and cannot be expanded to meet the needs of an increasing population. Therefore, it must be used carefully and in the best possible manner. The total geographical area of India is 32.88 lakh sq. kms. The major landuses in India are:

Net Sown Area (NSA)

The total land area on which crops are grown in a region is called **net sown area.** The net sown area and the area sown more than once together are called **gross cultivated area**. In India, about 47 per cent of total **reporting area** is under the net sown area.

States namely Punjab, Haryana, West Bangal, Uttar Pradesh, have the high proportinal share of NSA than the national average. Against this, the shere of NSA is less than one half of the national average in states of Himachal Pradesh, Uttarakhand, Meghalaya, Manipur, Nagaland, Mizoram, Sikkim and Arunachal Pradesh. All these states suffer from physical disabilitis such as undulating terrain due to hilly topography, limiting the availability of plain land and fertile soils, important for cultivation. This is evidently clear from state wise distribution of proportional share of NSA that physiographic factors play an important role in availability of net cropped area in a region.

Forest

The area under forest cover is about 68 million hectares or 22 per cent of the total area in the country. This area has increased from 40 million hectares in 1951 to 68 million hectares in 2000. For the ecological balance the forest cover should be at least 33 per cent of the total geographical area of a country. The states of Arunachal Pradesh, Mizoram, Jammu & Kashmir and Tripura have relatively larger proportion of area under forest cover.

Land Not Available for Cultivation

The land under the settlements, roads, mines and quarries along with barren lands are included in this category. The sandy waste land of Rajasthan, marshy land of Kutchh (Gujarat) and rugged and eroded areas of northeast and northern mountains are few examples of barren lands. About 13 per cent of the total reported area is recorded under this category. Nagaland, Manipur and Assam registered a very high percentage of area not available for cultivations.

Fallow Lands

When lands are left unused to regain their lost fertility in a natural way is called fallow land. On the basis of usability criteria follow lands can be divided into two groups current and old. Current fallow is the land in which no crop is raised during the current year. Old fallow land remain unused for a period of one or more years but not exceeding 5 years. This is due to low investment capacity of numerous small and marginal farmers in advanced technology, lack of awareness, loss of fertility of soil, inadequacy of rainfall, lacking in irrigational facility etc. The fallow land occupy about 7.5 per cent of the total reported area. The states of Mizoram, Tamil Nadu, Meghalaya, Bihar, Andhra Pradesh and Rajasthan have a high percentage of area under fallow land. It is to be noted here that old fallow land may not be economically important but from ecological point of view fallow land is important category of land.

Cultivable Waste

It is the land in which crops were raised for some period of time but has not been cultivated for the last five years due to certain deficiencies such as alkalinity and salinity in the soils. Such cultivable waste are locally known *as reh, bhur, usar*, and *khola* in the some part of North India. Maghalaya, Himachal Pradesh and Rajasthan have a very high share of cultivable waste land in total land use in respective states.

Permanent Pastures and Grazing Lands

Not withstanding the highest live stock population in the world, India has only less than 4 per cent of the country under pastures and grazing lands. The states of Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Gujarat and Rajasthan have high above 5% of area under this category.

The area under different landuses are given below (Table 22.1)

Table 22.1: Land Utilization in India

	Landuses	*Area (in lakhs hectare)*	*In percentage*
1.	Area under non-agricultural uses	212	6.95
2.	Barren and uncultivable land	197	6.46
3.	Net area sown	1442	46.64
4.	Forest lands	679	22.27
5.	Miscellaneous tree crops and groves	37	1.21
6.	Cultivable waste lands	150	4.92
7.	Current fallows	138	4.53
8.	Old fallows	96	3.15
9.	Permanent pastures and grazing land	118	3.87
	Total	3049*	100

* Total geographical area of which land utilization data is available.

22.2 AGRICULTURAL LAND USE

The net sown area, current fallows and land under tree crops and groves are included in agricultural land use. The agricultural land in India is little more than 50 per cent of the total geographical area in the country. This is the highest share of land in any country in the world. But due to large size of population in India, per capita arable land is available only 0.17 hectares, which is lower than the world average (0.24 hec). The per capita agricultural land in some select countries is much higher than India. In Australia it is 2.8 hec., in Canada 1.35 and in Brazil 0.33 hec. The lower per capita availability of land is an indicator of high pressure of population on land resources. Since there is little scope for increasing land under the plough, the way out to feed the growing population can be found in increasing land productivity. Over the period, area sown more than once has been increasing which is about 15 per cent. If the same piece of land is sown more than once in a year, it is called cropping intensity. Which stands for the ratio between gross cropped area and net sown area..The use of new technology, fertilizers, good quality of seeds and irrigation facilities are necessary for increasing intensity of cropping. The so called Green Revolution is also nothing but technological package, which include HYV seeds, chemical fertilizers and artificial irrigation. After the adoptation of Green Resolution by India in 1966 onwards agricultural, land use has undergone a significant change.

22.3 TYPES OF FARMING

The basis for the classification of different types of agriculture in India are rainfall, irrigational facilities, purpose of production, ownership and size of holding and technology used. On the basis of these factors a number of farming can be identified. The main types of farming in India are:

A. Dry Farming

This type of farming is practised in the areas where the amount of annual rainfall is generally less than 80 cms. In such regions, the farmers are generally dependent upon rainfall. Here, moisture content in the soil is less. Hence, only one crop can be grown in a year. Millets like jawar, bajra, ragi, pulsees etc. are important crops grown under this type of farming. Rajasthan, Maharashtra, parts of Madhya Pradesh, Southern Haryana, part of Gujarat and Karnataka fall under this category of farming. In such areas, farmers adopt subsidy activities such as dairy, cattle farming to supplement their meagre farm incomes.

B. Wet Farming

This type of farming is practised in the areas of alluvial soils where annual average rainfall is more than 200cm. Here, more than one crops are grown in a year because enough amount of moisture in the soil is available. Rice and jute are the main crops of this types of farming. West Bengal, Assam, Nagaland, Meghalaya, Tripura, Manipur, Mizoram and Malabar coast fall under this category of farming.

C. Irrigated Farming

This type of farming is practiced in the areas where average rainfall is between 80 to 200 cms which is insufficient for certain crops,. This system of farming can be practised only in those areas where availability of water from underground or surface water bodies like rivers, tanks, and lakes is sufficient throughout the year. The other condition for this farming is the availability of levelled agricultural land. The main areas were much farming is practised are in Punjab, Haryana, Uttar Pradesh, north western Tamil Nadu and the deltas of peninsular rivers. The other important pockets of irrigated farming are found in the Deccan Plateau region particularly in Maharashtra, Karnataka and Andhra Pradesh. Wheat, Rice and Sugarcane are important crops of this farming.

D. Subsistence Farming

This types of farming is practised primarily to fulfill self requirements of the people of the area. The main objective of this farming is to provide subsistence to the largest number of people of a given area. Size of holdings is small, use of manual labour and simple farm implements are common features of this type of farming. Subsistence agriculture is practised in parts of Chhattisgarh, Uttarakhand, Jharkhand and the hilly areas of the country.

E. Shifting Cultivation

In this type of cultivation, land is cleared by cutting and burning of forests for raising crops. The crops are grown for a few years (2-3 years). As fertility of land declines, farmers move to new areas, clear the forests and grow crops there for next few years. This farming is practised in some pockets of the hilly areas of Northeast and in some tribal belts of Orissa, Chhattisgarh and Andhra Pradesh. In northeast, such type of cultivation is known as “Jhuming”.

F. Terrace Cultivation

It is practised in hilly areas. The farmers in these regions carve out terraces on the hill slopes, conserve soil and water to raise crops. In India, this type of cultivation is practised on the slopes of the Himalayas and the hills of the peninsular region. Due to pressure of population, terrace cultivation is being adopted in the North-Eastern states of India where shifting agriculture was practiced earlier.

G. Plantation Agriculture

Well organized and managed cultivation of crops particularly a single one on a large scale is called plantation agriculture. It requires large investment on the latest technology and proper management. Tea, coffee and rubber are examples of plantation agriculture. This agriculture is prectised in Assam, West Bengal and the slopes of Nilgiri hills.

H. Commercial Farming

Under this farming, the farmers raise crops mainly for the market. Under this system, generally those crops are grown which are used as raw materials for industries. Cultivation of sugarcane in Uttar Pradesh and Maharashtra; cotton in Gujarat, Maharashtra and Punjab; and Jute in West Bengal are some of the examples of this farming.

I. Contract Farming

It is viewed as an important tool to increase private corporate involvement in agro-processing. In this system, companies engaged in processing/ marketing of agriculture products enter into contract with the farmers. They provide the farmers necessary facilities and buy back the products with a rate specified in advance. The Field Fresh Company, a multi national has 1000 acres land under horticulture in Punjab. Pepsi and McDonalds have started contact cultivation of citrus fruits and lettuce respectively. Ballapur and ITC provide farmers with fast growing cloned varieties of tree that mature in just four years and buy the out-put. Such type of farming is said to be getting popular among farmers expecially in Punjab. However, some scholars fear that shift of lands from food crops under this contract farming on a scale is likely to result in food insecurity, expecially for lower income groups.

J. Eco-Farming or Organic Farming

This farming avoids the use of synthetic fertilizers, pesticides, growth regulator and livestock feed additives. This types of farming rely on crop rotation, crop residues, animal manure, off-farm organic wastes and biological pest control to maintain soil productivity. A few farmers from Rajasthan, Andhra Pradesh, Madhya Pradesh, Pondichery and Punjab are adopting this types of agriculture.

INTEXT QUESTIONS 22.1

1. Match the following.

	Types of farming		*Chief characteristics*
(i)	Subsistence Farming	(a)	Factory like management
(ii)	Wet Farming	(b)	Large production for market
(iii)	Shifting Cultivation	(c)	Practised in the Area of low rainfall
(iv)	Dry Farming	(d)	Forests are cleared for raising crops
(v)	Commercial Farming	(e)	Practised in the Areas of high rainfall.
(vi)	Plantation Farming	(f)	Most of the production consumed locally.

2. Which state of India has the highest percentage of net sown area?

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22.4 CATTLE REARING

Cattle rearing is an important economic activity in India. Milk and milk products (Butter, Ghee etc) meat, eggs, leather, and silk are raw materials for industries. Animals provide a large proportion of energy required in the farm sector. The bullocks, buffaloes, horses, ponnies, camel etc. are used as draught animals. They are used in agricultural activities like ploughing of fields, drawing of water from wells and for carrying loads. It is to be noted here that with rise in mechanized farming, the use of animal power for farm operations is on gradual decline. This is more true of Green Revolution areas. Hides and skins of animals are used as raw material for leather industries. Sheep, goats and camels provide wool. Their dung are used for biomass gas production and for making manure.

India is leading producer of milk in the world. It is due to initiative taken by government through 'Operation Flood'. Under this program good breeds of cows and buffaloes, which yield more milk, have been introduced. Co-operative societies in this field were encouraged. The modern dairy farms produced milk powder, butter, and cheese; condense milk, cream, and ghee along with milk.

The largest number of livestock is found in Uttar Pradesh followed by the states of Rajasthan, Bihar and Madhya Pradesh. These four states account for 44% of total livestock of India. The density of animals in India is the highest in the world. It is about 130 heads of livestock per 100 hectare of land. The percentage of area under permanent pasture is very low in comparison to the density of animal population. Cattles, Buffaloes, sheep and goats are important livestock in India.

Distribution of Animal Resources in India

Cattle rearing in India is an important economic activity. The cattle population accounts for 43.5% of the total livestock in the country. The largest number of cattles in the country is found in Uttar Pradesh. Except Haryana, Punjab and Rajasthan, in other states of India the number of cattles are greater among livestock. The yield of milk from Indian cows is the lowest in the world. It is only 188 liters per animals per annum in India while in Netherland it is 4200 liters differing by about twenty three times. Buffaloes account for 18% of total livestock in India. They outnumber other animals in the states of Haryana and Punjab. For the milk point of view, buffaloes are important as they account for about 53% of total milk production in India.

Sheep are found mostly in the cold and dry regions of the country. They are very few in areas which are very hot and receive heavy rain during monsoon. They develop hoof diseases in hot and humid climate. Rajasthan, Tamil Nadu, Jammu & Kashmir, Himachal Pradesh, Andhra Pradesh and Uttar Pradesh are major states where sheep are in large numbers.

Among the other animals goats, camels, horses, yaks and mithuns are important.The goats reared mainly for meat and milk. In Rajasthan goats are greater in number than other animals. Camels are reared in western Rajasthan and adjoining areas

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of Gujarat, Haryana and Punjab. Camel is called the aeroplane of desert region implies to Thar Desert of India. Horse and ponies are distributed all over India specially in Jammu & Kashmir, Uttar Pradesh, Bihar, Madhya Pradesh and Punjab. Yaks are found in mountainous areas of Jammu & Kashmir, Haryana, Himachal Pradesh, Sikkim, and Arunachal Pradesh. Mithuns are found in Nagaland and Arunanchal Pradesh.

> The general condition of animals in India is very poor due to the lack of nutritious fodder, and harsh hot and humid weather conditions. Also, there is a lack of artificial insemination centers, and veterinary hospitals and doctors.

22.5 FISHING

Fishing has been an important occupation of the people in the coastal areas. However, in spite of having a long coastline and broad continental shelf, India's fishing industry is still largely in a developing stage. Modernization on limited scale has started recently. Fisheries are of two types (i) the inland and (ii) the open sea. The inland fishing is done in rivers, tanks, ponds and canals. The major rivers like Brahmaputra, Ganga, Satluj, Narmada, Mahanadi and Godavari; and numerous tanks and ponds are tapped for fishing. Inland fish production is accounted for two fifths or 40 percent of total fish production in India during 1995-96.

Open sea fishing or marine fishing, done in sea water, is caught in shallow water in our country. More than two-thirds of marine fish is landed on western coast of India. While remaining one third on the eastern coast . India caught 5.6 lakhs tonnes of fish during 2000-01.

Though, India has huge potential for fishing but the actual catch is very small. The main factors responsible for poor performance in fishing are traditional methods, wooden loge made boats, driven by human energy, and poor socio-economic conditions of the fishermen

In order to increase fish production and trade, the Government has taken a number of steps including (i) financial assistance to fishermen (ii) introduction of large vessels, (iii) better harbours and breathing facilities (iv) provision of refrigerated wagons and road transport facility (v) introduction of accident insurance scheme and (vi) marketing of fish on co-operative basis.

The rapid increase in the production of fish in the country is called **Blue Revolution.** This is synonymous with **shrimp farming** or **Aquaplosion.**

INTEXT QUESTIONS 22.2

Tick the most appropriate answer for the following questions from the options given in brackets.

1. Of the total cattle population in the world, what percentage is found in India? (15/25/35/45)

2. Which state of India has the largest number of cattle population?
   (West Bengal/Uttar Pradesh/Tamil Nadu/Kerala)

3. Which state of India has the highest number of goats?
   (Uttar Pradesh/Rajasthan/Bihar/Assam)

4. What is the percentage share of land area under the forests in India.
   (20/22/24/26)

22.6 MAJOR CROPS IN INDIA

Owning to cash physical diversity, a variety of crops are grown in our country. The crops grown in the country may be categorised as under:-

Types of Crops

Foods crops	**Pulses**	**Oil seeds**	**Beverages**	**Fibre crops**	**Other crops**
Paddy	Gram	Groundnut	Tea	Cotton	Sugarcane
Wheat	Arahar	Mustard	Coffee	Jute	Spices
Jawar	Pease	Cottonseeds	Coco		Fruits
Bajara	Black gram	Soyabean			Vegetable
Maize	Lentil	Coconuts			Floriculture
Ragi		Sunflower			Rubber
					Tobacco

(i) Paddy

Paddy is basically a tropical crop. India is one of the major producers of rice in the world, accounting for one-fifth of the world production, ranking next only to China. About 23 per cent of the total cropped area in the country is under this crop. Paddy is grown in Kharif season.

Paddy is ideally grown in rainfed areas where annual rainfall is more than 125 cms. It requires high temperature (20^0-25^0C). However, it is also grown in areas of less than 125 cms rainfall with the help of irrigation. At present, 51 per cent of rice producing area is under irrigation.

Deep fertile loamy or clayey soils are considered ideal for this crop. It requires considerable be manual labour for sowing and transplantation. Although paddy crop is grown in almost all states of India, the leading producing states are West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamil Nadu, Bihar, Orissa and Assam. Andhra Pradesh is the largest producer of rice in India but consumption of rice being large, it has to import from other states. Against this, Punjab is the biggest contributor of rice to control public distribution system. In some states, three crops of paddy in a year are grown. For example, in West Bengal three crops are known as Aman, Boro and Aos.

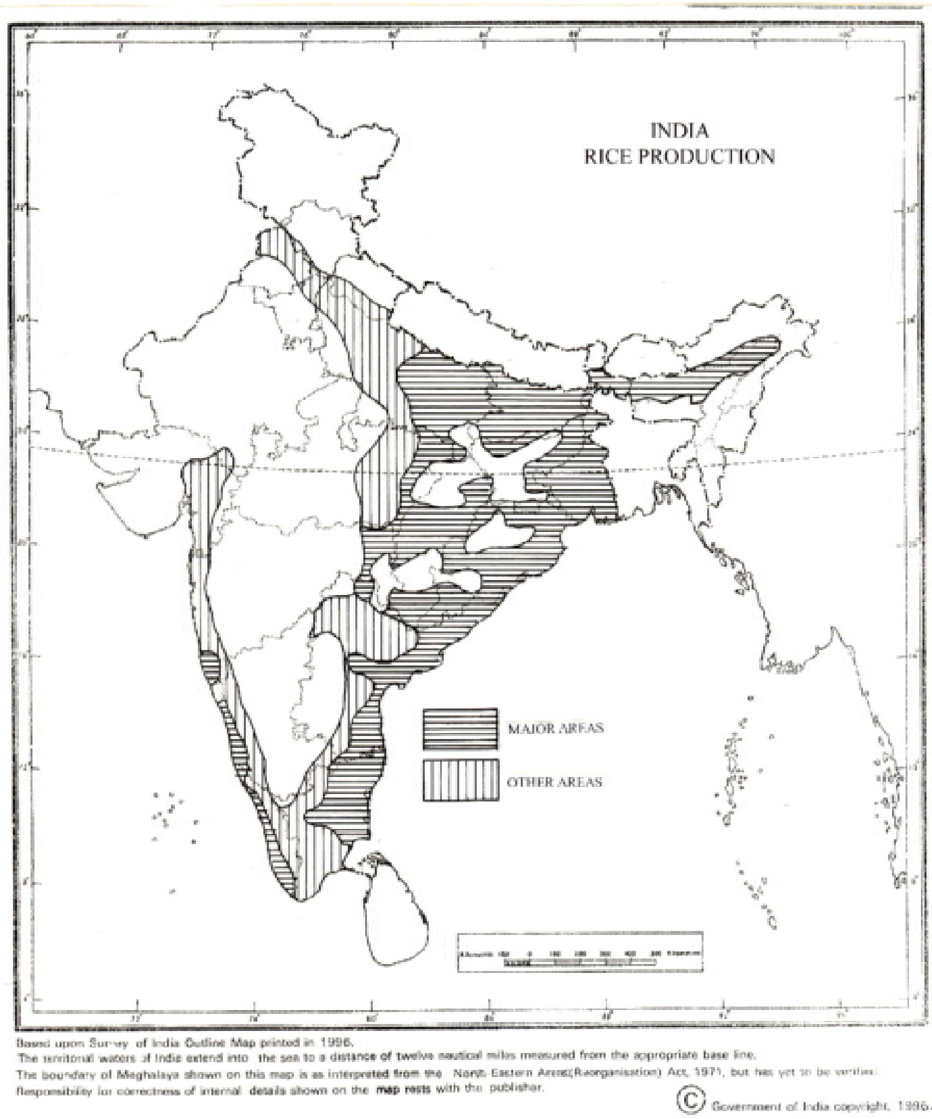

Fig. 22.1 INDIA: Rice Producing Areas

(ii) Wheat

Wheat is basically subtropical crop grown in the winter season in India. It is grown in rabi crop season, while paddy is sown in kharif season. Wheat ranks second after Paddy crop, having about 13 per cent of total cropped area under it. Wheat requires cool weather with moderate rainfall. It grows well in the northern plains of India during winter season when the mean temperature is between 10 and 15 ^{0}C. Well drained loamy soil is ideal for wheat cultivation.

Uttar Pradesh, Punjab and Haryana are major wheat producing states in India. They accounted for 60 per cent of total area under wheat and 73 per cent of total wheat production in the country in 2000-2001. Other important wheat growing states are Rajasthan, Bihar, Madhya Pradesh and Maharashtra. The wheat production in the country showed maximum increase after Green Revolution introduced in 1966. During 2000-01 the total production was 688 lakh tonnes. India is an important producer of wheat in the world. It is followed by China and USA. Although productivity per hectare has increased rapidly from 815 kg. in 1950-51 to 2743 kg. in 2000-01 per hectare the yield of wheat in India is lower in comparison with other major wheat producing countries.

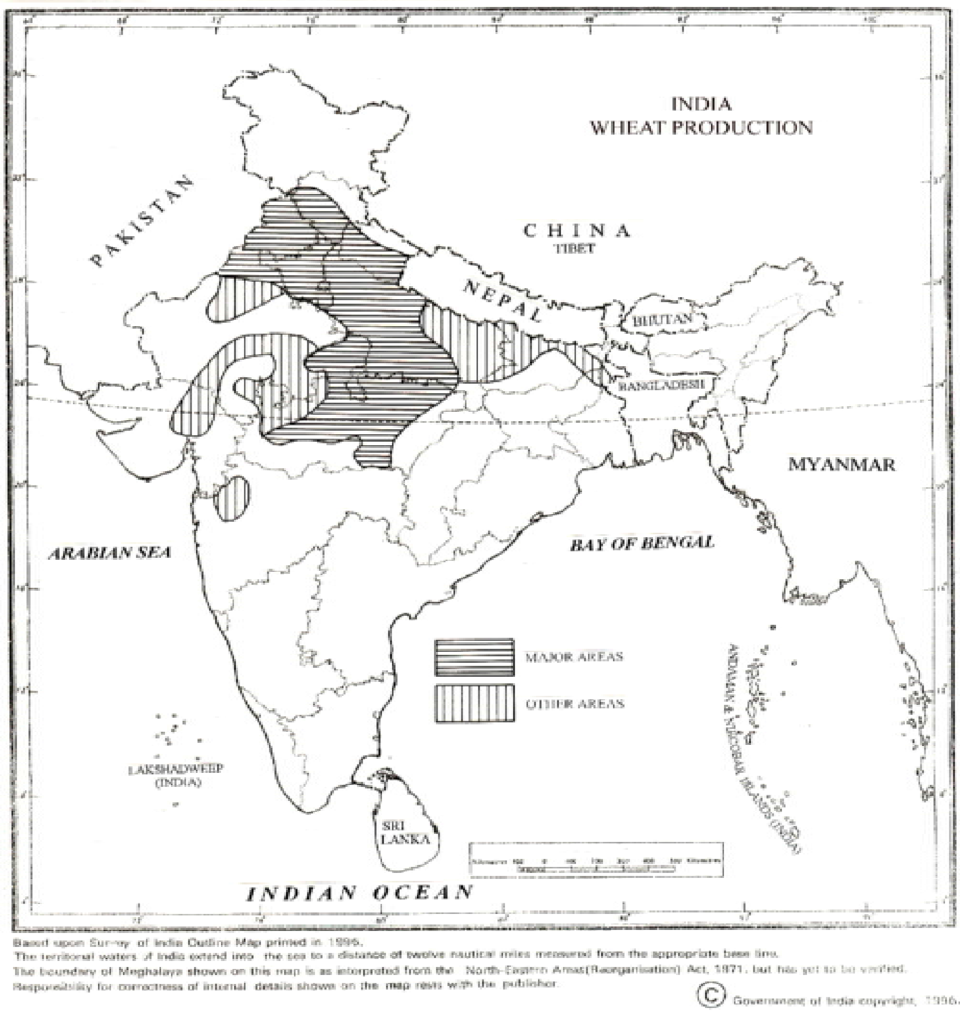

Fig. 22.2: INDIA: Wheat Producing Areas

(iii) Tea

India is the leading producer and consumer of tea in the world. The country earns a sizable amount of foreign exchange through export of tea. Tea grows best on the mountain slopes receiving large amount of rains (above 150 cms.) Well drained deep loamy soils, rich in humus is ideal for tea plantation. Most of the tea producing areas are on the hilly slopes of Surma and Brahamputra valleys in Assam, Darjeeling and Jalpaiguri districts of West Bengal. In south India, tea cultivation is confined mainly to the Annamalai and the Nilgiri hills. A small quantity of tea is also produced in the Kumaon hill in Uttarakhand and in the Kangra valley of Himanchal Pradesh. India produced 8.5 lakh tonnes in 1999. An amount of Rs. 2000 crores were earned in foreign exchange from the export of tea in 2000-01 despite huge demand in the domestic market.

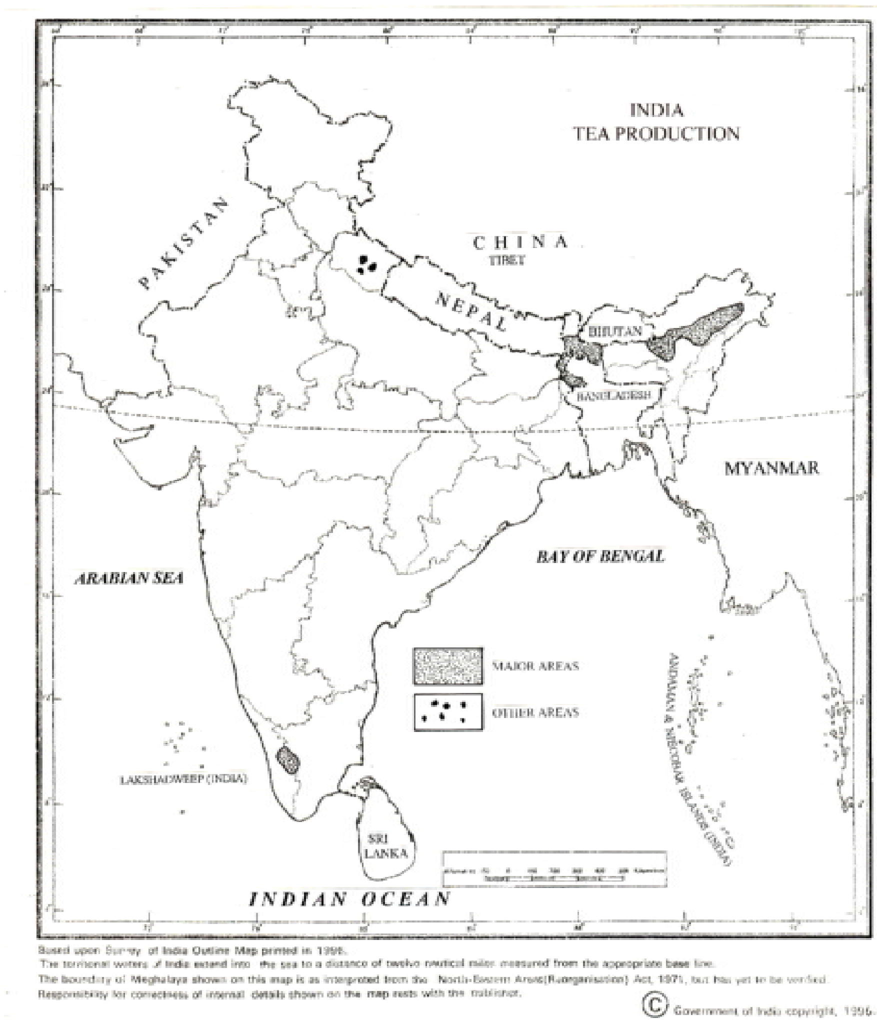

Fig.22 3: INDIA: Tea producing Areas

(iv) Cotton

India is one of the leading cotton producing countries in the world. The fibre of the cotton crop is used as raw material for the textile industries whereas oil extracted from its seeds is used in the vanaspati industry. Cotton seeds are also used as a cattle feed.

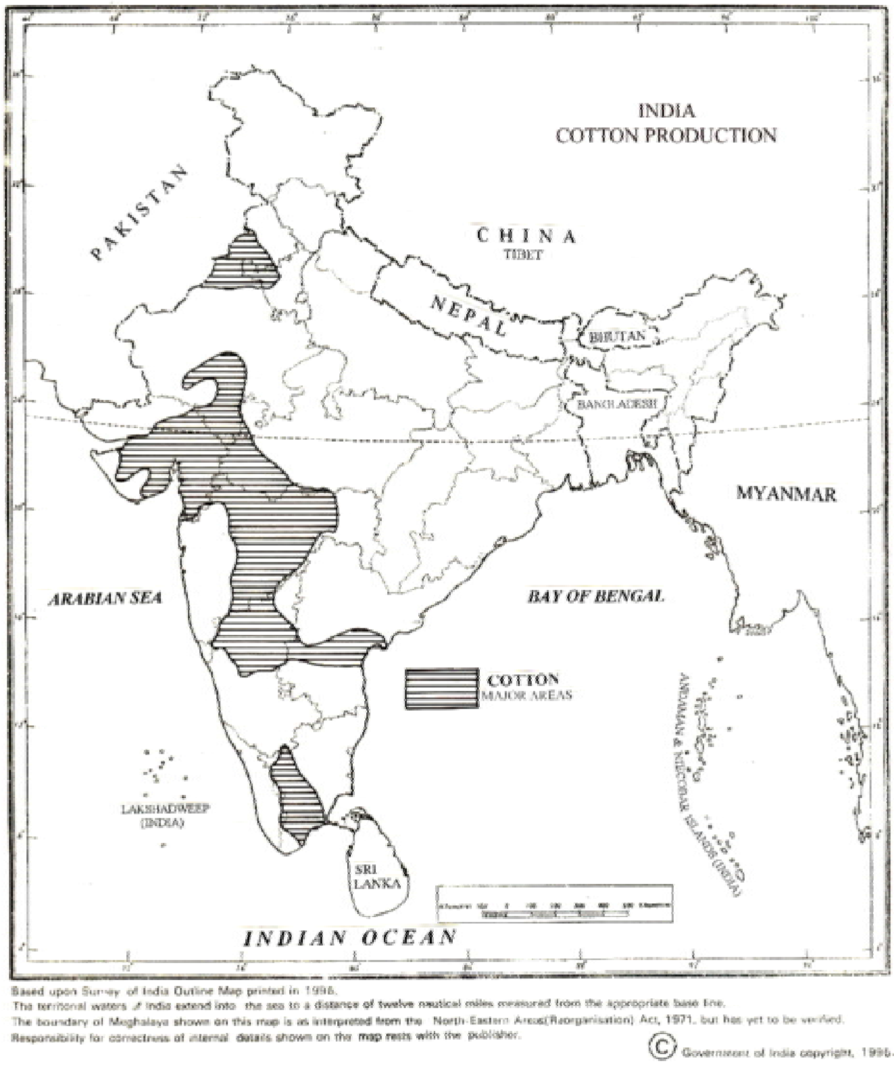

Fig.22. 4: INDIA: Cotton Producing Areas

Cotton require a moderate rainfall of about 75 cms. and a cloud free weather for about 150 days at the time of flowering and ball opening. Well drained black soils of the Deccan Plateau is considered ideal for its cultivation, though it is also grown on alluvial soils of the northern plains.

India produces about 8 per cent of the world's cotton and is the fourth largest producing country after USA, China and Russia. However, the quality of cotton is rather poor. Therefore, the long staple cotton is imported to make good quality of fibre. The good quality of cotton is grown in Punjab and Haryana. Leading producers of cotton in India are Maharashtra, Gujarat, Andhra Pradesh, Haryana, Rajasthan, Punjab, Karnataka, Madhya Pradesh and Rajasthan.

(v) Sugarcane

Sugarcane is the native plant of India. The country has the largest area under this

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crop in the world. It requires a hot and humid climate. Irrigation facility is required if rainfall is not enough. Fertile loamy and black soils are ideal for this crop.

Sugarcane is cultivated in two belts (i) in Northern Plains from Punjab to Bihar, and (ii) in Peninsular India from Gujarat to Tamil Nadu, Maharashtra, Karnataka and Andhra Pradesh. More than 60 per cent of the total area under sugarcane is found in the North Plains. The yield per unit area of sugarcane in South India is higher than in the North India.

Fig.22. 5: INDIA: Sugarcane Producing Areas

The leading producers of sugarcane are Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh. During 2000-2001, about 300 lakh tonnes of sugarcane was produced in India which is the highest in the world. Efforts are being made to increase production of sugarcane by developing hybrid varities. The Sugarcane Research Institute at Coimbatore is engaged in its research.

(vi) Spices

India produces a wide variety of spices including black pepper, cardamom, chillies, turmeric, ginger, cloves etc. Indian spices are known for their quality and find a market all over the world.

Chilly is an important condiment crop which is widely grown in the country and shares more than one third or 34 per cent of total production of spices in India. Tamil Nadu, Andhra Pradesh, Maharashtra and Karnataka are the leading producers of chillies.

After chillies, turmeric is second important spice crop in India. Major producing states are Andhra Pradesh, Tamil Nadu, Maharashtra, Orrisa and Bihar.

Among all the states, Kerala is one state where a large number of spices such as cloves, black pepper, ginger, cardamom are produced in the largest quantity. The other leading states in the production of spices are Karnataka, Tamil Nadu, Himachal Pradesh, Maharashtra, Orissa and Bihar.

Table 22.2 : Area, Production and Yield of selected crops in India, 1951-2001

Crops	Area (in lakh hectares)		Production (in lakh tonnes)		Yield (kg./ hectare)	
	1950-51	2000-01	1950-51	2000-01	1950-51	2000-01
Tea	3.1	4.4	2.8	8.7	87.6	1996
Cotton	59.0	86.0	31.0*	97.0*	98.3	191
Rice	388.0	444.0	206.0	849.0	668.0	1913
Wheat	98.0	251.0	65.0	688.0	815.0	2743
Sugarcane	29.0**	43.0	1100.0**	2996.0	33422.0	69636

* bales of 170 kg.
** 1960-61

(vii) Fruits

India accounts for about 10 per cent of the production of fruits in the world. It leads the world in the production of mango, banana, sapota and lemons.

A large variety of fruits are grown in India. Mango, bananas, citrus fruits pineapple, papaya, guava, sapota, jack fruit, lichi and grapes are tropical and subtropical fruits. The fruit of temperate areas are apple, pear, peach, plum, apricot, almond and walnut which are grown mostly in the mountainous areas of the country. The important fruits of arid zone of India are aonla, ber, pomegranate and figs.

Mango is the most important among fruit crops covering about 39 per cent of the area and account for 23 per cent of the total fruit production in the country. More than one-half or about 54 per cent of the world's mango is produced in

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India. The mango tree grows throughout the country especially in Uttar Pradesh, Andhra Pradesh, Maharashtra, Tamil Nadu and Kerala. **Dussahari and Alphonso** varieties of mango are in great demand in foreign countries. The country exports such varieties to earn foreign exchange.

In terms of area Citrus fruits rank next only to mango. Oranges and lemons are grown in Assam, Maharashtra, Punjab, and Tamil Nadu. Undulating sloppy terrain is most suitable for the growth of citrus fruits.

India is ranking first in the world in the **Banana** production. Banana ranks third in areal coverage and are grown mainly in Maharashtra, Tamil Nadu and Kerala. It is also grown in West Bengal, Orissa and Assam.

Apple is the fourth major fruit crop, mainly grown in the Himalayan region of the country. **Guava** is largely produced in Uttar Pradesh and Bihar, whereas **pineapple** is produced in Assam, Meghalaya, West Bengal, Tripura, Andhra Pradesh, Kerala and Karnataka.

(viii) Vegetables

India is the second largest producer of vegetables in the world next only to China. It contributes about 13 per cent to the world vegetable production. It occupies first position in the production of cauliflowers, second in onion, and third in cabbage in the world. Other major vegetable crops are potato, peas, tomato and bringal. More than fifty varieties of vegetables are grown in India.

(ix) Floriculture

With breaking of trade barriers in post-globalisation phase, international trade in vegetables, fruits and flowers has become lucrative. India can earn a sizable amount of foreign exchange by exporting flowers. Flower such as rose, jasmine, marigold, chrysanthemum, tuberose, and aster are grown over large area in Karnataka, Tamil Nadu, Andhra Pradesh, Rajasthan, West Bengal, Maharashtra, Delhi, Uttarakhand, Assam and Manipur.

INTEXT QUESTIONS 22.3

1. (a) Name two important fiber crops of India

(i)________________________ (ii)________________________

(b) Name two important sugarcane producing belts in the country.

(i)________________________ (ii)________________________

(c) Name the city where Sugarcane Research Institute is located

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(d) What is the ranking of India in the production of Banana in the world?

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(e) Which state is the largest producer of Rice in India.

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22.7 AGRO-CLIMATIC REGIONS OF INDIA

India has diverse agro-climatic conditions. It has almost all types of climatic conditions, capable of producing almost all kinds of agricultural produce in one or the other region. Several attempts have been made to classify India into various agricultural regions based on climatic and natural vegetation.

In 1989, the Planning Commission divided India into following 15 Agro-climatic regions. (Figure No. 22.6)

I The North-Western Himalaya

II The North-East Himalaya

III The Lower Ganga Plain

IV The Middle Ganga Plain

V The Upper Ganga Plain

VI The Trans Ganga plain (Punjab plains)

VII The Eastern Plateau and hills

VIII The Central Plateau and hills

IX The Western Plateau and hills

X The Southern Plateau and hills

XI The East Coast Plains and hills

XII The West Coast Plains and Ghats

XIII The Gujarat Plains and hills

XIV The Western Dry Region

XV The Islands

AGRO-CLIMATIC REGIONS OF INDIA

Fig. 22. 6: Agro-climatic Regions of India

22.8 CROPPING PATTERNS

The agricultural land devoted to different crops in a region or state or country at a particular point of time is called the cropping pattern. The cropping pattern of a region is an outcome of a long term agricultural practices, social customs and traditions, physical conditions and historical factors.

Features of changing crop-pattern

Changing crop pattern in India is as under:-

A. Dominance of food crops over non-food crops

- At the time of Independence, more than 75 per cent of the total area sown in the country was devoted to the production of food crops. Gradually with commercialisation of agricalture, farmers in India have started shifting area to non-food crops. Now, relative share of area under food crops has declined from 76.7% during 1950-51 to 65.8% during 1999-2000. This trend shows commercialisation of agriculture in India.

B. Variety of crops grown

Almost every kind of crops are grown in India as it is endowed with a variety of soils. These crops can be grouped into (a) Food crops (b) Fibre crops (c) Oilseeds (d) Medicinal plants and spices. Food crops are of two types- cereal and non-cereal. Among the cereals rice, wheat and millet are important. Pulses come next and then oilseeds. Similarly a number of spices and medicinal plants are also cultivated throughout the country. Emphasis is placed now on production of oilseeds, because a large amount of foreign exchange is spent on import of edible oils. Special attention is also given to production of medicinal plants, fruits, flowers and vegetables.

C. Dominance of cereals among food crops:

Within broad group of food crops cereals like wheat and rice dominate. About 82 per cent of the area under food crops has been put to cultivation of cereals. This is due to better prices, less risk in production and the availability of better seeds.

D. Decline in coarse cereals

Jwar, Bajra, Maize, Millets, Barley etc. are called coarse or inferior cereals. The area under these crops to the total area under cereal crops has declined significantly from 48 per cent in 1950-51 to about 29 per cent in 2001. This is due to spread of irrigation facilities, improved inputs and a shift in consumption patterns of the people.

E. Declining importance of Kharif crops

There are mainly three cropping seasons in India (i) Kharif (ii) Rabi (iii) Zaid. The Kharif season corresponds to the rainy season, while Rabi season with the winter. The short period in between the harvest of the Rabi crops and the sowing of the Kharif crops is called the Zaid season. Till recently, Kharif crops have been contributing the large share in the crop production in India. But this dominance is on the decline. The share of Kharif has declined from 71 per cent in the 1970's to 49 percent in 2003-2004. This makes a significant change in Indian agricultural practices after Green Revolution. This change is important because it would lessen uncertainty in crops production, as Rabi crops are more reliable than Kharif ones. The Kharif crops are not reliable because they are mostly dependent on rainfall. The most parts of India get rainfall from monsoon which is unreliable. Contrary to this, mostly Rabi crops in India are raised on irrigation which is comparatively reliable.

Climate-rainfall, temperature, humidity; soils, size of farms, availability of fertilizer, good quality of seeds, irrigational facilities and price incentives are the factors which effect cropping patterns.

22.9 ISSUES IN AGRICULTURAL DEVELOPMENT

Agriculture contributes a significant share to the national income (26%) but more importantly it is a major source of livelihood for majority of work force in the countryside. However, the per hectare production of different principal crops in the country is relatively low. In some cases it is as low as 1/4th to 1/5th as compared to other countries due to traditional methods of cultivation, small farms size, low investment, low input, poor health and lack of education among the farmers, lack of linkages between agriculture and industry, and poor condition of infrastructure. Limited availability of cultivable land and ever increasing population has left no alternative but to increase productivity of crops.

It is this sector that continues to have great potentinal for reducing poverty and hunger in rural areas. Following issues are important for the development of agriculture in India:-

A. The Use of Farm Inputs

For high growth rate, farm inputs like seeds, fertilizers, and irrigational facilities play an important role. The use of high yielding varieties of seeds, chemical fertilizers have increased particularly in Green Revolution areas of Punjab, Haryana, western Uttar Pradesh, coastal Andhra Pradesh and Tamil Nadu. However, in several other parts of the country the use of chemical fertilizers is much below the national average. In regard to irrigation, the irrigated land in the country is less than 50 per cent of the potential. Hence, there is a need for equitable and efficient use of inputs in the country so that regional disparities in its use can be minimized. Another important factor associated with use of chemical fertilizers is their im balanced use. Nitrogen, phasphorous and calcium required by the plants for balanced growth and good health of the soils are not used by most of the Indian farmers. There is over emphases on the use of nitrogen, resulting in damage to fertility of soils and adverse effect on crop productivity.

B. Small Size of Land holdings

About 89 per cent of operational farm holdings in the country are below two hectares in size. Over 70 per cent of agricultural production comes from the subsistence agriculture. Unless small farmers are helped to improve the productivity and profitability of their farms, the agriculture in India will not develop in its true sense. This can be possible by optimum use of available land, water, credit facilities and labour resources.

C. Farm Mechanization

The use of improved agricultural implements and machines such as the plough, tractor, trolley, harvester, thrasher, water pump, sprinkler etc. are important to modernize Indian agriculture. These machines are being used in some parts of the country. Diffusion of modern farm technology and techniques is both necessory as well as a big challange. To increase productivity, some agricultural implements are being made available to the farmers through Development Blocks and Co-operative Societies.

D. Consolidation of Holdings

Small and scattered holdings of land are one of the reasons of low agricultural productivity in India. This is an obstacle in the way of modern agriculture in which machines, improved equipments and techniques are used. These problems are being minimized through consolidation of land holdings. However, in many parts of the country it is still a big problem. For example, apart from hill states, Rajasthan and Bihar are two states in the northern plain where land consolidation is yet to be implemanted. This problem needs to be addressed on priority basis by the respective governments.

E. Diversification of Agriculture

Diversification of agriculture means a shift of resources from farm to allied activities, e.g. shift to dairy farming. Also, there is a need to give more importance to higher value crops in comparison to lower value. The diversification will improve income, generate employment, alleviate poverty, increase productivity, food security, and will also promote exports. Although, impressive gains have been made in agricultural production by diversifying agriculture in some parts of the country like in Punjab, Haryana and western Uttar Pradesh, remaining parts of the country, still needs much attention.

F. Agriculture and Industry Interface

For the better development of agriculture, it must be linked with the industry. It will increase investment in agriculture and boost agricultural productivity. It will also increase industrialisation and employment opportunities. Although, the interdependence of agriculture and industry has increased over the years, yet much is required to be done in time to come.

The agriculture and agriculture based industries need helping hand for over all development of rural areas.

Green Revolution

The eight years between the commencements of the Third-Five Year and fourth-Five Year Plans 1961-69 were the year of great significance for Indian agriculture. During this period a new strategy of agricultural production was introduce first in 1960-61 as a pilot project, in some districts of Punjab and was subsequently extended to other districts of the country. The core of this strategy was the use of High Yielding Variety (HYV) of seeds, application of chemical fertilizers and extension of adequate and assured irrigation. It also made it imperative to use pesticides and insecticides and improved agricultural implements to enhance agricultural productivity. It also became essential to make provision of cheap credit, storage and marketing facilities, crops preservation measures, and support price for agricultural products. Due to these measures, food grains production surged in India and country became self sufficient in food grains. This achievement of Indian farmers is called 'Green Revolution'. The term Green Revolution was used first in 1968 by Dr. William Gadd of the U.S.A.

The Green revolution in India has been successful mainly in Punjab, Haryana, and western Uttar Pradesh because these regions had advantage of assured irrigation, adequate supply of fertilizers, HYV seeds, and modern agricultural implements at subsidised rate. The majority of farmers and the areas in the country have not been benefited by it, resulting in ever increasing inequalities in agricultural and rural development in the country. Due to increased application of chemical fertilizer and over irrigation, soils in the areas of the Green Revolution have been degraded in the form of salinity and water logging. The Green Revolution package has led to serious environmental disruption in areas of its sucess. Excessive concentrations of chemical fertilizers and pesticides contaminate the streams and the ground water with serious health hazards for the people. Fish are not found in the paddy fields any more and the water table has decreased drastically in these areas.

Green Revolution means rapid increase in farm production per unit area through the application of (i) high yielding seeds (ii) chemical fertilizers and (iii) assured and adequate irrigation.

G. Infrastructural Development

The Government has tried to develop various infrastructural facilities in rural areas- e.g. electrification, provision of irrigation facilities, construction of metalled roads to connect villages to the markets. The scheme of crops insurance has also been introduced. Awareness programs for farmers through radio and television are being relayed. A number of magazines are being published to provide the latest information about new techniques in agriculture. Recently call centers have been established to solve problems of farmers on telephone. But existing infrastructural facilities are not adequate in the country. There is a need of spreading these facilities to small farms, in general, and to the farmers of remote areas, in particular.

H. Agricultural Credit

Commercial banks, Regional Rural (*Grameen*) Banks and Cooperative banks, provide credit support and services for agricultural and rural development. Commercial Banks account for 50 per cent, Cooperative Banks 43 per cent and regional Rural Banks 7 per cent share in the credit flow for agriculture. *Kissan* Credit Card scheme was introduced in 1998-99 to facilitate access of credit to farmers from commercial banks and Regional Rural Banks. There is need for expanding this scheme to other geographical areas.

I. Globalization and Indian Agriculture

Globalization, in simple term means integration of the economy of a country with worlds economy. In Indian context, this refers to the opening up the economy to foreign direct investment in different field of economic activities, removal of obstacles to the entry of Multi National Companies (MNC's) in India, allowing Indian companies to enter into foreign collaborations, to encourage setting of joint ventures abroad, bringing down the level of import duties and opening the Indian market for the world.

Impact of Globalization on Agriculture: The experts are divided on the impacts of globalization on agriculture. They say that India will get benefited through improved prospects for agricultural export as a result of increase in the world prices of agricultural commodities with reduction in heavy farm subsidies provided in the developed countries and breaking of barriers to trade. The prices of agricultural products in India are not likely to increase as all major programmes such as subsidies on P.D.S. (Public Distribution System) and on agriculture are exempted from the contol of W. T. O. Agreement on agriculture. It is mainly because of the fact that subsidy given on agriculture in India is below the limit of 10 per cent of value of agricultural products. Furthermore, India has the skills and the low cost labours which make it one of the lowest-cost producer of agricultural products in the world. Hence, there will be a large market world wide for these products. Moreover, it is also said that an improvement in terms of trade in favour of agriculture will promote faster agricultural growth in India.

However, these claims are questionable on the following grounds:

(i) Due to globalization, the Indian farmers might have to face much unstable prices of agricultural products as world prices for these products fluctuate largely on year-to-year basis.

(ii) The impact of trade liberalizations on the prices of agricultural products at international level and domestic level depends on what policies other countries follow. For example, developed countries are not willing to reduce subsidies on their agricultural products, to keep these still cheaper to benefit their farmers.

(iii) Due to liberalization, MNC's engaged in agro-business would operate freely in India. For their strong financial background, they could produce hybrid varieties of seeds and the specialised agro-chemicals, using advance biotechnology. These hybrid seeds cannot be regrown or reproduced by the farmers as they are genetically modified to terminate after first use. Therefore, these seeds will have to be purchased every year from the MNCs for the monopoly they have over it under IPR (Intellectual Property Rights) regime.

(iv) There would be uneven distribution of income across social classes and geographical region due to effect of globalization on agricultural practices and trade. Rich regions or social groups will be richer in the country.

Intellectual Property Rights (IPRs)

It is an important feature of the WTO agreements among the member countries related to intellectual property rights (IPRs). It covers copyright, trademarks, geographical indications including appellations of origin, industrial, patents on production of new varieties of plants and seeds, etc. Under this agreement on the above subject all member countries have to (i) provide minimum standards of protection (ii) facilitate domestic producers and remedies for the information of IPRs and (iii) settle dispute between the WTO members.

The traditional knowledge of farmers and indigenous people in respect of uses of different variety of plants are being used by MNCs for their business profits patenting them under IPRs. The famous examples are patent of neem and turmeric product by American MNCs.

22.10 AGRICULTURAL DEVELOPMENT POLICIES DURING FIVE YEAR PLANS

The agriculture in India during five-year plans has registered a phenomenal growth.

At the time of Independence, partition of Indian sub-continent on communal lines, resulted among others in acute shortage of food and raw material for her industries. Therefore, during first five-year plan (1951-56) the highest priority was accorded to increaseof agricultural production. Nearly one third or 31 per cent of total plan funds were allocated to agriculture sector. River valley projects were taken up. Irrigational facilities and fertilizer plants were established. Consequently, production of food-grains increased by 36 per cent in a short span of five years.

The second five-year plan (1956-61) was focused on industrial growth and only 20 per cent of plan allocation was devoted to agriculture. Still food-grains production exceeded the target due to extension of irrigation facilities and use of chemical fertilizers.

During the third Five Years Plan (1961-66), the priorities were on self-sufficiency in food grains, meeting the raw material needs of industries and increase in exports. During this period, Green Revolution programme was started on a small scale. But this plan failed to meet the target due to Chinese aggression (1962), Indo-Pak war (1965) and severe and prolonged drought during 1965-66. There were a great crisis of food that forced the Prime Minister L. B. Shatri to appeal to people to observe fast once a week.

During next three annual plans (1966-69) agriculture recorded 6-9 per cent annual growth under the impact of Green Revolution. The production of food grain touched 94 million tonnes.

The Fourth Plan (1969-74) aimed at 5 per cent annual growth in food grains. High Yielding Variety (HYV) of seeds, fertilizer use, new agriculture techniques and irrigation facilities provided to expand area of Green Revolution. The production of wheat increased sharply but growth in rice, oilseeds and coarse grains were nominal resulting in only 3 per cent annual growth against the target of 5 per cent.

During Fifth Plan Period (1974-79) emphasis were given to self-sufficiency in food production and poverty eradication. Stress was laid on the extension of irrigation, expansion in cultivated area under HYV seeds and grant of loans and subsidies to farmers. Dry farming was propagated. This plan achieved its target successfully with 4.6 per cent growth. Almost all food grains except pulses witnessed increase in production.

The Sixth Plan (1980-85) imphasized on land reforms, use of HYV seeds, chemical fertilisers and groundwater resources and improving post harvest technology as well as marketing and storage facilities. The annual growth rate was 6 per cent, highest ever during plan periods. The food-grain production reached 152 million tonnes.

The highest growth in food-grain, pulses and coarse cereals was recorded during Seventh Plan (1985-90) showing over all annual growth rate of 4 per cent. The areas of Green Revolution were expanded during the period.

The Eighth Plan (1992-97) witnessed a tendency of stagnation in foodgrain production while oilseed registered a rapid growth.

The Ninth Plan (1997-02) witnessed a mixed success. There were fluctuations in the foodgrain production. During this plan period National Agricultural Policy, 2000, was framed and several measures were announced including, watershed management, development of horticulture, agricultural credits and insurance scheme for crops.

In the Tenth Plan (2002-2007) focus is placed on (i) sustainable management of water and land resources, (ii) development of rural infrastructure to support agriculture, (iii) dissemination of agriculture technology, (iv) credit flow to agriculture sector, and (v) agricultural marketing reforms.

The New Agricultural Policy

The Government of India has announced (28th July 2000) a new National Agricultural policy, 2000, in the light of changes arising out of economic liberalization and globalization. The main aims of the polict are (i) achieving more than 4 per cent per annum growth rate in agriculture sector, (ii) growth based on efficient use of resources and conservation of soil, water and biodiversity, (iii) growth with equity-in region and among the farmers, (iv) growth that caters to domestic market and maximizes benefits from exports of agricultural products and (v) technologically, environmentally and economically sustainable growth.

The main features of this policy are:-

(1) privatisation of agriculture and price protection of produce,

(2) land leasing and contract farming by private companies,

Notes

(3) raising the ceiling of land holdings,

(4) involving national livestock breeding strategy to meet requirement of milk, meat, egg and livestock products.

(5) protection of plant varieties and improvement of horticultural crops, live-stock species and agriculture.

(6) liberalization of domestic market by dismantling of restriction on movement of commodities in the country.

(7) improving the domestic and international marketing system.

(8) facilitating the flow of credit to farmers against pledging of their products and providing them most other facilities available to manufacturing sector.

(9) keeping agriculture outside the regulatory and tax collection system.

(10) encouraging consolidation of land holdings and speeding up tenancy re-forms to recognize the right of the tenants and sharecroppers

It may be noted that the policy are intentions of Government, thus, its success depends on the commitment of the Government to convert it into reality.

INTEXT QUESTIONS 22.4

1. What are the determinants of cropping pattern in India?

____

2. What do you understand by globalization?

____

3. Name three agricultural seasons found in India?

1.________________ 2.________________ 3.________________

4. During which five year plan period a special programme for the Green Revolution started?

____

5. Write four objectives of new National Agricultural policy 2000.

____

WHAT YOU HAVE LEARNT

India has different types of land uses. About 47 per cent of its total area is under cultivation leaving very little scope for brining further land under cultivation. The food for rapidly growing population can be provided only by improving productivity per hectare of land as cultivable land in India is only 13 per cent. There is need of increasing forest land for ecological balance.

Animal rearing is important economic activity in India. It accounts for a quarter of the total agricultural output. India has the highest number of livestock but the quality of livestock is very poor. Efforts are being made to improve the quality of animals through operation flood. As a result, India is now leading in milk production in the world. Fisheries is also an important occupation in India.

Rice, wheat, sugarcane, cotton and tea are important crops grown in India. Efforts are being made to increase production of fruits, vegetables, spices and flowers. The importance of these crops have increased due to global opportunities in export of agricultural commodities. India can earn a sizable amount of foreign exchanges with export of these items.

The government of India has formulated a new agricultural policy in 2000 in the light of economic libralization. In the new agricultural policy emphasis have been placed on privatization of agriculture, increasing animal products, aquaculture, flowriculture, improving domestic and international market systems and facilitating credit flow to the farmers.

TERMINAL QUESTIONS

1. Discuss changing pattern of cropping in India.
2. What is meant by Green Revolution? Write its impact on agricultural production and environment.
3. What is the impact of globalization on agricultural sector in India?
4. Show the sugarcane and tea producing areas on an outline map of India.
5. Write short notes on following:-
   (a) Eco-farming/organic farming
   (b) White Revolution
   (c) Blue Revolution
   (d) Agricultural policy of India.

ANSWER TO INTEXT QUESTIONS

22.1

1. (i) (f)
   (ii) (e)

Notes

(iii) (d)

(iv) (c)

(v) (b)

(vi) (a)

2. Punjab (84%)

22.2

1. 25
2. Uttar Pradesh
3. Rajasthan
4. (ii) 22

22.3

1. (a) (i) Cotton (ii) Jute

   (b) (i) from Punjab to Bihar in the Northern Plain.

   (ii) from Gujarat to Tamil Nadu in South India.

   (c) Coimbatore

   (d) (i) First

   (e) West Begal

2. See Map on page No.

22.4

1. Climate (rainfall, temperature, humidity), soils, size of farms, availability of fertilizers, good quality of seeds, irrigational facilities and price incentives are the factors which effect cropping patterns
2. Globalization means to make global, worldwide or effecting whole world or all people. It integrates economy of a country with world economy.
3. There are three agricultural seasons in India - (i) Rabi (ii) Kharif (iii) Zaid.
4. During third plan (1961-66).
5. i) Achieving more than 4 per cent annum growth rate in agriculture sector (ii) Growth based on efficient use of resources and conservation of our soil, water and biodiversity, (iii) Growth with equity-in region and among the farmers, (iv) growth that caters to domestic market and maximizes benefits from exports of agricultural products.

HINTS TO TERMINAL QUESTIONS

1. Refer to section 22.6 and 22.8
2. Refer to box information under section 22.9
3. Refer to section 22.9 (I)
4. Refer to Fig. No. 22.3 and 22.5
5. (a) Refer to 22.3(J)

   (b) Refer to 22.4

   (c) Refer to 22.5

   (d) Refer to 22.10

Notes

23

DEVELOPMENT OF MINERAL AND ENERGY RESOURCES

In the previous lessons, we have read about land, soils water and forests resources. In this lesson, we will study another two vital resources namely minerals and energy resources. Minerals like land and water are invaluable treasures of the earth. Without them, we cannot think of industrialisation and hence the development of our economy. In many countries, they are the main source of national income. The social and economic development of a nation depends on its capacity to utilise its natural resources, avoiding its wasteful use to the extent possible. The most important characteristics of minerals which have bearing on our present and future well-being is that they are practically lost, once used. They are non-renewable resources. Hence, the need to conserve these resources and to recycle them cannot be over emphasised.

Among the many causes of the fall of the Roman Empire, the depletion of the mineral deposit and the erosion of soil is said to be one. Even during the recent past, several mining towns turned into ‘ghost towns’ in many parts of the developed world. The Canadian township of Elliot Lake which turned out to be “the first nuclear-age ghost town” is the most recent example of this process. Built at an enormous cost in response to the discovery of uranium in mid fifties, its population declined from 25,000 in 1958 to 5,000 in 1961 as soon as an alternative source was found by the U.S.A. It only shows that prosperity based exclusive on mineral and energy resources cannot be taken for granted as permanent.

In this lesson, we will be studying some of the important minerals, mineral fuels and other energy resources, their geographical distribution, problems associated with these resources and the need for their conservation.

OBJECTIVES

After studying this lesson, you will be able to:

- state about the mineral resources of the country;
- explain the importance of minerals and energy resources for the economic development;
- differentiate between (i) metallic and non-metallic minerals, (ii) conventional and non-conventional resources of energy
- locate on the outline map of India, the different areas where mineral and energy resources are found.
- infer the effects of mining/refining and using of fossil fuels on local environment; and
- suggest measures to conserve minerals and energy resources.

23.1 MINERAL RESOURCES OF INDIA

India is richly endowed with minerals. Our country possesses more than 100 minerals. Out of 100 minerals, there are 30 minerals which have economic significance. Some of the examples are coal, iron ore, manganese, bauxite, mica etc. The situation is also satisfactory in felspar, florides, lime-stones, dolomite and gypsum etc. But the reserves of petroleum and some nonferous metallic minerals especially copper, lead, zinc, tin, graphite are inadequate. Non-ferous minerals are those which do not contain iron. Country fulfills internal demands for these minerals by importing them from other countries.

As you have read in the history, India was least industrialised and most of the minerals were exported during British period. After independence though export continues but also mineral production has picked up in consonance with the increasing industrial demands in the country. As a result the total value of all minerals produced in the country reached about Rs 744 billion in 2004 – 05 from Rs 892 million in 1950-51. Therefore, there has been 834 times increase during the past fifty five years. If we look at mineral wise break up it has been found that fuel minerals (coal, petroleum, natural gas and lignite) accounted for about 77%, metallic minerals for about 10% and non-metallic minerals for about 3% of total value of minerals produced. In metallic mineral category, iron ore, chromite, manganese, zinc, bauxite, copper, gold are important minerals whereas in non-metallic category lime-stone, phosphorite, dolomite, kaolin, magnesite, barytes and gypsum are important. If we look at individual minerals in terms of value, then coal (36.65%) followed by petroleum (25.48%), natural gas (12.02%), iron ore (7.27%), lignite (2.65%), lime stone (2.15%) and chromite (1.1%) are the few minerals that contributes more than one percent each of the total value of all minerals produced in the country.

Till now we have a detailed discussion about the minerals that are found in our country, their economic significance. In the next section, we will find out their geographical distribution.

23.2 SPATIAL DISTRIBUTION OF MINERALS AND ENERGY RESOURCES

The distribution of mineral and energy resources is uneven. It's because occurrence of mineral resources are associated with certain types of geological formation. Coal deposits are mostly associated with Gondwana system, Dharwar and Cuddapah systems contain resources of major metallic minerals like copper, lead, zinc etc and major non-metallic minerals like limestone, dolomite, gypsum, calcium, sulphate etc are found in cuddapah and upper vindhyan system.

If we look at the distribution in terms of region, then it has been found that much of the peninsular region west of a line from Mangalore to Kanpur has very little mineral wealth. East of the line which covers the state of Karnataka, Andhra Pradesh, Orissa, Madhya Pradesh, Chhatisgarh, Jharkhand, Bihar and West Bengal. These states have the major reserve of metallic minerals like iron, bauxite, manganese etc and non-metallic minerals like coal, limestone, dolomite, gypsum etc. Most of these mineral bearing states are located in the peninsular plateau region of India. Within peninsular plateau region of India the following three mineral belts can be demarcated.

(1) **The North eastern plateaus:** It covers chhotanagpur plateau, orissa plateau and eastern Andhra plateau. This belt contains rich deposits of a variety of minerals, speacially used for metallurgical industries. Prominent minerals that are large and widely distributed are iron ore, manganese, mica, bauxite, limestone, dolomite etc. This region has also rich deposits coal, along the river valleys of Damodar, Mahanadi, Son etc. This region has also substantial amount deposit of copper, uranium, thorium, phosphate etc.

(2) **South-western plateaus:** This region extends over Karnataka plateau and adjoining Tamil Nadu plateau and is rich in metallic minerals particularly in iron ore, manganese and bauxite and in some non-metallic minerals. All the three gold mines of India are found in this region. However, coal is not found in this plateau region.

(3) **North-western region:** This belt extends from gulf of Khambhat in Gujarat to the Aravalli range in Rajasthan. Petroleum and natural gas are principal resources of this belt. Deposits of other minerals are small and scatterred. However, it is known for reserves and production of several non-ferrous metals particularly copper, silver, lead, and Zinc.

Outside of these mineral belts, upper Brahmaputra valley is a significant petroleum producing area whereas Kerala possesses enormous concentration of heavy mineral sands. Outside these above mentioned areas minerals deposits are very poor, scatterred and reserves are inconsistent.

In the next section we will discuss about mineral fuels and mineral. Under mineral fuel we will discuss coal, petroleum, natural gas, and atomic minerals namely uranium and thorium. Under minerals certain selective minerals under ferous and non-ferous categories will be discussed.

23.3 MINERAL FUELS

Mineral fuels include coal, petroleum, natural gas and atomic or radio-active minerals.

(a) Coal

In India, coal is the primary source of commercial energy. It is used as fuel in industries, thermal power stations and also for domestic purposes in some parts of the country. It is also used as a raw material in chemical and fertiliser industries and in the production of thousands of items of daily use.

As per the assessment of January, 2005 the total coal reserves of the country stand at 2,47,847 million tonnes. Unfortunately, the bulk of the Indian coal reserves are of rather poor quality. We meet part of our coking coal requirements through import. In India, emphasis is being laid on setting thermal and super thermal power station on or near the coal fields and electricity generated is supplied to far off places through transmission lines. At one time Indian railways were the largest consumer of coal. Since they have switched on to the use of diesel and electricity they are no more the direct consumer of coal.

Table 23.1 Production of Coal in India (including Lignite)

Year	Production (in Million Tonnes)
1950-51	32.8
1960-61	55.7
1970-71	76.3
1980-81	118.8
1990-91	225.7
2004-05	376.63

Source: India 2006, A Refrence Annual, P. 276

Distribution

Coal in India occurs in two important types of coal fields. They are the Gondwana coal fields and Tertiary coal fields. Out of the total coal reserves and production in india, Gondwna coal fields contribute 98% and the rest 2% is produced by tertiary coal fields. The Gondwana coal fields are located in the sedimentary rock systems of lower Gondwana Age. They are distributed chiefly in the river velleys of the Damodar (Jharkhand - West Bengal); the Son (Madhya Pradesh–Chhatisgarh); the Mahanadi (Orissa), the Godavari (Andhra Pradesh) and the Wardha (Maharashtra). Tertiary coalfields occur in the extra-peninsular areas which include Assam, Meghalaya, Nagaland, Arunachal Pradesh, Jammu & Kashmir and Sikkim. Besides lignite or brown coal are found in coastal areas of Tamil Nadu, Gujarat and in land basins of Rajasthan.

Jharkhand ranks highest in production as well as reserves of coal in India. The coal deposites of Jharkhand mainly occur in Dhanbad, Hazaribagh and Palamau district. In Dhanbad district the most important coalfields of Jharia and Chandrapura are located. The oldest coal fields of Raniganj is situated in West Bengal. It is the second largest coalfield in India. Raniganj coalfield stretches over Burdwan and Purulia districts. In Chhatisgarh, coal deposits occur in Bilaspur and Sarguja districts. In Madhya Pradesh, coal deposits are found in Sidhi, Shahdol and Chhindwara districts. Singrauli coalfield in Shadhol and Sidhi districts is the largest in the state. In Andhra Pradesh, coal occurs in the district of Adilabad, Karimnagar, Warangal, Khammam and West Godavari. In Orissa, Talcher is an important coal field. Other coal field are in Sambalpur and Sundargarh districts. In Maharashtra the coal fields are found in the districts of Chandrapura, Yeotmal and Nagpur.

In comparison to India's coal reserves, lignite reserves are relatively modest. The bulk of lignite reserves are located in and around Neyveli in Tamil Nadu. Significant lignite reserves are found in Rajasthan, Gujarat, Pondicherry and Jammu & Kashmir.

- Coal is used as raw material in chemical and fertiliser industries and in the production of thousands of items of daily use.
- Coal are mainly found in the Gondwana and Tertiary coal field.
- The states of Jharkhand, West Bengal, Chhatisgarh, Andhra Pradesh and Orissa are the leading producers of coal.
- The bulk of lignite reserves are found in and around Neyveli in Tamil Nadu.

(b) Petroleum

Petroleum has often been called liquid gold because of its value in our modern

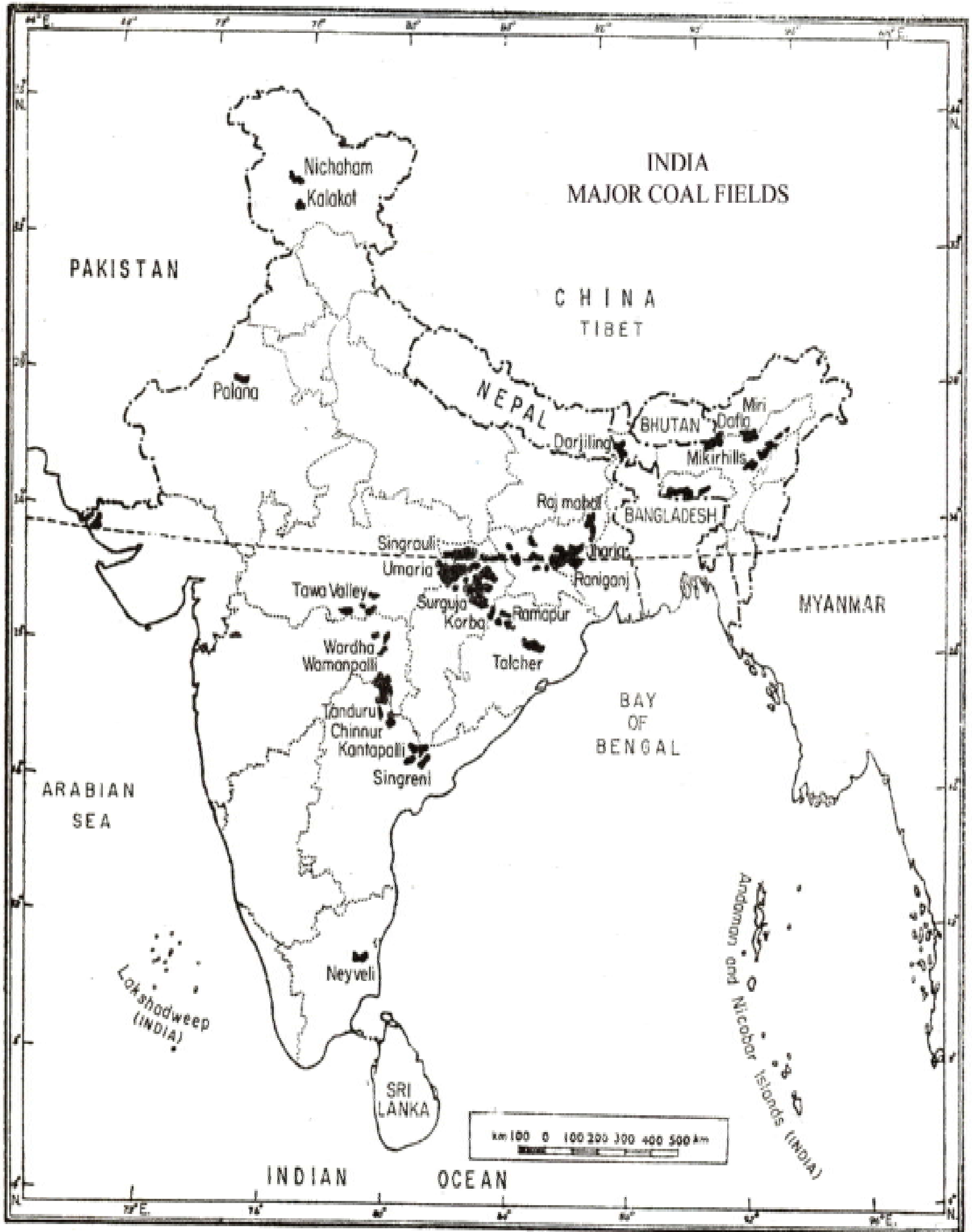

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Fig. 23.1 INDIA : Major coal fields

civilization. Our agriculture, industry and transport system depend on petroleum in several ways.

The crude petroleum is a mixture of combustible hydrocarbons in solid, liquid and gaseous forms. Petroleum products used as fuel, lubricant, material for manufacturing synthetic derivatives and chemicals required in industries. Petrol, kerosene, diesel, detergents, synthetic fibres, plastics, cosmetics etc. are important products derived from petroleum.

Distribution

Petroleum occurs in anticlines and fault traps. In India, it is found in the sedimentary rock formation. Most of such areas lie in the Assam, Gujarat and off shore areas along the western coast.

The entire production of India till today comes from the Assam belt, Gujarat-Cambay belt and Bombay High. The Assam belt extends from Dehang basin in the extreme north-east of Assam along the outer flanks of hill ranges forming the eastern border of Bhitra and Surma Valley. The Gujarat-Cambay belt extends from Mehsana (Gujarat) in the north to the continental shelf off the coast right up to Ratnagiri (Maharashtra) in the south. It covers Bombay High which is the largest producer of petroleum in the country. In Assam, the oil producing area is located in the Lakhimpur and Sibsagar districts. The oil wells are located mainly around Digboi, Naharkatiya. Sibsagar and Rudrasagar. In Gujarat, the oil producing area covers Vadodara, Broach, Kheda, Mehsana and Surat Districts. Recently petroleum reserves are discovered in the state of Rajasthan covering major areas of Bikaner, Barmer and Jaisalmer and gas has been discovered along the east coast in the Godavari and Krishna deltas. The prospective areas lie in the Bay of Bengal, which covers the coastline along the state of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Andaman and Nicobar Islands.

- Petroleum occurs in anticlines and fault traps. In India it is found in sedimentary rocks. Most of such areas lie in the Assam, Gujarat and off shore areas along the western coast.
- Petrol, kerosene, diesel, detergents, synthetic fibres, plastics, cosmetics etc. are important products derived from petroleum.
- Petroleum products are used a fuel, lubricant material for manufacturing synthetic derivatives and chemicals required in industries.

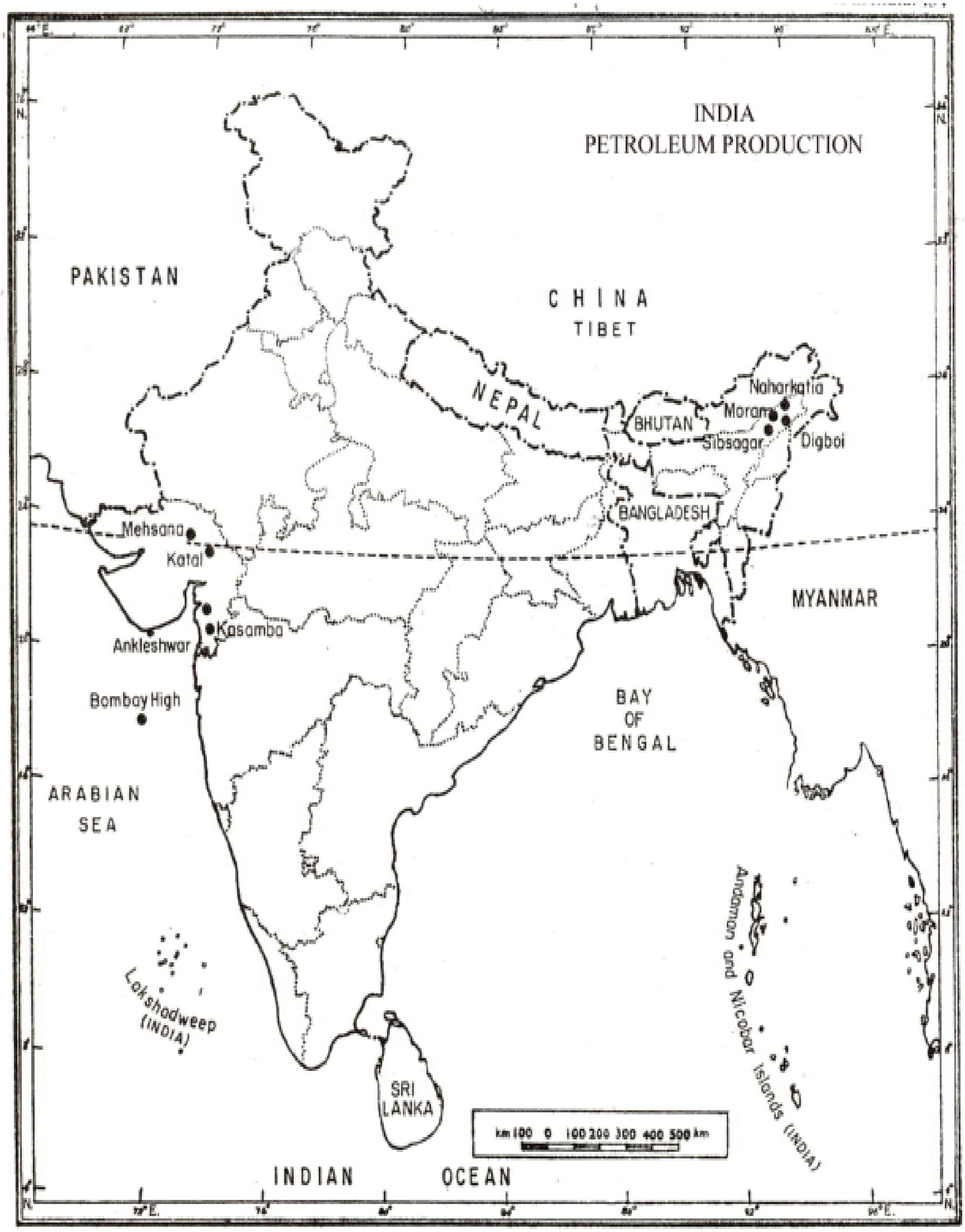

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Fig. 23.2 INDIA : Petroleum production

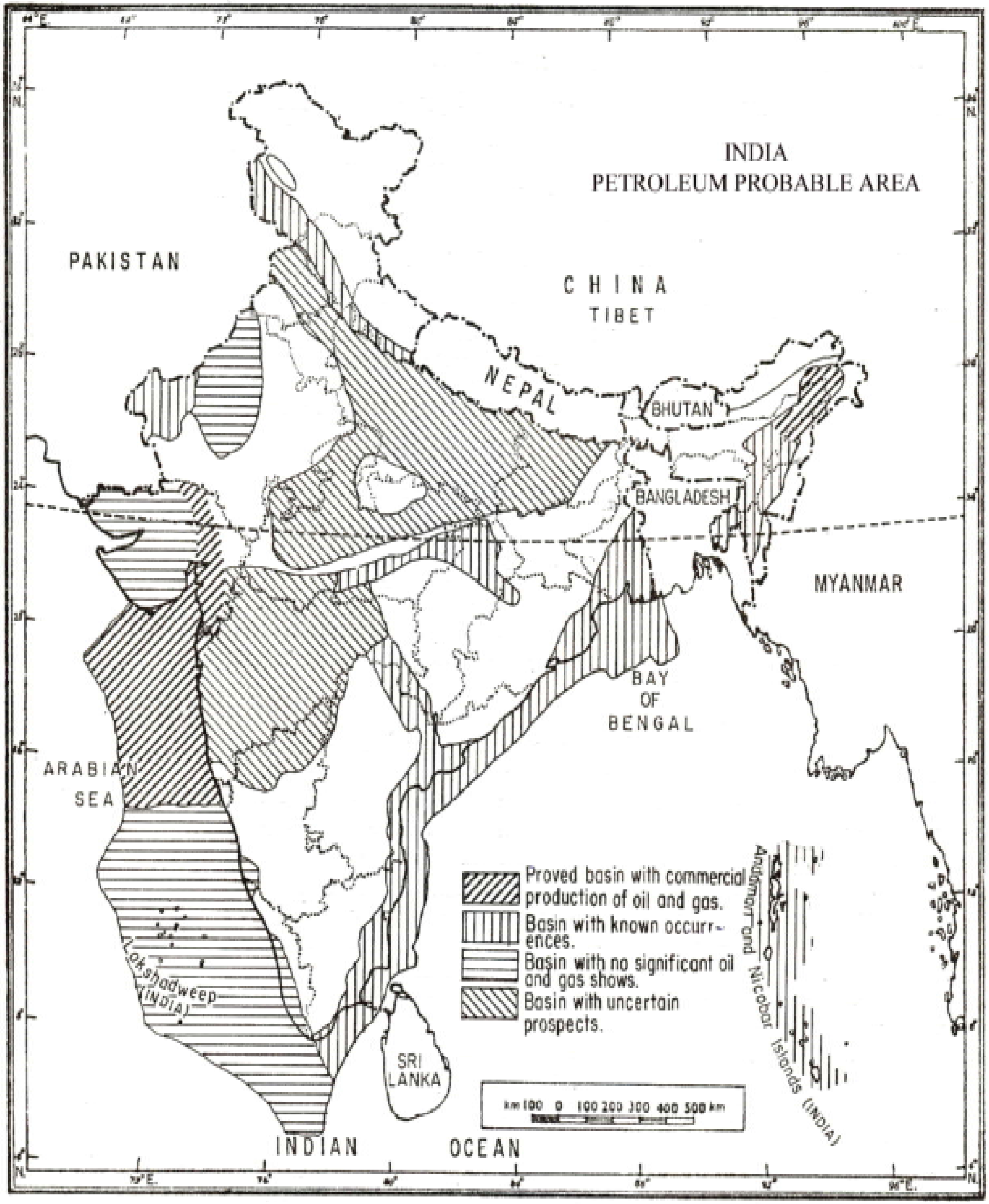

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Fig. 23.3 INDIA : Petroleum probable Area

Table 23.2 Production of Crude Petroleum in India

Year	Production (in million tonnes)
1960-61	0.5
1970-71	6.8
1980-81	10.5
1990-91	33.0
2000-01	32.4
2005-06	32.2

Source : Economic Survey 2006-07, S-1

Oil Refineries in India

The crude petroleum taken from oil fields needs to be refined before it can be used. Oil refining is really a big chemical engineering industry involving a complicated process. Presenty there are 17 oil refineries in India under public sector and one in private sector which belongs to Reliance Industries Ltd. These refineries are at Digboi, Bongaigaon, Nunamati (All are in Assam), Mumbai (two) (Maharashtra), Vishakhapatnam (Andhra Pradesh), Barauni (Bihar), Koyali (Gujarat), Mathura (U.P.), Panipat (Haryana), Kochi (Kerala), Mangalore (Karnataka) and Chennai (Tamil Nadu).The only private oil refineries belongs to Reliance Industries Ltd. is located at Jamnagar (Gujarat). These oil refineries are supplied crude oil either by ships or by pipelines. Although the annual production shows an increasing trend, the country has to import petroleum and petroleum products to meet its requirements.

- Presently, there are 17 oil refineries in India under the Public sector and 1 in private sector.
- Although the annual production shows an increasing trend, the country has to import petroleum and petroleum product to meet its requirement.

(c) Natural Gas

Natural gas is energing as an important source of commercial energy. Most of the time it is found in association with petroleum. The recoverable reserves of natural gas (as on 1st April, 2001) are estimated at 638 billion cubic metres. But this quantity will increase as more and more reserves are discovered at eastern coast namely Krishna, Godavari and Mahanadi basins. Production of natural gas in 2003-04 was about 31 billion cubic metres.

Gas Authority of India was established in the year 1984 with an aim for processing, transporting, distributing and marketing of natural gas. The company owns and operates a network of over 5,340 km of natural gas pipeline in the country.

(d) Atomic Minerals

Atomic energy can be produced by fission or fusion of the atoms or rather the nuclear parts of radio-active minerals like uranium thorium and radium. India possesses the world's largest reserves of monazite, the principal source of thorium and some reserves of uranium.

Uranium

In India, uranium is embedded in the igneous and metamorphic rocks in Jharkhand, Rajasthan, Andhra Pradesh and some parts of Himalaya. A substantial source of uranium deposits is also found in the monazite sands along the Kerala coasts.

The production of uranium at present is confined to the mines at Jaduguda in Singhbhum district of Jharkhand. The total reserves of uranium in the country are enough to support 5,000-10,000 mw of electricity generating capacity.

Thorium

Thorium is principally obtained from monazite. The beach sands of Kerala in Palghat and Quilon district contain the world's richest monazite deposits. It also occurs on the sands of Visakhapatnam in Andhra Pradesh.

- The production of Uranium is presently confined to the mines of Jaduguda in Singhbhum district of Jharkhand. .
- India possesses the world's largest monazite reserves, the principal source of thorium.
- The beach sand of Kerala in Palghat and Quilon districts contain world's richest monazite deposits.
- In India Uranium is found in the igneous and metamorphic rocks in Jharkhand, Rajasthan, Andhra Pradesh and some parts of Himalaya.

INTEXT QUESTION 23.1

1. Tick (√) the correct alternative from the given with each statement

(a) Which one of the following is the leading mineral in terms of economic value

(i) Coal (ii) Petroleum (iii) Iron ore (iv) Gold

(b) All the three gold fields of the country are found in which region

(i) North-eastern plateaus (ii) South-western plateaus (iii) North-eastern region (iv) North-western region.

(c) Oil refining is done at

(i) Kanpur (ii) Barauni

(iii) Kandla (iv) Masulipatnam

(d) The chief oil fields of India are in

(i) Assam and Gujarat

(ii) Andhra Pradesh and Rajasthan

(iii) Madhya Pradesh and Assam

(iv) Gujarat and Bihar

(e) 80 percent of coal reserves of India are in

(i) Godavari Valley (ii) Wardha Valley

(iii) DamodarValley (iv) Mahanadi Valley

(f) Tertiary coal is found in the state of

(i) Kerala (ii) Jammu & Kashmir

(iii) Bihar (iv) Uttar Pradesh

(g) The largest coal producing coal field is

(i) Raniganj (ii) Jharia

(iii) Bailadila (iv) Talcher

(h) Recently gas reserves are discovered in the basins of

(i) Narmada and Tapi (ii) Ganga and Brahmaputra

(iii) Krishna and Godavari (iv) Damodar & Subarnarekha

23.4 DISTRIBUTION OF SOME IMPORTANT MINERALS

In India mineral resources are very unevenly distributed. Most of the minerals are found in the ancient crystalline rocks of the Deccan and Chhotanagpur Plateau. Some minerals are found in the Himalayan region, although they are difficult to exploit.

Minerals are broadly divided into two groups metallic and non metallic minerals. Metallic minerals are further subdivided into ferrous and non ferrous minerals.

(A) FERROUS MINERALS

Ferrous minerals are those which contain iron in substantial quantity.

(a) Ferrous Metallic Minerals:

Ferrous minerals account for about three-fourth of the total value of the production of metallic minerals. They constitute the most important mineral group after fuel minerals. They include iron, manganese, chromite, pyrite etc. These minerals provide a strong base for the development of metallurgical industries, particularly iron, steel and alloys.

(i) Iron Ore

India is one of the few countries of the world which is endowed with vast reserves of good quality of iron ore. She possesses over 20 percent of the world's total reserves. The quality of Indian ore is very high with iron content of above 60 percent.

Most of iron ore found in the country is of three types :- Haematite, magnetite and limonite. Haematite ore contains up to 68 percent of iron. It is red in color and is often refered to as 'red ore'. Next to haematite in quanitity and richness is the magnetite ore. It contains up to 60 percent of the iron. It is dark brown to blackish in colour, and is often referred as 'black ores', Limonite is the third type of ore which has iron content of 35-50 percent. It is yellow in colour. Since India has large reserves of haematite and magnetite ores, inferior quality ore like limonite is rarely exploited.

The total estimated reserves of iron ore in the country are placed at about 12,857 million tonnes of which12,317 million tonnes are haematite ore and about 540 miillion tonnes of magnetite ore. This is roughly about one fourth of the world reserves.

Table 23.3 Production of iron ore in India

Year	Production (In million tonnes)
1950-51	3.0
1960-61	11.0
1970- 71	32.5
1980-81	42.2
1990-91	53.7
2004-05	140.46

Source: India 2006: A Reference Annual, p.571

Distribution

Iron ore deposits are found practically in every state of lndia. However, 96 percent of the total reserves are in Orissa, Jharkhand, Chhatisgarh, Karnataka and Goa. These states also account for 96 percent to the total production of iron ore in the country. About 3 percent of the country's total production comes from Tamil Nadu, Maharashtra and Andhra Pradesh.

Orissa and Jharkhand together possess about 50 percent of India's reserves of high-grade iron ore. The principal deposits are located in Sundargarh, Mayurbhanj and Keonjhar districts of Orissa and Singhbhum district of Jharkhand.

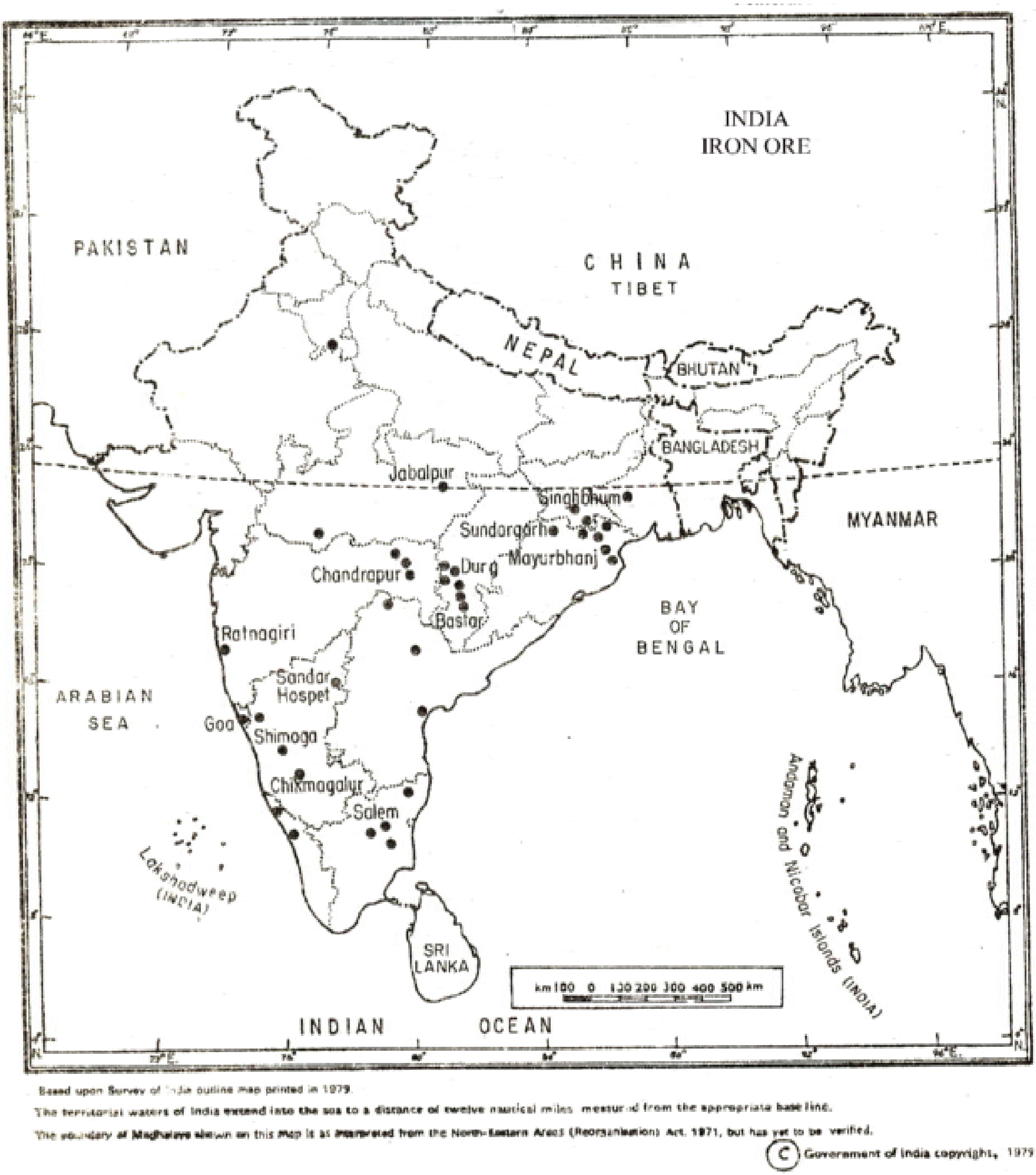

Fig. 23.4 INDIA : Distribution of Iron ore

Notes

Chhatisgarh and Madhya Pradesh contributed about 25 percent of country's total iron ore reserves and about 20-25 percent of country's production of iron ore. The reserves are located in Bailadila range, Raoghat area near Aridongri in Bastar district and Dhalli Rajhara range in Durg district.

Goa posseses inferior quality ore but its contribution to the country's total production is impressive. Most of the mines are open cast and mechanized. Almost the entire production of iron from Goa is exported from Marmagao Port to Japan. In Karnataka, the most important deposits are found in the Sandur-Hospet area of Bellary district; Babaudan hills of Chikmagalur district and in Simoga and Chitradurga district.

Iron ore deposits of Andhra Pradesh are scattered in the Anantpur, Khammam, Krishna, Kurnool, Cuddapah and Nellore districts. Some deposits are also located in the state of Tamil Nadu, Maharashtra and Rajasthan.

India contributes about 7 to 8 percent of the total world trade. Now deposits are being worked out specially for export purpose. For example, Bailadila and Rajhara mines of Chhatisgarh and Kiruburu mines in Orissa are being worked for this purpose. Japan, Romania, the former Czekoslovakia and Poland are important importing countries. Iron ore is exported from Haldia, Paradip, Marmagao, Mangalore and Visakhapatnam ports.

- India posseses over 20 percent of the world's total reserves in iron.
- Iron ore deposits are found practically in every state. However, 96 percent of the total reserves are in Orissa, Jharkhand, Chhatisgarh, Karnataka and Goa.
- Bailadila and Rajhara mines in Chhatisgarh and Kiruburu mines in Orissa are being worked out specially for export purpose.

(ii) Manganese Ore

India ranks third in the production of manganese ore in the world, next only to Russia and South Africa. About one fourth of the total production of India exported.

Manganese ore forms an important ingredient in the manufacture of iron and steel. It is also used in manufacture of dry batteries, in photography, leather and match industries. About 85 percent of total manganese consumption in India is used by metallurgical industries.

Distribution

The important areas of production are in Orissa, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. Over 78 percent of total reserves of manganese ore of India occur in a belt stretching from Nagpur and Bhandara districts of Maharashtra to Balaghat and Chindwara district of Madhya

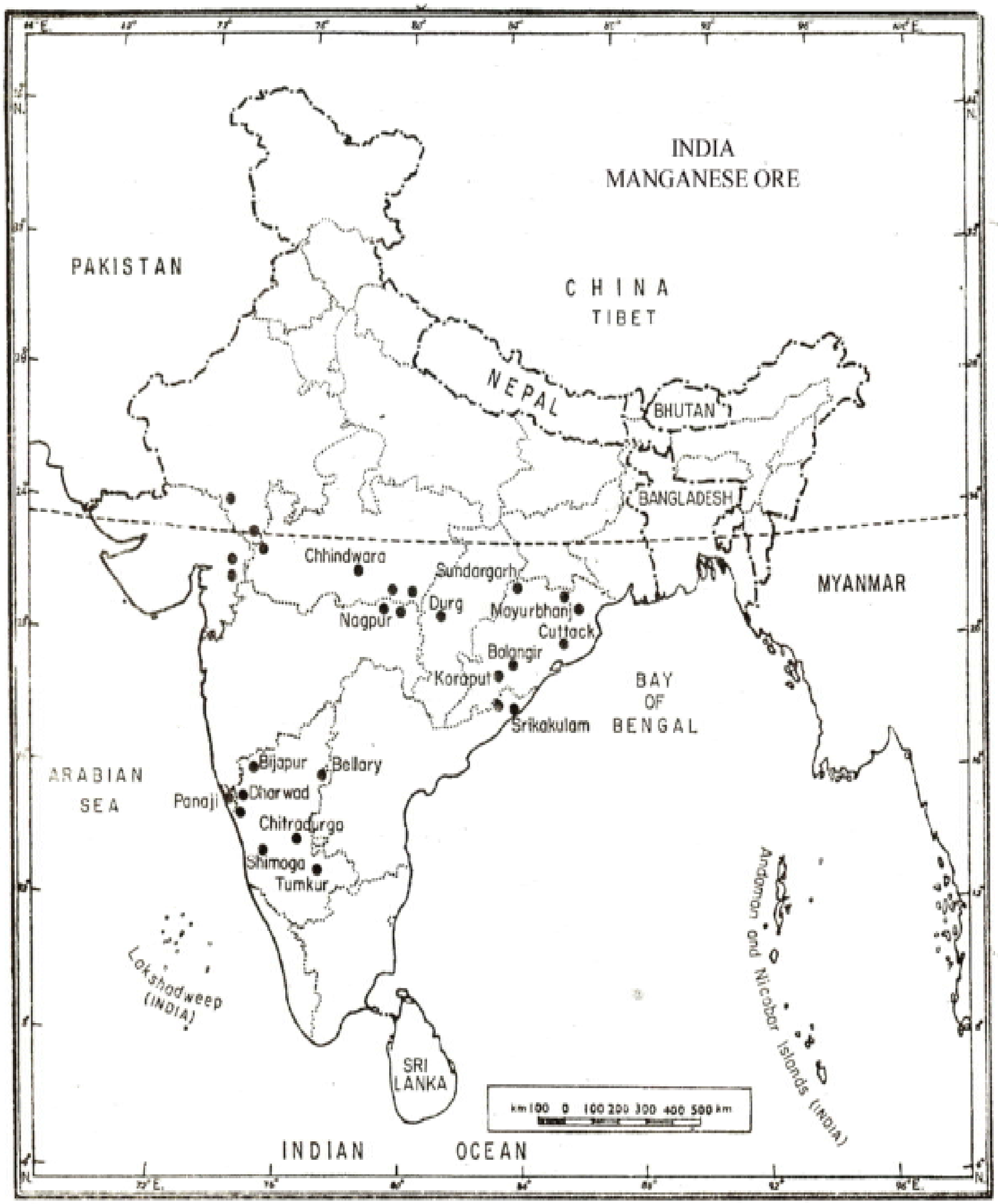

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Fig. 23.5 INDIA : Distribution of Manganese ore

Pradesh. But these two states contribute only 12 and 14 percent of total production respectively. The remaining 22 percent of reserves are distributed in Orissa, Karnataka, Gujarat, Rajasthan, Goa and Andhra Pradesh.

Orissa tops in the production of manganese accounting for 37% of the total production of the country. Its reserves are only 12 percent of total reserves of India. The important mining districts are Sundargarh, Rayagada, Bolangir, Keonjhar, Jajpur, and Mayurbhanj.

In Karnataka, the deposits are located in the districts of Shimoga, Chitrdurga, Tumkur and Bellary. Small deposits are reported in Bijapur, Chikmagalur and Dharwar districts. Karnataka is the second largest producer of manganese ore, accounting for 26 percent of country's total productions. It accounts for 6.41 percent of country's total reserves.

Andhra Pradesh is a significant producer of manganese ore, contributing about 8 percent of India's total production, although her reserves are insignificant. Goa, Jharkhand and Gujarat also have some deposits of manganese ore.

- India ranks third in the production of manganese ore in the world.
- About 85 percent of total manganese consumption in India is used by metallurgical industries.
- The important areas of production are in Orissa, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh.

(b) NON-FERROUS METALLIC MINERALS

Non ferrous minerals are those which do not contain iron. They include gold, silver, copper, tin, lead and zinc. These metallic minerals are highly important in day to day life. However, India is very poor and deficient in all of these minerals

(i) Bauxite

Bauxite is a non-ferrous metallic mineral. It is the ore from which aluminium metal is produced. India's reserves of bauxite are sufficient to keep the country self-reliant. Aluminium extracted from the ore is used in making aeroplanes, electrical appliances and goods, household fittings, utensils etc. Bauxite is also used for manufacturing of white colour cement and certain chemicals. India's reserves of bauxite of all grades have been estimated at 3037 million tonnes.

Table 23.4 Production of Bauxite in India

Year	Production (in thousand tonnes)
1951	68.1
1961	475.9
1971	1,517.1
1981	1,954.6
1991	4,977.0
2004-2005	11598.0

Source: India 2006: A Reference Annual p.570

Distribution

Bauxite has a wide occurrence in the country. Major reserves occur in Jharkhand, Maharashtra, Madhya Pradesh, Chhatisgarh, Gujarat, Karnataka, Tamil Nadu, Goa and Uttar Pradesh.

Jharkhand accounts for 13 percent of India's total reserves and 37 percent of the country's total production. The important deposits are located in Palamau, Ranchi and Lohardaga districts.

Gujarat contributes 12 percent to the total production and equal percentage to the total reserves of the country. The deposits are found in the Bhavnagar, Junagadh and Amreli districts.

Madhya Pradesh and Chhatisgarh accounts for 22 percent of the total reserves of the country and 25 percent of the total production. The three important bauxite ore regions in these states are Sarguja, Raigarh and Bilaspur districts in the Amarkantak Plateau; Maikala range in Bilaspur, Durg (bothe these regions are in Chhatisgarh), Mandla, Shahdole and Balaghat districts; and Katni district in Madhya Pradesh.

Maharashtra accounts for a relatively small production of the country, 18 percent of the total, but possesses the second largest bauxite reserves consisting of 22 percent of the country's total reserves. Bauxite occurs in Kolhapur, Raigarh, Thana, Satara and Ratnagiri districts.

In Karnataka the reserves of bauxite occur in the north-western parts of Belgaum district. Huge deposits of bauxite have been discovered in the eastern ghats in Orissa and Andhra Pradesh, Salem, Nilgiri and Madurai district of Tamil Nadu, and Banda district of Uttar Pradesh also have workable deposits of bauxite.

India exports bauxite to a number of countries. The leading importer of Indian bauxite is Italy, followed by the U.K., West Germany and Japan.

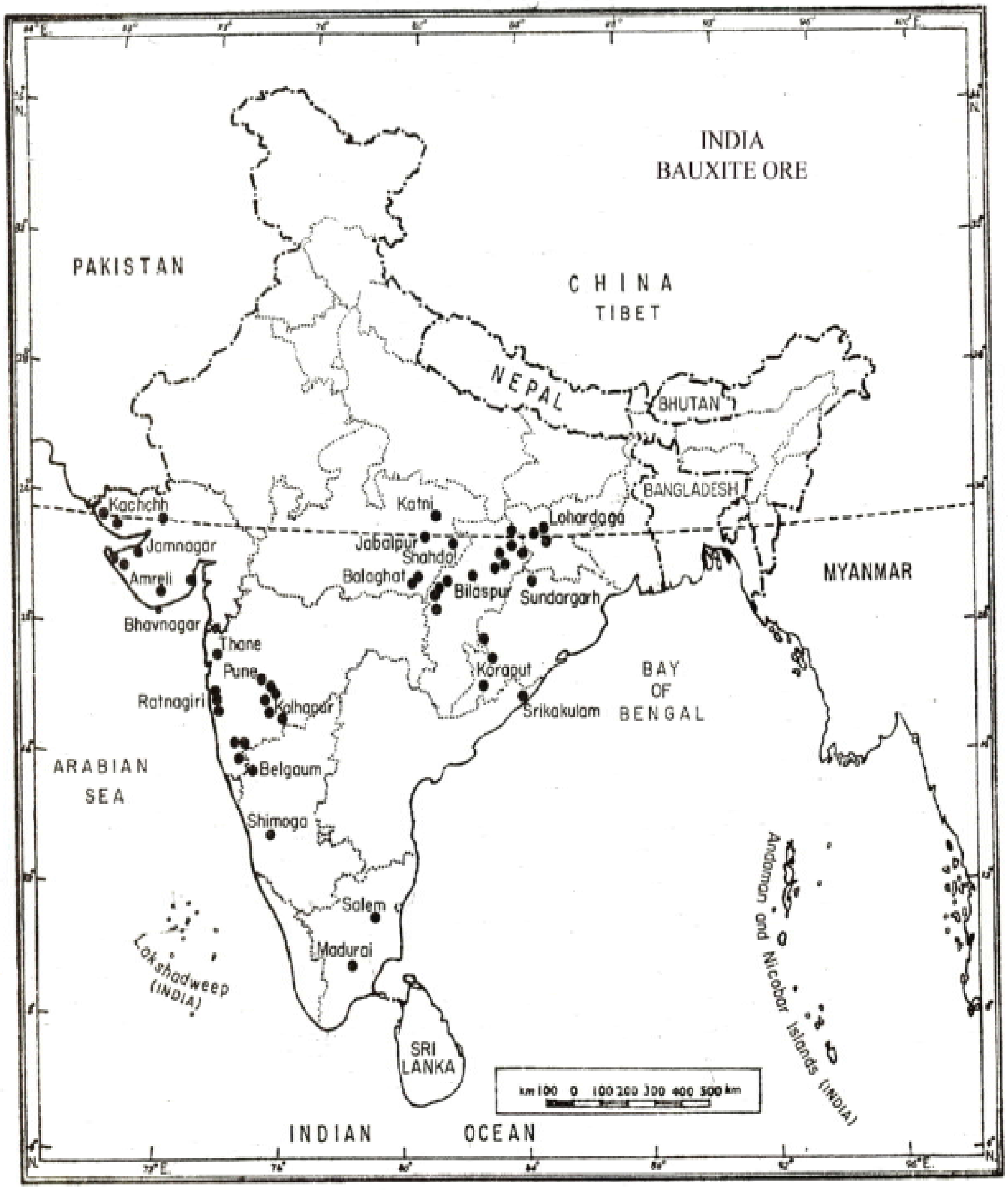

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Fig. 23.6 INDIA : Distribution of Bauxite

- Bauxite is the ore from which aluminium metal is extracted.
- Bauxite is used for manufacturing white colour cement and certain chemicals.
- Major reserves occur in Jharkhand, Maharashtra, Madhya Pradesh, Chhatisgarh, Gujarat, Karnataka, Tamil Nadu, Goa and Uttar Pradesh.

(B) Non-metallic Minerals

A large number of non-metallic minerals are found in India but only a few of these are commercially important. They are limestone, dolomite, mica, kyanite, sillimanite, gypsum and phosphate. These minerals are used in a variety of industries such as cement, fertilizers, refractories and electrical goods. In this lesson we will be studying about mica and limestone.

(i) Mica

India is the leading producer in sheet mica. It was one of the indispensable minerals used in electrical and electronic industries till recently. However its synthetic substitute has reduced our exports as well as production considerably.

Distribution

Although mica is widely distributed but workable deposits occur in three principle belts. They are in the states of Andhra Pradesh, Jharkhand, Bihar and Rajasthan.

Bihar and Jharkhand produces the high-quality ruby mica. The mica belt in Bihar and Jharkhand extends from Gaya district in the west through Hazaribagh and Munger district to Bhagalpur district in the east. Outside this main belt, mica occurs in Dhanbad, Palamau, Ranchi and Singhbhum district. The state supplies more than 80% of the india's output. In Andhra Pradesh mica is found in a belt in Nellore district. Rajasthan is the third largest mica producing state. The mica, bearning zone, covers the districts of Jaipur, Udaipur, Bhilwara, Ajmer and Kishangarh. The quality of mica is inferior. Besides these three belts, some deposits occur in Kerala, Tamil Nadu and Madhya Pradesh.

Mica mining in India was mainly done for export. The principal importing country was the U.S.A. which took about 50 percent of the exports.

(ii) Limestone

Limestone is used in a wide range of industries. 76 percent of the country's total consumption is used in cement industry, 16 percent in iron and steel industry and 4 percent in chemical industries. The remaining 4 percent is used by sugar, paper, fertilisers and ferromanganese industries. Limestone with high silica content is preferred in cement industry.

Distribution

Madhya Pradesh possesses 36 percent of the total reserves. Other major producing states are Chhatisgarh, Andhra Pradesh, Gujarat, Rajasthan, Karnataka, Tamil Nadu, Maharashtra, Himachal Pradesh, Orissa, Bihar, Jharkhand, Uttarakhand and Uttar Pradesh. The remaining part comes from Assam, Haryana, Jammu & Kashmir, Kerala, and Meghalaya. Karnataka contributes about 10 percent of the total reserves. They are found in Bijapur, Belgaum and Shimoga districts. In Andhra Pradesh the deposits are found in Visakhapatnam, Guntur, Krishna, Karimnagar and Adilabad districts. Sundargarh district of Orissa; Rohtas district of Bihar and Palamau districts of Jharkhand also have limestone deposits.

- India is the leading producers in mica.
- Mica is used in electrical and electronic industries.
- Mica is widely distributed but workable deposits occur in the states of Bihar, Andhra Pradesh and Rajasthan.
- Limestone is mostly used in cement, iron and steel, and chemical industries.
- Limestone is mostly found in Madhya Pradesh, Karnataka, Andhra Pradesh, Orissa, Bihar, Jharkhand and Meghalaya.

INTEXT QUESTIONS 23.2

1. Tick (√) the correct alternative from the choices given for each statement.

(a) Iron ore from Bailadila is exported through

(i) Paradip (ii) Kakinada
(iii) Visakhapatnam (iv) Haldia

(b) Iron ore with highest iron content is

(i) Magnetite (ii) Haematite
(iii) Limonite (iv) Saderite

(c) Which is the leading state in the production of Manganese ?

(i) Bihar (ii) Orissa
(iii) Madhya Pradesh (iv) Karnataka

(d) Which one of the following industry is leading consumer of manganese in India?

(i) Leather industries (ii) Match industries

(iii) Metallurgical (iv) Photography industries

(e) Bauxite is a

(i) Metallic mineral of ferrous group

(ii) Metallic mineral of non-ferrous group

(iii) Non-metallic mineral

(iv) Mineral fuel

(f) The ore of aluminium is

(i) Hematie (ii) Magnetite

(iii) Bauxite (iv) Limonite

(g) India is the leading producer of

(i) Lime stone (ii) Copper

(iii) Mica (iv) Phosphate

23.5 PROBLEMS

There are various problems posed by mineral extraction. The major problems are as follows:

(a) Depletion of Mineral

Due to the excessive exploitation, many minerals are going to be depleted in near future. So it calls for conservation and judicious utilisation.

(b) Ecological Problems

Mineral extraction has led to serious environmental problems. Rapidly growing mining activity has rendered large agricultural tracts almost useless. Natural vegetation has been removed from vast tracts. Such areas suffer from frequent floods and for want of proper drainage, they have become breeding grounds for mosquitoes spreading malaria with vengenance. In hilly mining areas landslide are a common phenomenon taking toll of life, cattle and property. In many mines, miners have to work under most hazardous conditions. Hundreds of lives are lost each year by fire in coal mines and due to occasional flooding etc. Occurrence of poisonous gas in pockets of mines is a great enemy of miners.

(c) Pollution

Many mineral producing areas lead to air and water pollution in the surrounding region which in turn lead to various health hazards.

(d) Social Problems

New discoveries of minerals often lead to displacement of people. As many tribal areas are rich in minerals, the tribal people are most affected. Industrialisation of such areas has badly shattered their economy, values and life style.

23.6 CONSERVATION OF RESOURCES

In world of diminishing resources, it becomes essential that the mineral resources should be judiciously used by the present generation to ensure a resource base for future generations. The strategies for resource conservation include:

1. Reclamation

Efforts should be made to reclaim various minerals as much as possible. This can be done by using latest technology. Remote sensing satellite has rendered a great help in identifying mineral resources.

2. Recycling

It means reuse of waste in a production process e.g. (a) The waste papers, rags, used bottles, tins, plastic waste material can all be recycled to produce paper, newsprint, plastics glass wares, packing tin materials etc. This process saves consumption of water and electricity considerably. Such steps can help to prolong the life of our depleted forest wealth. (b) Post consumption recyling - scrap iron from old machinery, automobiles, industrial equipment which is added to the charge and becomes cast iron or steel which is then shaped into a new consumer product.

3. Substitution

Due to advancement of technology and new needs have lead to many changes in the use of minerals. Products of petro-chemical industry have replaced traditional brass or clay jars. Plastics now compete with copper for uses such as piping and with steel in car bodies.

4. More efficient use

It also helps in conserning mineral resources for long. Today mineral resources are used more efficiently. For example engineering and construction processes which make automobiles more energy efficient and aerodynamic

23.7 ENERGY RESOURCES

This is an essential input for economic development and improving the quality of life. It is very difficult to imagine modern living without the use of energy resources. Day by day the consumption of energy has been increasing. It is available in various forms in India. In the following section we will discuss. it in details.

23.8 SOURCES OF ENERGY AND THEIR CLASSIFICATION

There are several sources of energy. They are classified in different ways. One way is to distinguish between commercial and non-commercial sources of energy. In rural India even today a large number of people use human labour or man power, animal power, animal refuge, farm or crop residue as easily available and relatively inexpensive sources of energy. As against this, the sources of energy used in urban areas are commercial in nature. They may include coal, petroleum, natural gas, cooking gas and electricity. But the scenario in rural areas has been changing for quite sometime.

Another classification of sources of energy is based on their longevity. For instance mineral resources such as coal, petroleum, natural gas and radio-active minerals are all non-renewable or exhaustible resources. On the other hand running water, the sun, wind, tides, hot springs and bio-mass are all inexhaustible or renewable sources of energy. They are also pollution free.

Mineral sources of energy include coal, petroleum and natural gas. These mineral sources of energy represent nothing but the stored energy of the sun. Hence they are also called fossil fuels. Then there are radio-active or atomic minerals. They all cause pollution. Non-mineral sources of energy include running water, sun, wind, tides and hot springs. The power derived from these is pollution free.

Yet another classification of energy is based on conventional and non-conventional sources. The former includes coal, petroleum, natural gas and running water. The non-conventional sources of energy include sun, wind, tides, hot springs and bio-mass.

- Fuel wood, animal waste and crop residue are traditional or non-commercial sources of energy. They still meet the energy demand in rural areas to a considerable extent.
- Coal, petroleum, natural gas, water falling from a hieght and uranium and thorium are the conventional sources of energy.
- The Sun, wind, bio-mass, tides and hot springs are the non-conventional sources of energy. They are still in the initial stage of experimentation for want of appropriate and viable technology.
- They are important because they are renewable and pollution free sources of energy.

23.9 GROWING PRODUCTION AND CONSUMPTION OF ELECTRICITY

Electricity is the most convenient and versatile form of energy. When, coal, petroleum and natural gas are used for generating electricity, it is called thermal energy. Power generated from running water, is known as water power or hydel power or hydro-electricity. Yet another way of generating electricity is through nuclear fission from atomic minerals. This energy is termed as nuclear power. It is also a thermal energy but from a different source and needs highly developed technology.

In 1947 the per capita availability of electrical energy in India was as low as 2.4 KWH. By 1995-96 the per capita consumption of domestic power was 53 KWH. Despite vast improvement, this is very low compared to many other countries of the world. India is a country of about 600,000 villages. In 1947, hardly 300 villages had electricity. Now it has reached to more than 5 lakh villages. This became possible because we have increased production of electricity by about 85 times between 1947 to 2005. The installed power generation capacity in the country has increased from 1,400 MW in 1947 to 1,18,419.09 MW as on 31 March, 2005. This comprises of 80,902.45 MW thermal, 30,935.63 MW hydro 38,11.01 MW wind and 2770 MW nuclear.

Now let us have a look at the actual generation of electricity over these five decades. The total energy produced in 1950-51 was 6.6 billion kwh. By 1995-96 this figure rose to 415 billion kwh. Out of this over-all figure, the break up for 380 billion kwh is available as the remaining amount of 35 billion kwh stands under the head of non-utilities. The production of hydroelectricity in 1950-51 was 2.5 billion kwh. It rose to 72.5 billion kwh in 45 years i.e. by 1995-96. The production of thermal power was not much different from that of hydel power in 1950-51, when it was 2.6 billion kwh. This is more than four times the share of hydroelectricity. The share of nuclear energy is almost insignificant in the overall production of electricity.

INTEXT QUESTIONS 23.3

I. Answer the following questions:

1. (a) Name the two popular types of power plants in India.

   (i)________________________ (ii)____________________

   (b) Name a conventional source of energy which is renewable

   ____

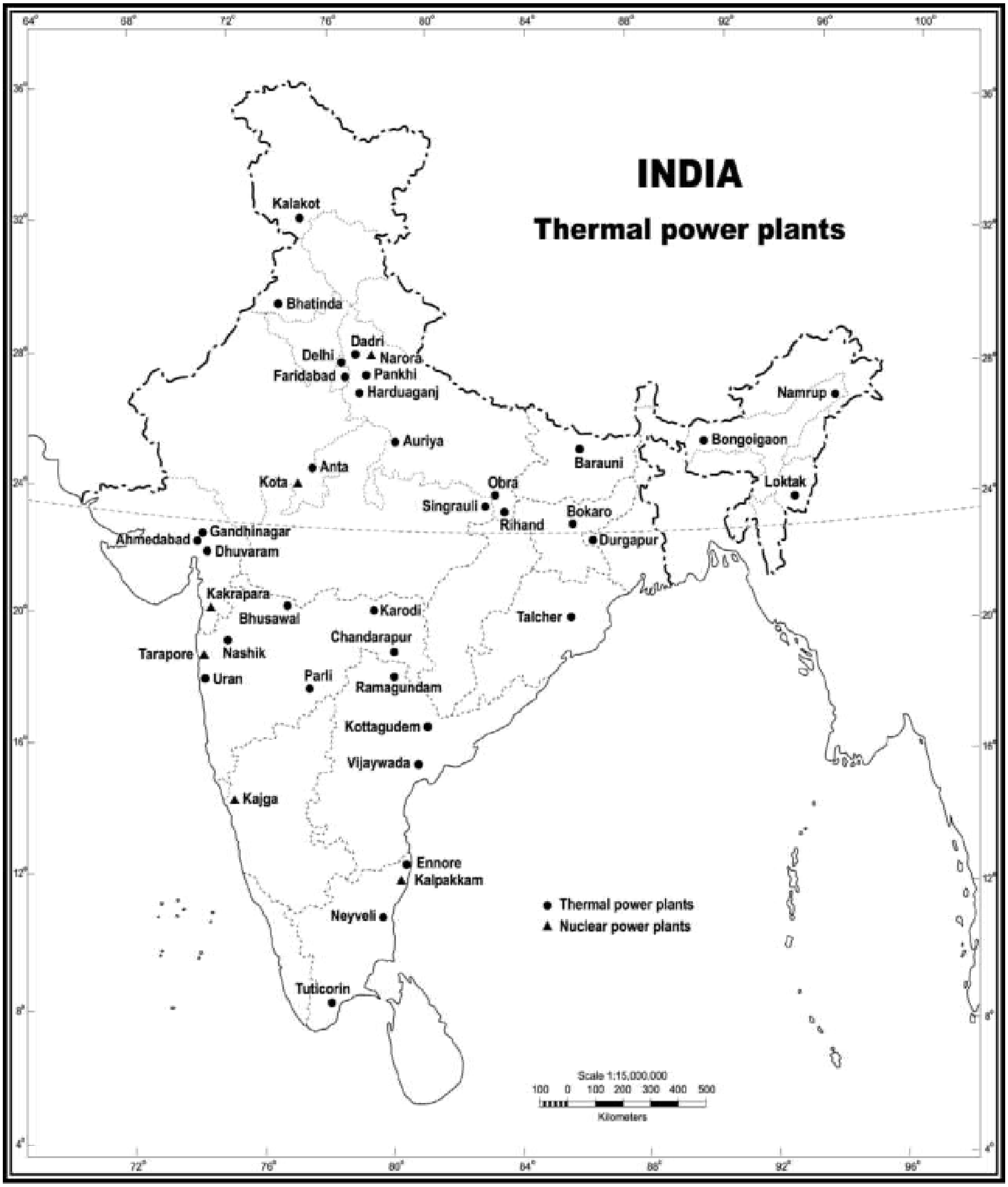
   (c) Name three minerals widely used for producing power in India.

   (i)______________(ii) ____________ (iii)_____________

II Choose the correct option

(1) Which one of the following sectors has shown sharp increase in power consumption in recent years?

   (a) Agriculture



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 23.7 INDIA : Thermal Power Plants

Notes

(b) Industry

(c) Transport

(d) None of them

(2) Which one of the following forms of energy is non-conventional?

(a) Thermal energy

(b) Hydel power

(c) Solar energy

(d) Nuclear power

(3) Which one of the following has the highest share in the total energy production?

(a) Hydel power

(b) Thermal power

(c) Nuclear power

(d) Wind energy

23.10 THERMAL POWER SOURCES

In thermal power, the major source of energy are coal, diesel and natural gas that are used for generation of electricity. It is the largest source of power supply in the country. The installed capacity of thermal power stations is about three times the installed capacity of the hydel power. During 2004-05 share of thermal power was about 80,903MW out of 1,18,419MW of electricity produced in the country. This is approximately 68% of the total electricity produced in India. Share of thermal electricity increased very rapidly after creation of the National Thermal Power Corporation (NTPC) in the year 1975. Presently, NTPC has to it's credit 13 coal based super thermal power projects and seven gas/liquid fuel based. During the 2004-05, NTPC produced 24,435 MW which is about 30% of the all India thermal production during the same period. Coal based thermal power units-have been set up near the coal mines to avoid transport costs. Transmission of power over long distances is relatively cheaper despite some loss of energy in transit.

Super Thermal Power plants have been established mainly very close to big coal mines. These are Singrauli (U.P.), Korba (Chhatisgarh), Ramagundam (A.P.), Farakka (W.B.), Vindhyachal (M.P.), Rihand (U.P.), Kawas (Gujarat), Gandar (Gujarat) and Talcher (Orissa). Most of these power plants have improved their efficiency and profitability through improved plant load factor (78% against the national average of 63%) with the electrification of trunk routes railways have also set up their own super thermal power stations in the regions lying away from major coal fields. In Tamil Nadu there is a big thermal power plant at Neyveli which is fed by local lignite coal field.

Besides coal based thermal power plants, the latest trend is to encourage diesel and natural gas based thermal power plants. Such plants can be set near the distribution or market centres. The gestation period of oil or gas based plants is generally the shortest. These plants are also found to be more efficient than coal based plants. The oil and gas pipes have to be laid for continious supply of petroleum and natural gas for such power plants.

As India is poor in its mineral oil and proven gas resources, it has to import these raw materials including naptha etc. from Middle East countries. The new Dabhol Thermal Power plant of Maharashtra on the Konkan coast is based on such imported raw material. This plant is an indicator of the new trend.

Petroleum based power units have been set up in the remote areas of North East and Himalaya region.

It is very interesting to note that Karnataka and Kerala states in South have not a single thermal power plant till now. Can you explain the reason?

23.11 HYDEL POWER RESOURCES

Water power resource differs from thermal power in more than one ways. It is a renewable or inexhaustible resource. It is pollution-free. Its recurring or maintenance coast is minimal. However, this source of energy, has two major drawbacks. Firstly, it calls for huge financial lay out particularly in those regions where water is to be impounded in huge quantity to ensure free flow of water all the year round. Secondly, in most cases its gestation period is too long.

With the water power potential of 41000mw, India ranks fifth in world after congo, Russia, Canada and the U.S.A.

Hydroelectric Power: Development of hydroelectric power started in the last decade of the 19^{th} century with the establishment of a hydroelectric plant for supplying electricity to Darjeeling in 1897. In 1902, another hydropower plant was erected at Sivasamundram water fall on Kaveri river in Karnataka. Later, a few plants were erected in the Western Ghats to meet the requirements of Mumbai. Hydropower plants were also commissioned in Uttar Pradesh, Himachal Pradesh in the north, and Tamil Nadu and Karnataka in the south in 1930s. Total generation capacity reached to 508 MW in 1947. Massive efforts were made to develop waterpower during the Five Year Plans and several multipurpose projects were commissioned.

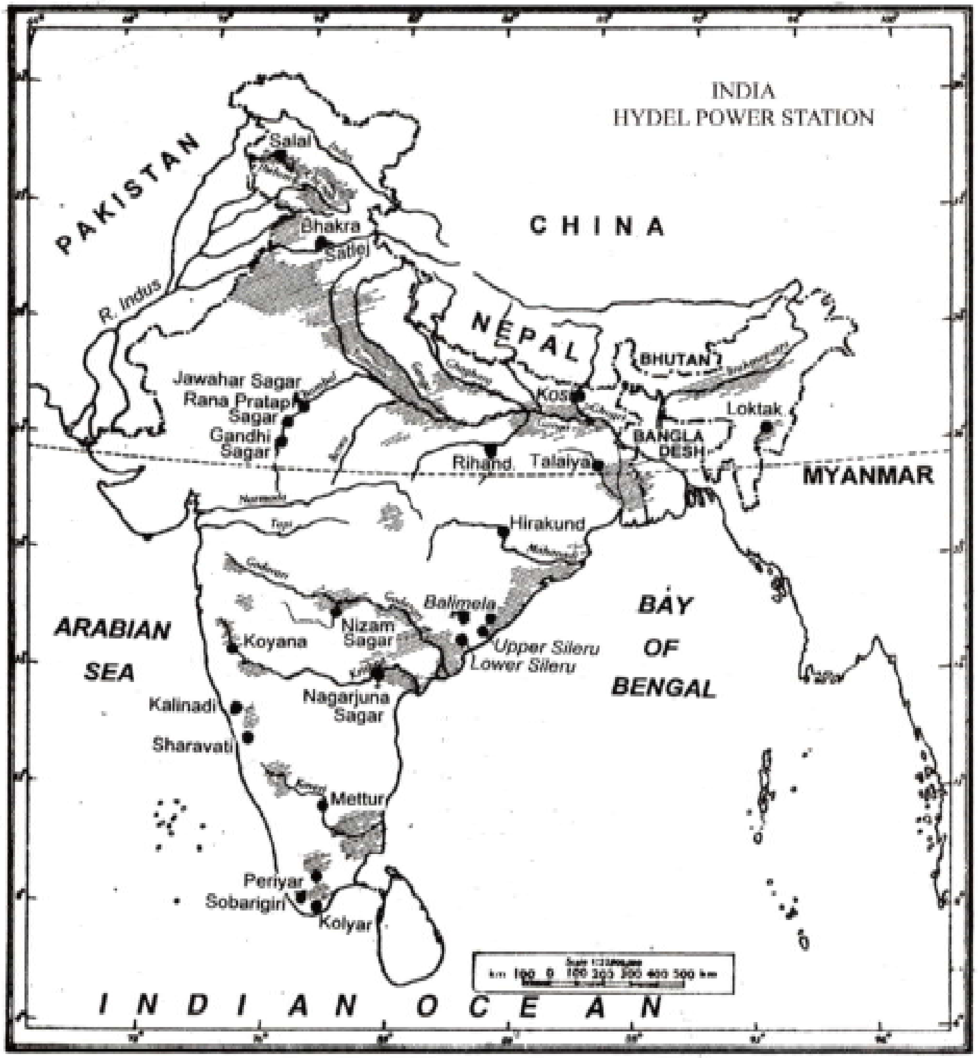


Fig. 23.8 INDIA: Hydel power station

Total installed capacity of hydroelectricity increased to 25219.55 MW at the end of 2000-01, which was nearly one-fourth of the total installed capacity, of electricity. In spite of being cheaper, pollution-free and renewable source of power, significance of hydroelectricity has declined in post-independence period. Its share in total power generation declined from 49 percent in 1950-51 to only 14.9 percent in 2000-01. Nevertheless, hydroelectricity plays a very significant role in northern, western and southern grids. The Northeastern grid is primarily dependent on hydel power.

In context of the energy crisis in the country hydroelectric power has assumed pivotal significance. Indian rivers drain 1677 billion cubic metres of water to the sea every year. The Central Water and Power Commission estimated the potential of hydroelectric power at about 40 million kW at 60% load factor from these rivers. Central Electricity Authority re-estimated this potential at 84,000 MW at 60% load factor. It is equivalent to about 450 billion units of annual energy generation. Basin-wise distribution of the potential is given in Table.

Table 23.5: India: Basin-wise estimated Potential of Hydropower (potential in thousand MW at 60 per cent load factor)

Basin	Potential	% of Total
Indus	20.0	23.8
Brahmaputra	35.0	41.7
Ganga	11.0	13.1
Central Indian basins	3.0	3.6
West flowing rivers	6.0	7.1
East flowing rivers	9.0	10.7
Total	**84.0**	**100.0**

This potential depends on several physical and economic factors. Among them, river regime, volume of river water, regularity in river flow (all these are dependent on rainfall pattern), nature of terrain, availability of other sources of power, level of economic development creating demand, and technological status are important. Regular flow of sufficient water with high velocity provides favourable condition for the development of hydroelectricity. Amount and regularity of flow depends on nature of rainfall while slope determines the velocity of flow. Since these conditions vary throughout the country, the distribution of hydropower potential is also very uneven.

The rivers originating from the northern mountainous region are the most important ones in this respect. They have their sources in glaciers and snowfields, therefore, they are perennial and their flow of water is regular throughout the year. Velocity of flow is high because of dissected terrain and the competition for use of water for other purposes is low. The northeastern part of this mountainous region, constituting the Brahmaputra basin, has the largest power generating potential. The Indus basin in the northwest is at second place. The Himalayan tributaries of the Ganga have a potential of 11,000 MW. Thus, three-fourths of the total potential is confined in the river basins originating from the northern mountainous region.

The rivers of peninsular India are comparatively poor in this respect. They depend entirely on the rainfall for their flow, and therefore, their flow is very erratic exceptionally high flow during the monsoon period fol1owed by a long period of lean flow. Storage of water is essential to regulate the flow. The bulk of the potential in this part is confined in the hilly regions along the middle and upper reaches of various river systems. The topographical features in these reaches are seldom favourable for development of irrigation. Consequently, development of hydroelectric sites would not clash with other priority uses of water. The Western Ghats, Northwestern Karnataka, Nilgiri and Anamalai hills and upper Narmada basin are major areas of concentration of potential in peninsular India. Despite this, potential of hydropower has been comparatively more developed in southern states because these states are far away from coalfields of the northeastern plateaus.

Table 23.6 Important Hydroelectric Plants in Different States of India

States	Name of Hydroelectric Plants
Jammu and Kashmir	Lower Jhelum, Salal on Chenab, Dool Hasti and Karrah.
Punjab and Himachal Pradesh	Bhakra-Nangal on Satluj, Dehar on Beas, Giri Bata, Andhra, Binwa, Rukti, Rongtong, Bhabanagar, Bassi, Baira Siul, Chamera, Nathpa-Jhakri on Satluj (biggest hydel power project in India).
Uttar Pradesh	Rihand, Khodri, Chibro on Tons.
Uttarakhand	Tehri dam on Bhagirthi.
Rajasthan	Ranapratap Sagar and Jawahar Sagar on Chambal.
Madhya Pradesh	Gandhi Sagar on Chambal, Pench, Bargi on Narmada, Bansagar-Tons.
Bihar	Kosi.
Jharkhand	Subarnarekha, Maithon, Panchet, Tilaiya (all three under DVC).
West Bengal	Panchet.
Orissa	Hirakund on Mahanadi, Balimela.
Northeastern states	Dikhu, Doyang (both in Nagaland), Gomuti (Tripura), Loktak (Manipur), Kopili (Assam), Khandong and Kyrdemkulai (Meghalaya), Serlui and Barabi (Mizoram), Ranganadi (Arunachal Pradesh).
Gujarat	Ukai (Tapi). Kadana(Mahi).
Maharashtra	Koyana, Bhivpuri (Tata Hydroelectric Works), Khopoli, Bhola, Bhira, Purna, Vaiterna, Paithon, Bhatnagar Beed.
Andhra Pradesh	Lower Sileru, Upper Sileru, Machkund, Nizam Sagar, Nagarjun Sagar, Srisailam (Krishna).

Karnataka	Tungabhadra, Saravati, Kalinadi, Mahatma Gandhi (Jog fall), Bhadra, Sivasamudram (Kaveri), Shimsapura, Munirabad, Lingnamakki.
Kerala	Iddikki (Periyar),Sabarigiri,Kuttiaddy, Sholayar, Sengulam, Pallivasal, Kallada, Neriamangalam, Parambikulam Aliyar, Poringal, Ponniar.
Tamil Nadu	Pykara, Mettur, Kodayar, Sholayar, Aliayar, Sakarpathi, Moyar, Suruliyar, Papanasam.

23.12 NUCLEAR POWER

India had developed the technology of generating energy from nuclear minerals such as uranium and thorium. Installation of nuclear rectors for generating power requires huge capital and sophasticated technological skills. The share of nuclear power, in the total energy produced in the country is hardly2%. Nuclear power is a promising source of energy for future. It would play a complementary role when the other sources of power like coal and petroleum would be exhausted.

Nuclear power programme was initiated in the 5th decade of the last century and an apex body for decision-making regarding atomic programmes, the 'Tata Atomic Energy Commission' was incorporated in August 1948. But progress in this direction could be made only after the establishment of the Atomic Energy Institute at Trombay in 1954. Which was renamed as the 'Bhabha Atomic Research Centre' (BARC) in 1967. Consequently, first nuclear power station with 320 MW capacity was set up at Tarapur near Mumbai in 1969. Later, atomic reactors were installed at Rawatbhata (300MW) near Kota in Rajasthan, Kalpakkam (440 MW) in Tamil Nadu, and Narora in Uttar Pradesh, Kaiga in Karnataka and Kakarapara in Gujarat also have nuclear energy plants. Thus at present, nuclear energy is produced from ten units located at six centres. Requirements of fuel and heavy water of these power reactors are fulfilled by the Nuclear Fuel Complex located at Hyderabad and heavy water plant at Vadodara.

16,707 mus nuclear power was generated in the year 2004-05 which is a small fraction of the country's total production of electrical energy. The Department of Atomic Energy (DAE) has an ambitious nuclear power programme aiming at achieving an installed nuclear power capacity of 20,000 Mwe by the year 2020.

Generation of nuclear power is highly hazardous. A slight carelessness in the security may cause severe accidents endangering lives of thousands of people in its surrounding areas. Therefore, strict precautions and security measures are highly essential.

23.13 REGIONAL CLASSIFICATION ON THE BASIS OF SOURCES OF ELECTRICITY

Three types of regions can be identified on the basis of sources of electricity:

1. **Hydro-electricity dominated region:** The states included under this category are Karnataka, Kerala, Himachal Pradesh, Uttarakhand, Jammu and Kashmir, Meghalaya, Nagaland, Tripura, and sikkim. These states are far away from coal fields but have optimum conditions for the development of hydro electricity.

2. **Thermal power dominated region:** It included states such as West Bengal, Jharkhand, Bihar, Chhatisgarh, Madhya Pradesh, Gujarat, Uttar Pradesh, Maharashtra, Assam, Delhi, Haryana and Punjab. Majority of these states have reserves of coal which are utilised for power generation. Bihar, Uttar Pradesh, Haryana and Punjab do not have coal reserves but have direct acces to coal fields by railway lines. However, they are diversifying their sources of power.

3. **Nuclear power dominated region:** Rajasthan is the only state which comes under this category. In Rajasthan more than half of the total commercial energy is nuclear. It's because the state is deficit both in coal and water.

INTEXT QUESTIONS 23.4

I Fill in the blanks:

(i) Electricity generated by using coal is ____________ energy.
(hydel energy, thermal energy)

(ii) The electricity generated by the force of running water is ____________energy. (Hydel energy, Tidal energy)

(iii) The two minerals used for generating nuclear power are (1)____________ and (2) ____________ (Uranium, Coal, Thorium)

(iv) The first atmotic power station developed in India was at ____________ (Rawat Bhata, Tarapur)

II Answer the following Questions briefly:

(i) Give two main advantages of Hydel power.

(a)________________________ (b)________________________

(ii) What rank does India hold in the world in water power potential?

____

Notes

(iii) Name two gas based thermal power plants in UP.

(a)________________________ (b)________________________

(iv) Which region of India has developed the largest proportion of its water power potential?

____

23.14 NON-CONVENTIONAL SOURCES OF ENERGY

Conventional sources of power like coal, petroleum and natural gas are likely to exhaust in near future. The development of hydel power alone can not meet the demand of electricity for the future. Therefore, there is a need to find and develop alternative sources of power. Sun, wind, tides, biologoical wastes and hot springs are such sources which can be developed as the alternative sources of power. They are called the non-conventional sources of energy. These sources of energy are renewable and pollution free. We shall discuss some important non-conventional sources of energy with reference to their development in our country.

(a) Solar energy

For the planet earth, the Sun is the primary source of all energy. Sun is the most vital, abundant and direct source of energy. India lies in the tropical zone and has plenty of sun shine, for long hours of a day. There are large possibilities to develop solar energy in the country and that too without much cost.

Solar energy is tapped through the system of Solar Photo Voltaic (SPV) cells. The thermal heating system can be used for water heating, solar codkers for cooking meals and drying food grains etc. Solar energy can be developed in almost every part of the country but more so in hot, dry and cloud free areas like Rajasthan.

(b) Wind Energy

Wind can be used as a source of energy in those regions where strong and constant winds blow throughout the year. Wind energy can be used for pumping water for irrigation and also for generating electricity. India has about 45,000MW estimated wind power potential. Prospective sites for generating electricity wind have been located in Tamil Nadu, Gujarat, Andhra Pradesh, Karnataka and Kerala. The potential that can be tapped at present is limited to around 13,000 MW. But at present 2,483MW is generated through wind which places India in the fifth position globally after Germany, USA, Denmark and Spain.

(c) Biogas

Biogas is obtained by using animal refuge like cow dung. It is widely used in rural areas mainly as domestic fuel. Efforts are being made to popularise the biogas plants in the country.

Urban and industrial waste is another source of biological energy in big cities and industrial centres. These materials can be used for generating electricity or biogas. The work in this direction is still in its initial stage. Such plants have been installed in Delhi and few cities in India.

(d) Biomass Energy

Energy generated from farm or agricultural wastes, agro-industrial wastes, energy plantations etc is known as biomass energy. The potential of biomass power in the country has been estimated at about 19,500 MW. So far a total capacity of 614 MW biomass based power generating system has been installed and a capacity of 643MW are under installation in the country.

(e) Tidal Energy

Energy can also be generated from high tidal waves. Some of the important sites identified for generating tidal energy are located in the Gulf of Kuchch and Cambay in Gujarat state and the coast of Kerala. A plant of 150 MW capacity has been installed on Kerala coast.

(f) Geothermal energy

The potential of geotherma1 power is very limited in India. Important sites selected for generating geothermal power are situated in Himachal Pradesh (Mani Karan) and Jammu and Kashmir (Puga valley in Ladakh). Assessment of geothermal energy potentials of selected sites in Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Jharkhand and Chhatisgarh is being undertaken.

As we have discussed earlier, the non-conventional sources of energy are renewable and pollution free. They can be helpful in the utilization of resources scattered all over the country. But the development of these energy resources is very slow, due to lack of suitable and economically viable technologies. Even so there is no doubt that they would become a reality in not a very distant future.

There are prospects of expanding the manufacturing industries and mechanization of agriculture in the nooks and corners of the country. Naturally there will be more demand for energy derived from the non-conventional sources.

INTEXT QUESTIONS 23.5

Answer the following Questions briefly:

(i) Give two main advantages of non-conventional sources of power.

(a)____________________ (b)___________________________

(ii) Which areas of the country have largely been benifitted by biogas plants?

____

(iii) Name two sites identified for developing tidal energy in Gujarat

(a)____________________ (b)________________________

(iv) Name two ways of tapping the solar energy.

(a)____________________ (b)________________________

(v) Which are the two main uses of tapping wind energy?

(a)____________________ (b)________________________

WHAT YOU HAVE LEARNT

Mineral and power resources play an important role in the industrial development of a nation. They provide the industrial raw materials and fuel. Minerals are classified into metallic and non-metallic minerals. Metallic minerals can be further grouped into ferrous and non-ferrous. Mineral fuels are coal, petroleum, and natural gas. India's position is particularly good in the metallic minerals of ferrous group. It is well endowed with iron ore of high quality. India has rich deposits of mica and bauxite. It is also one of the leading producers of mica in the world. Coal is the primary source of power in India. It occurs in the rock formations of Gondwana and Tertiary age. Gondwana coal fields account for 96% of the total reserves and production in India. India's position is not satisfactory in the reserves as well as production of petroleum. Assam belt and Gujarat-Cambay and Bombay High belt are the two important petroleum producing regions in India. Uranium and thorium are the two important atomic minerals in India. The major problems faced by mineral resources are depletion of mineral resources, ecological problems, pollution and social problems. Various methods are adopted for conservation of mineral resources. The measures are reclamation, recycling, substitution and more efficient uses.

Recently some on-shore as well as off-shore oil fields has been discovered. On-shore oil fields are discovered in the state of Rajasthan where as off-shore oil fields are discovered along the coast of Tamil Nadu and Andhra Pradesh. Natural gas is energing as an important source of commercial energy because in recent years more and more reserves are discovered at eastern coast namely Krishna, Godavari and Mahanadi basins.

Notes

Energy is a highly important infrastructural resource for the economic development of a country. Main sources of power are coal, petroleum, natural gas, nuclear power and water power. All these sources are known as the conventional sources of energy. Power generated by the use of coal petroleum and natural gas is called thermal energy. These sources of energy are exahaustible and non-renewable. They cause pollution. Hydel power is a renewable and pollution free source of energy. Its maintenance costs are very low. Nuclear power is source of power. It requires huge capital and sofisticated technology. Careful handling and security measures are necessary for the protection of life all around their sites. The share of thermal power is more than 70 percent out of the total energy produced in India. Next comes is the hydel power whose share is about 26 percent. The share of nuclear power is only less than 2.5 percent.

Coal based thermal power plants are located either near the coal fields or near the consumption centres. These plants are largely located in Madhya Pradesh, Chhatishgarh, Jharkhand and Orissa. However, thermal plants on the borders of Uttar Pradesh, Maharashtra and Andhra Pradesh are also very important as they serve far off regions in these three states. There has been sufficient development of hydel power in the southern states. India has developed about 50 percent of its total water power potential. Sun, winds, tides, hot springs, biogas etc. are the alternative sources of power. They are known as non-conventional sources of energy. They are renewable, pollution free and inexpensive. There is a slow progress in the utilisation of these sources for want of suitable and economically viable technologies.

TERMINAL QUESTIONS

1. Describe the position of India in mineral resources.
2. Describe the distribution and production of the following minerals and mineral fuels in India:
   (a) Iron Ore
   (b) Coal
   (c) Petroleum
3. What are the problems associated with exploitation of mineral resources?
4. Describe various methods of conservation of mineral resources.

5. Answer in briefly:
   (i) Name three important sources of energy which are non-renewable and also pollution free.
   (ii) Differentiate between thermal, hydel and nuclear energy. State the share of each in the total production of energy.
   (iii) Mention two advantages of non-conventional sources of energy.
   (iv) Describe the role of biogas as an energy for the rural areas.

6. Distinguish between
   (i) Conventional and Non-conventional sources of power.
   (ii) Solar energy and Wind energy.

7. On an outline map of India show the following
   (i) Jharia and Raniganj coal fields.
   (ii) Ankaleswar and Digboi oil fields.
   (iii) Mathura and Panipat oil refineries.
   (iv) Talcher and Korba thermal power plants.
   (v) Kaiga and kota atomic power plants.
   (vi) Bhakra and Nagarjuna Sagar hydro-electric plants.

ANSWER TO INTEXT QUESTIONS

23.1

1. (a) coal (b) South-western plateau (c) Barauni (d) Assam and Gujarat (e) Damodar valley (f) Jammu and Kashmir (g) Jharia (h) Krishna and Godavari

23.2

1. (a) Visakhapatnam (b) Haematite (c) Orissa (d) Metallurgical industries (e) Metallic minerals of non-ferrous group (f) Bauxite (g) mica

23.3

I (a) (i) Thermal (ii) hydel (b) hydel power (c) (i) coal (ii) petroleum and (iii) natural gas.

II 1. (a), 2. (c), 3. (b)

23.4

I (1) Thermal energy (2) hydel energy (3) Uranium and Thorium (4) Tarapur.

II.

(i) (a) renewable and (b) pollution free

(ii) fifth

(iii). (a) Dadri (b) Auriya

(iv) Peninsular region

23.5 (i) (a) pollution free (b) renewable

(ii) Rural areas

(iii) (a) Gulf of Kachch and (b) Gulf of cambay

(iv) (a) Thermal heating system and (b) generating electricity through photovoltaic routes.

(v) (a) For pumping water and (b) for generating electricity

HINTS TO TERMINAL QUESTIONS

1. Refer to section 23.1
2. (a) Refer to (i) Iron ore under (a) Ferrous metallic minerals of section 23.4(A)

   (b) Refer to section 23.3(a)

   (c) Refer to section 23.3(b)
3. Refer to section 23.5
4. Refer to section 23.6

5. (i) Refer to section 23.8

   (ii) Refer to sections 23.10, 23.11 and 23.12

   (iii) Refer to section 23.14

   (iv) Refer to section 23.14(c)

6. (i) Refer to sections 23.8, 23.10, 23.11, 23.12 and 23.14

   (ii) Refer to section 23.14(a) and (b)

7. Refer to maps.

24

INDUSTRIAL DEVELOPMENT

The processing of natural resources into more useful items is called manufacturing. These manufactured goods are finished products derived from the raw materials. These raw materials used in manufacturing industry may be either in their natural form such as cotton, wool, iron ore etc. or may be in the semi processed form like cotton yarn, pig iron etc. which can further be used for making more useful goods. Thus the finished product of one industry may serve as the raw material for another industry. Economic development cannot be achieved by a country without developing its industries. There is a direct relationship between the level of industrial development and the economic prosperity of a country. Developed countries like the USA, Japan, Russia owe due to their prosperity to highly developed industries. Industrially less developed countries export their natural resources and import finished goods at higher prices and continue to remain economically backward.

In India manufacturing industries contributed about 30 per cent of the gross domestic product. These industries provide employment to about 28 million people. Thus industries are a major source of national income and employment.

In this lesson, we will study different types of industries, their classification and then distribution in India.

OBJECTIVES

After studying this lesson, you will be able to :

- trace the historical development of industries in India;
- understand the role of industries in the economic development of our country;
- classify the industries on the basis of different criteria;

Notes

- establish the relationship of industrial development with agriculture, minerals and energy;
- examine the factors affecting the localization of industries;
- describe spatial distribution of some major agro-based and mineral based industries in India;
- locate and identify selected industries on the map of India;
- explain the role of different policies in augmenting industrial development in India;
- establish the relationship between industrial development and regional development;
- establish the effects of economic liberalization on location and growth of industries; and
- explain impact of industrial development on environment.

24.1 BRIEF HISTORY OF MODERN INDUSTRIES

The modern industrial development in India started with the establishment of the first cotton textile mill at Mumbai in 1854, predominantly with Indian capital and entreprenuership. Jute industry made a beginning in 1855 with the establishment of a jute mill in the Hooghly Valley near Kolkata with foreign capital and entreprenuership. Coal mining was first started at Raniganj in 1772. Railways were introduced in 1854. Tata Iron and Steel Plant was set up at Jamshedpur in 1907. Several other medium and small size industries like cement, glass, soaps, chemicals, jute, sugar and paper followed. The industrial production in pre-independence period was neither adequate nor diversified.

At the time of independence, the economy was under-developed with agriculture contributing to more than 60 per cent of the GDP and most of the country's export earnings. After 60 years of independance, India has now shown the signs of becoming a leading economic power.

Industiral development in India can be divided into two phases. The Government successively increased its control over different economic sectors during the first phase (1947-1980). In the second phase (1980-97) it took measures to liberalise the economy between 1980 and 1992. These measures were somewhat adhoc. After 1992, the whole process of liberalization became more focused and radically different in nature.

After independence, systematic industrial planning under different five year plans helped in establishing a large number of heavy and medium industries. The main thrust of the industrial policy was to remove regional imbalances and to introduce diversification of industries. Indigenous capabilities were developed to achieve self sufficiency. It is due to these efforts that India has been able to develop in the field of industry. Today, we export a large number of industrial goods to various countries.

INTEXT QUESTIONS 24.1

1. When and where was coal mining first started?

____

2. In which year the railways were introduced in India?

____

3. Where was Tata Iron and steel plant established?

____

24.2 CLASSIFICATION OF INDUSTRIES

Industries can be classified on different basis. Classification of industries on the basis of five criteria has been given in the following table.

Table No. 24.1 Classification of Industries

Sl.No. Criteria	*Types of Industries*	*Main characteristics*	*Examples*
1. Sources of Raw Material	(i) Agro-based Industries	Agricultural products used as raw materials	Cotton textile, jute, sugar and paper industry
	(ii) Mineral based Industries	Minerals are used as raw materials	Iron and steel, chemical and cement industry
2. Ownership	(i) Public Sector	Owned and managed by Government	Bokaro iron and steel plant, Chittaranjan locomotive works.
	(ii) Private Sector	Owned and managed by an individual or a group as a company	Tata Iron and Steel J.K. cement industry Appolo Tyres.
	(iii) Joint Sector	Owned jointly by public and private sectors	Maruti Udyog
	(iv) Cooperative Sector	Owned by cooperative society of raw material producers	Sugar industry in Maharashtra, Amul (Gujarat) and IFFCO (Kandla)
3. Function or Role	(i) Basic Industry	Finished products of basic industry are used as raw material for other industries	Iron and Steel and petro-chemical industries.
	(ii) Consumer Goods Industry	Finished products of this industry are directly used by individuals.	Toothpaste, soap, sugar industry
4. Size of Industry	(i) Large Scale Industry	Huge investment, heavy machinery, large number of workers, large factory, 24 hour's operation.	Iron and steel, oil refineries,

	(ii) Small Scale Industries	Small investment, small factory, few factory workers	cycles, electrical goods industry
	(iii) Rural and Cottage Industries	owned by family members, small machine at homes	Jewellery, handicrafts, handlooms, art work
5. Weight of Raw Materials and Finished Products	(i) Heavy Industries	Both raw material and finished products are heavy and bulky, high transport cost	Iron and steel, BHEL (Hardwar): heavy electrical like generator.
	(ii) Light Industries	Both raw material and finished products are light in weight, low transport cost.	Watches, readymade garments, toys, fountain pens.

This is not necessary for any particular industry to be included only in one category. Depending upon the classification, the same industry can become an example of different types of industries. For example, Bokaro Iron and Steel plant is a mineral based industry. It is in public sector. It is a basic industry. It is large scale industry and also an example of heavy industry.

INTEXT QUESTIONS 24.2

1. Which one of the following industries belongs to public sector?
   (i) J.K. Cement
   (ii) Tata Iron and Steel Plant
   (iii) Bokaro Iron and Steel Plant
   (iv) Raymonds Synthetics
2. Which one of the following is a consumer industry?
   (i) Petro-chemicals.
   (ii) Iron and steel
   (iii) Chittranjan Locomotives
   (iv) Sugar Industry
3. Which one of the following is a small scale industry?
   (i) Sugar
   (ii) Paper
   (iii) Cotton
   (iv) Ceiling Fans
4. Name five criteria under which industries can be classified.
   1. ____________ 2. ____________ 3. ____________
   4. ____________ 5. ____________

24.3 AGRO-BASED INDUSTRIES

Textiles, sugar, paper and vegetable oil industry are some of the examples of agro-based industries. These industries use agricultural products as their raw materials.

Textile industry is the largest industry in the organized sector. It comprises of (i) cotton textiles, (ii) woolen textiles, (iii) silk textiles (iv) synthetic fibres and (v) jute textile industries. Textiles has been a major component of the industrial sector. It accounts for nearly a fifth of the industrial output and a third of the export earnings. In term of employment, it comes next only to agriculture sector.

(A) COTTON TEXTILE INDUSTRY

The industrial development in India began with the establishment of first successful modern cotton textile mill at Mumbai in 1854. Since then the industry has witnessed a phenomenal growth. The numbers of mills increased from 378 in 1952 to 1782 by March 1998.

Cotton textiles has an important place in the economy of the country. It provides employment opportunities to a large number of people. About one fifth of the total industrial labour is absorbed by this industry.

(a) Production

Cotton textile industry comprises of three sectors: mill sector, handloom and powerloom. The share of large mill, handloom and powerloom sector in the total production of cotton cloth in 1998-99 was 5.4 per cent, 20.6 per cent and 74 per cent respectively. The cloth production of cotton textile increased from 421 crore square metres in 1950-51 to 1794.9 crore square metres in 1998-99.

The Cotton and synthetic fibre textile industry has made tremendous progress. Per capita availability of cloth from both the types was 15 metres only in 1960-61. In the year 1995-96, it has risen to 28 metres. This has enabled us to export cotton yarn, cotton fabrics and cotton and synthetic garments on a large seale. In 1995-96 we earned 2.6 billion dollars by their exports.

(b) Distribution

Cotton textile industry is one of the most widely distributed industries in our country. These mills are located in more than 88 centres in different parts of the country. But majority of cotton textile mills are still located in the cotton growing areas of the great plains and peninsular India. (Fig 24.1)

Notes

Fig. 24.1: India : Centres of Textile Industry

Maharashtra is the leading producer of cotton textile in the country. Mumbai is the major centre of textile mills. About a half of the Cotton textile mills are located in Mumbai alone. It is, therefore, rightly called as 'Cottonpolis' of India. Sholapur, Kohlapur, Nagpur, Pune, Aurangabad and Jalgaon are other important centres in Maharashtra.

Gujarat, which ranks second in the production of cotton textiles, Ahamedabad is the major centre of the state. Surat, Bharauch, Vadodara, Bhavnagar and Rajkot are other centres in the state.

Tamil Nadu has emerged as an important producer of cotton textiles in sourthern states. Coimbatore is an important centre in the state. Tirunelveli, Chennai, Madurai, Tiruchirapalli, Salem and Thanjavour are other important centers here.

In Karnataka, cotton textile industry is concentrated at Bangalore, Mysore, Belgaum and Gulberga. Kanpur, Etawah, Modinagar, Varanasi, and Hathras are important centres in Uttar Pradesh. In MadhyaPradesh this industry is concentrated at Indore and Gwalior. Howrah, Serampur and Murshidabad are important Cotton textile centres in West Bengal.

Rajasthan, Punjab, Haryana and Andhra Pradesh are the other states producing cotton textiles.

The following are the factors for the localization of textile industry in Ahmedabad–Mumbai – Pune region.

1. Availability of raw material – A large amount of cotton is grown in this belt.
2. Availability of capital – Mumbai, Ahmedabad and Pure are the places where capital for investment is easily available.
3. Means of transport – This region is well connected with the rest of India by roads and railways. It, therefore, facilities transportation of finished products.
4. Accessibility to the market – Maharashtra and Gujarat has a large market to sell textile products here. Developed means of transportation help in movement of textile products to other market centres as well as to foreign market. Now a days the market has become a domimant factor in determining the location of cotton textile industry.
5. Nearness to ports – Mumbai port facilitates the import of machinery and good quality of cotton from abroad and export of the finished products.
6. Cheap labour – Cheap and skilled labour is easily available from the surrounding areas.
7. Availability of power – Cheap and sufficient power is easily available here.

B. SUGAR INDUSTRY

Sugar industry is the second largest agro-based industry of India. If we take Gur, Khandsari and Sugar together, then India becomes the largest producer of sugar product in the world. In 2003, there were about 453 sugar mills in the country. This industry employs about 2.5 lakh people.

(a) Production

The production of sugar depends upon the production of sugarcane and it fluctuates with the fluctuations in the production of sugarcane. The total sugar production in 1950-51 was 11.3 lakh tonnes. It increased to 201.32 lakh tonnes in 2002-2003. In 2003-04, it fell down to 138 lakh tonnes.

(b) Distribution

Most of the sugar mills are concentrated in six states, namely Uttar Pradesh, Bihar, Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh.

Uttar Pradesh – It holds a significant position in the production of sugar. The sugar mills are highly concentrated in the western Uttar Pradesh in the districts of Meerut, Muzaffar Nagar, Saharanpur, Bijnor, Moradabad and Bulandshahar. In the eastern Uttar Pradesh Deoria, Basti, Gonda and Gorakhpur are important centres. Uttar Pradesh has largest area under sugarcane cultivation. It has about half of the total area under sugarcane cultivation. But it was able to produce only one third of the total production of sugar (2003-04) in the country. Evidently, per hectare production as well as sugar contain in produce are relatively low.

Maharashtra – Maharashtra is the most important state in the peninsular India producing about one fourth of the total sugar production in India. Major centres of sugar production are Nasik, Pune, Satara, Sangli, Kolhapur and Sholapur.

Andhra Pradesh – East and West Godawari, Visakha-pattnam, Nizamabad, Medak and Chittoor districts are the centres of sugar mills in this state.

Tamil Nadu – In Tamil Nadu North and South Arcot, Madurai, Coimbatore and Tiruchirapalli are the important districts for sugar production.

Karnataka – It is also an important sugar producing state. Belgaum, Mandya, Bijapur, Bellary, Shimonga and Chitradurga are sugar producing districts.

Bihar, Gujarat, Punjab, Haryana, and Rajasthan are other states where sugar mills are located.

The following are the factors for the localization of sugar industry –

1) Sugarcane is the main raw material for making sugar. Sugar mills can be set up only in the sugarcane producing areas. Sugarcane gets dry soon after harvesting. It can neither be stored nor kept for long period of time. Sugarcane should be taken immediately to the sugar mills after harvesting.
2) Transportation cost of sugarcane is high. Generally sugarcane is transported through bullock carts which can carry it upto 20-25 kilometers. Recently tractor trolleys and trucks have been used to carry sugarcane to the sugar mills.

   Beside these factors, capital, market, labour and power also play significant role in localization of this industry.

Reasons for shifting of sugar industry from North India to Peninsular India–

Over the period, sugarcane industry is gradually shifting from north Indian states to states in Peninsular India. Some of the important reasons are as follows:

1) The production of sugarcane per hectare is higher is Peninsular India. In fact, sugarcane crop grows well in the tropical climate of south India.

2) The sucrose contents is higher in the tropical variety of sugarcane grown in the south.
3) The crushing season in south India is longer than in north India.
4) In south India most of the mills have modern machinery.
5) Most of the mills in Peninsular India are in cooperative sector, where profit maximization is not the sole objective.

- Agro-based industries use agricultural products as their raw material.
- Cotton textile industry is the largest industry of organised sector in India.
- Cotton textile industry is widely distributed in India.
- Large number of sugar mills are located in Maharashtra, Uttar Pradesh, Tamil Nadu, Karnataka, Andhra Pradesh, Gujarat and Bihar.

INTEXT QUESTIONS 24.3

1. When and where was first modern Cotton textile mill established?

   ____

2. How much is the share of powerloom in the total production of cotton textiles in India?

   ____

3. Which state is the leading producer of cotton textiles in India?

   ____

4. State any three reasons behind the shifting of sugar industry from north India to south India.

   1. ______________________________
   2. ______________________________
   3. ______________________________

24.4 MINERAL BASED INDUSTRIES

Industries which use minerals as the raw material are called mineral based industries. Iron and steel industry is the most important among these industries. Engineering, cement, chemical and fertilizer industries are also important mineral based industries.

A. IRON AND STEEL INDUSTRY

Iron and steel industry is a basic industry and its products serve as a raw material for a number of other industries.

Although iron and steel manufacturing activity in India is very old, modern iron and steel industry started with the establishment of 'Bengal Iron and Steel Works' at Kulti in West Bengal in 1817. Tata Iron and Steel company was established at Jamshedpur in 1907. This was followed by 'Indian Iron and Steel plant' at Burnpur in 1919. All the three plants were established in the private sector. The first public sector iron and steel plant, which is now known as 'Visvesvarayya Iron and Steel works', was established at Bhadrawati in 1923.

The iron and steel industry made rapid progress after independence. The production capacity has increased in all the existing units. Three new integrated steel plants were established at Rourkela, Bhilai and Durgapur. Bokaro steel plant was established under public sector in 1964. Bokaro and Bhilai plants were set up with the collaboration of the former Soviet Union. Durgapur steel plant was set up in Collaboration with United Kingdom while Rourkela plant was established with the help of Germany. Vishakhapattnam and Salem plants were set up afterwards.

At the time of independence, India produced only a small quantity of iron and steel. Production of finished steel in the country was only 10-lakh tonnes in 1950-51 which has increased to 23.8 million tonnes in 1998-99.

The major iron and steel plants of India are situated in the states of Jharkhand, West Bengal, Orissa, Chhattisgarh, Andhra Pradesh, Karnataka and Tamil Nadu. Besides there are about 200 mini steel plants in India with a capacity of 6.2 million tonnes per annum. Mini steel plants produce steel from scrap or sponge iron. These units constitute an important component of iron and steel industry in the country.

Most of the steel plants are located in and around Chhota Nagpur plateau which is endowed with rich deposits of iron ore, coal, manganese and limestone. The details of raw material, ownership and location is given in the following table:-

Table No. 24.2 : INDIA : Iron and Steel Plants and their source of raw materials

Sl. No.	Name of the plant	Location	Owner-ship	Raw Material obtained from Coal/power	Iron-Ore	Limestone	Manganese
1.	TISCO	Jamshedpur	Private Sector	Jharia	Mayurbhanj Singhbhumi	Keonjhar	Singhbhumi
2.	IISCO	Burnpur	Public Sector	Jharia/ DVC	Singhbhumi Mayurbhanj	Keonjhar	Singhbhumi
3.	VISL	Bhadrawati	Public Sector	Sharavati Project	Kemaman-gundi	Bhandiguda	Chitradurga Shimoga
4.	HSL	Rourkela	Public Sector	Bokaro/ Jharia/ Hirakud Project	Sundargarh Keonjhar	Pumapani	Bara Jamda
5.	HSL	Bhilai	Public Sector	Kargali, Korba	Dalli-Rajhara	Nandini	Balaghat

6.	HSL	Durgapur	Public Sector	Jharia/DVC	Bolangiri (Keonjhar)	Birmitrapur (Sundargarh)	Jamda (Keonjhar)
7.	BSL	Bokaro	Public Sector	Jharia/ DVC	Kiriburu in Keonjhar Distt.	Palamau	Barakar
8.	SSP	Salem	Public Sector	Neyveli	Salem Distt.	Salem Distt.	Salem Distt.
9.	VSL	Vishakha Pattnam	Public Sector	Damodar Valley	Bailadila, Chhattisgarh	Chhattisgarh and MP	Balaghat

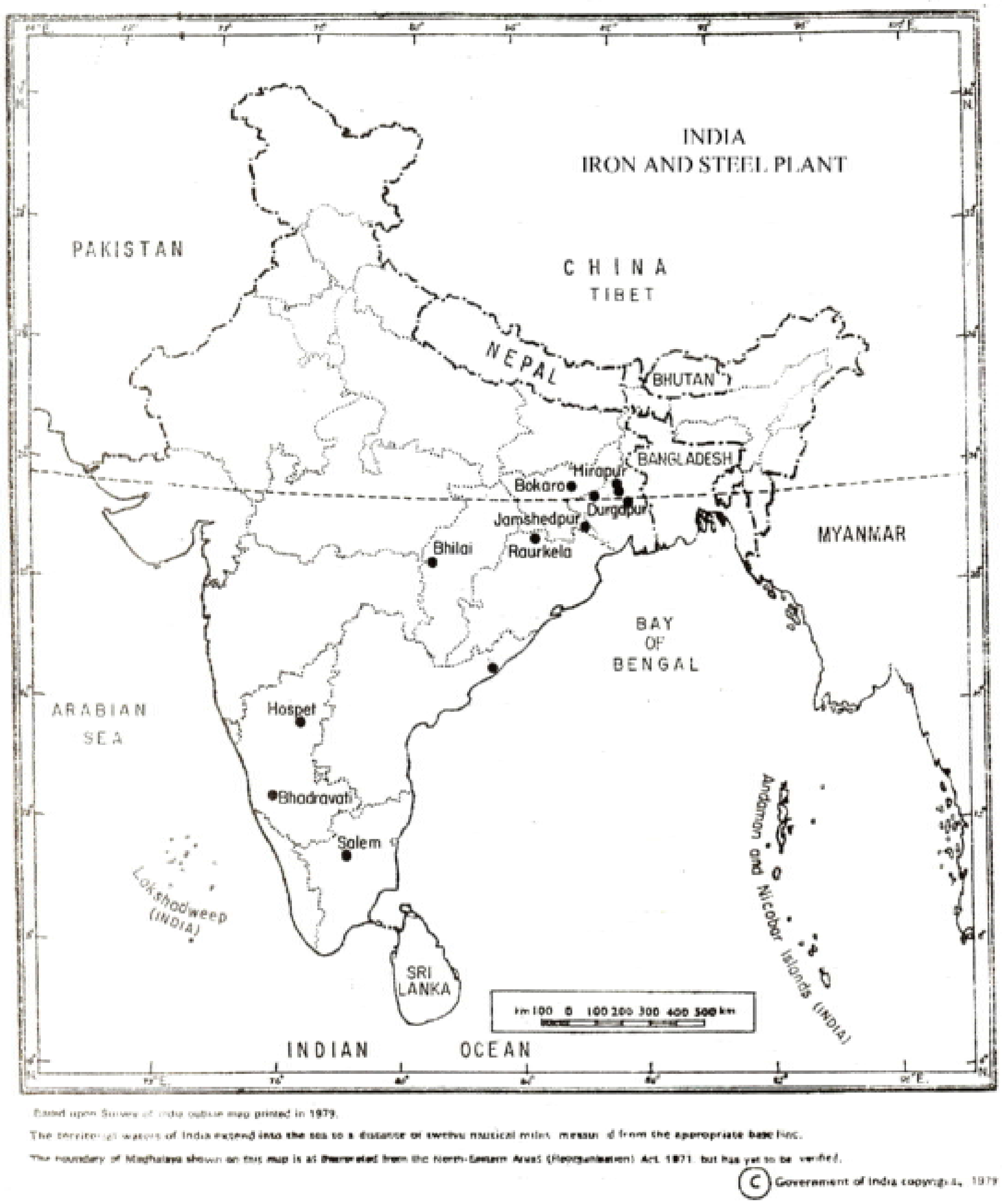


Fig. 24.2: India : Iron and Steel Plants

The information regarding availability of raw material given in the above mentioned table can also be refered with the figure no. 24.2.

INTEXT QUESTIONS 24.4

1. State the place of location and the year of establishment of 'Bengal Iron and Steel Works'?

2. In collaboration of which country, the Durgapur steel plant was established?

3. Which one of the following steel plants is located in the state of Andhra Pradesh?

   A) Durgapur B) Bokaro C) Bhilai D) Vishakhapattnam

4. Which one of the following steel plants is in private sector?

   A) Burnpur B) Bhadrawati C) Jamshedpur D) Bhilai

24.5 PETRO-CHEMICALS INDUSTRY

Petro-chemicals industry is one of the fastest growing industries of India. This industry has revolutionised the industrial scene by providing the products which are substituting the traditional raw materials like wood, glass and metals. Its products meet various needs of the people at the low cost. Petro-chemicals are derived from petroleum or natural gas. We use a variety of products from morning till evening made from petrochemicals Toothbrushes, toothpaste, combs, hairpins, soap cases, plastic mugs, garments, radiocaes, ball point pens, detergents, electric switches, lipstick, insecticides, bags, bed covers, and foam are some of the goods made from petro-chemicals.

Indian Petro-Chemical Corporation has set up a huge petro-chemical complex near vadodara producing a wide range of products. Besides Vadodara, Gandhar, and Hazira in Gujarat and Nagathone in Maharashtra are other important centres of petro-chemical industry. India is self sufficient in the production of petro-chemicals.

Crude oil has no value unless it is refined, while refining crude oil, thousands of products like kerosene, diesel, lubricants and raw material for petro-chemical industry are derived. India has at present 18 refineries.

These refineries are at Digboi, Bongaigaon, Nunamati (All are in Assam), Mumbai (two) (Maharashtra), Visakhapatnam (Andhra Pradesh), Barauni (Bihar), Koyali (Gujarat), Mathura (U.P.), Panipat (Haryana), Kochi (Kerala), Mangalore

(Karnataka) and Chennai (Tamil Nadu). The only private oil refineries belongs to Reliance Industries Ltd. is located at Jamnagar (Gujarat).

INTEXT QUESTIONS 24.5

1. Mention three important raw materials substituted by petro chemicals?

   1.______________ 2.______________ 3.______________

2. Where has Indian Petrochemical Corporation been headquartered?

   ____

3. Write one centre of Petro chemical industry in Maharashtra state.

4. Match the following –

A	B
(a) Nunmati	(i) Kerala
(b) Kochi	(ii) Assam
(c) Karnal	(iii) Bihar
(d) Barauni	(iv) Haryana

24.6 INDUSTRIAL CLUSTERS

There are regional variations in the levels of industrial development in India. Indian industries have concentrated in clusters at some locations. Most industrial regions in India have developed in the hinterlands of some major ports like Kolkata, Mumbai and Chennai. These industrial regions have all the advantages like availability of raw materials, energy, capital and markets. Six major industrial regions emerged out of which three are in the hinterlands of ports. The six major industrial regions are as follows:-

1. Hooghly Industrial region
2. Mumbai – Pune Industrial region
3. Ahmedabad – Vadodera region
4. Madurai – Coimbatore – Banglore region
5. Chhota Nagpur plateau region
6. Delhi and Adjoining region

Besides these major industrial regions, there are 15 minor industrial regions and 15 industrial districts.

24.7 INDUSTRIAL SELF RELIANCE

Industrial self reliance means that the people of India establish and operate industries with their own technical knowledge finances and using machines manufactured in our own country without depending on others.

The Govt of India formulated an industrial policy in 1956 with the objectives of increasing industrial output, generating employment, disperesal of industries, removing regional imbalances in the industrial development and the development of village and small scale industries.

Through planned development of Industries, we now manufacture several types of industrial goods. A major breakthrough has been achieved in the production of capital goods. India is now self reliant in the production of heavy machines and equipment used in mining, irrigation, power projects, transport and communication. We use machines fabricated in India for cement, textile, iron and steel and sugar industries etc..

Public sector has played an important role in achieving industrial self reliance. Iron and steel, railway equipment, petroleum, coal and fertilizer industries, have been developed in this sector. These industries were established in industrially backward regions. During the seventh five year plan an emphasis was laid on high technology, high value addition and knowledge based industries like electronics, advanced machine tools and telecommunications.

24.8 IMPACT OF ECONOMIC LIBERALIZATION

The process of industrialization in India can be divided into two parts – before and after 1992. During first forty years after independence the Indian economy had diversified and expanded very fast. But this growth was characterized by rigid controls and regulations.

In August 1992, Government of India took a bold step by changing its economic policies from state control to market forces. A need was felt to give more responsibility to private capital and enterprise, both domestic as well as foreign. In reponse to this, the new industrial policy of liberalization, privatisation and globalization was adopted in August 1992. The immediate cause of this changes in economic policy was to tide over balance of payment crises but having wide social, economic, political and geographical implications.

Liberalization means a reduced role for the Government and a greater role for the market or the liberal attitude of the Government for the establishment and running of industries. It was touted as a panacea for the ills of Indian economy. However, after 15 years of following the path of literalization, the results are not that sweet. The gap between the rich and the poor has increased. Production of goods of mass consumption has not improved. Employment opportunities have not increased at the desired rate. In privatisation there will be transfer of the ownership of public enterprises to private capital, opening of more industrial areas to private capital and enterprise. The main aim of privatisation is to make use of privately owned resources for collective welfare of the people.

Globalization which stands in the current phase for increasing integration between different economies of the world. The economic gap between different nations is reduced by removing all restrictions between nations on the movement of goods, services, capital and technology.

Globalization has made significant impact on consumption patterns and life style of the people. Now a days the whole world has become a market. Globalization has also affected on value system.

INTEXT QUESTIONS 24.6

1. When did India formulated its first industrial policy?

   ____

2. Mention any three industries on which emphasis has been laid in the VII five year plan.

   ____

3. What is meant by liberalization?

   ____

WHAT YOU HAVE LEARNT

The processing of natural resources into more useful items is called manufacturing. Economic development of a country is directly linked with the level of industrial development. In India the share of manufacturing industries in GDP has been increasing, over the peried, especially in post-economic reforms period. Before independence, India was industrially less developed. But after independence India initiated industrial development in a planned manner during its Five Year Plans. Today, India exports a large number of industrial goods to different countries of the world.

Industries can be classified into different categories on the basis, such as of sources of raw material, ownership, functions, size of industry and weight of raw material and finished products. Since India is still an agricultural country, it has developed various agro-based industries such as cotton textile, woolen textile, jute textile and sugar industry. Cotton textile industry is the largest organised sector industry in India. India is also endowed with various minerals, enabling the country to establish various mineral based industries such as iron and steel, heavy engineering, automobiles, chemicals and petro chemical industry.

The Government of India framed policies which have made India self reliant in various sectors of industries. Liberalization, globalization and privatization have helped in bringing foreign capital and modern technology into the country. Private enterprise is being allowed to enter into various core sectors. This, has resulted into the faster growth of industrial sector.

TERMINAL QUESTIONS

1. Why is the cotton textile industry mainly concentrated in and around Mumbai? Give four reasons.
2. State three reasons for the shifting of sugar industry from north India to south India.
3. Giving suitable examples, classify industries on the basis of ownership.
4. Define industrial self reliance. Why does India need industrial self reliance.
5. Describe any four factors responsible for the concentration of iron and steel industry in and around Chhotanagpur plateau.
6. Differentiate between agro-based and mineral based industries. Give two examples of each.

ANSWERS TO INTEXT QUESTIONS

24.1

1. 1772, Raniganj
2. 1854
3. Jamshedpur

24.2

1. (iii)
2. (iv)
3. (iv)
4. Source of raw material, ownership, function, size of industry, weight of raw material and finished products. (Any five)

24.3

1. 1854, Mumbai
2. 74%
3. Maharashtra
4. High production of sugarcane/hectare
   Higher sucrose content
   Longer crushing season

Notes

Modernized and well equipped machinery

Mills in cooperative sector (any three)

24.4

1. Kulti in West Bengal, 1817
2. United Kingdom
3. D
4. C

24.5

1. Wood, Glass, Metals
2. Vadodara
3. Negathone
4. (a) and (ii), (b) and (i), (c) and (iv), (d) and (iii)

24.6

1. 1956
2. Electronics, advanced machine tools and telecommunications
3. Reduced role of government and greater role of market.

HINT TO TERMINAL QUESTIONS

1. Refer to 24.3A
2. Refer to 24.3B
3. Refer to 24.2 (Table 1)
4. Refer to 24.7
5. Refer to 24.4
6. Refer to 24.2 (Table 1)

25

TRANSPORT, COMMUNICATION AND TRADE IN INDIA

In the previous lesson, you have studied mineral and energy as an important infrastructural resource. Transport, communication and trade are yet another important services. They facilitate agriculture and industry to grow to their fullest potential. Transport carries the people and goods from one place to another. It helps both the production, distribution as well as consumption processes. Communication is the process of receiving and sending massages between two persons or agencies located at different places. Radio and Television are the means of mass-communication which provide information, news and entertainment to the people spread over vast distances. Telephone and telegraph services bring the people closer to one another. Their contribution in promoting business and trade is incalculable. Trade involves exchange of goods among people living in different regions or countries of the world. It plays a vital role in accelerating the progress of agriculture and industry of a country.

In this lesson, you will study the relative importance of transport, communication and trade in India. You would also learn about the distribution and density of transport and communication networks. In trade you will know its volume and direction.

OBJECTIVES

After studying this lesson, you will be able to:

- define the term "infrastructure;"
- explain the role of infra-structure in area development;

- establish relationship between needs and mode of transport system;
- identify the pattern and networks of important roads, railways, airways and water ways;
- describe the role of different modern means of communications;
- appreciate the role of transport and communication changing the way of life in rural and urban areas;
- explain the significance of trade in day to day life, inter-regional dependence, and national integration;
- interpret data, graphs, diagrams showing changing patterns of trade;

25.1 INFRASTRUCTURE: DEFINITION AND ITS ROLE IN AREA DEVELOPMENT

According to World Book Dictionary the term "infrastructure" denote the essential elements forming the basis of a system or a structure. Infrastructure covers the resources, which strengthen the basis of the economy of a country. Better infrastructural services including transportation (railways, roads, ports, civil aviation etc.), communication (telecommunication and post); and electricity transmission and distribution boost the growth of a nation.

Infrastructural resources always becomes key elements during preparation of a plan for area development. Quality infrastructure, covering the services of transportation, electricity transmission and distribution, communication, water supply and sanitation, and solid waste management is one of the most important necessities for unleashing high and sustained growth and alleviating poverty, particularly in the backward state. It works as a nerves of the economy of a country.

By providing these infrastructural services an undeveloped or underdeveloped area can be developed. An area planner always keep in mind appropriateness and balance between different services of infrastructure in an area.

25.2 IMPORTANCE OF TRANSPORT

India is a vast country with long distances. A dense and efficient network of transport is essential to promote social cohesion, accelerate economic prosperity and ensure security and territorial integrity.

Transport consists of three different modes - land, water and air. Each one of them has some advantages and disadvantages. They all compete with one another. More importantly they complement each other and in the process consititute a single integrated network.

While air transport is of recent origin, the other two have been as old as the nomadic man himself. The land transport comprises road and rail transport. Of the

Notes

two, the rail transport is relatively new. It is highly useful for carrying heavy goods over long distances at affordable costs. It is most convenient and cost effective for long distance passengers. The road transport on the other hand is very handy and convenient to carry goods and passenger over relatively short distances. Goods can be transported and handed over to a customer at his doorstep safely and at a reasonable cost.

Water transport for passengers is now no more attractive; but it is an ideal means of transport to carry heavy and bulky goods along navigable rivers and across the oceans of the world. By far this is the most inexpensive means of transport despite being rather slow.

Air transport has become tremendously popular for people who are called upon to visit urgently various parts of the world at a very short notice. Despite high fares, it is indeed very economic as it saves both time and energy. It is now also used for carrying perishable goods and precious cargo from one part of the world to another. Recently due to introduction of various private airlines, fares have been reduced significantly both at domestic and international level.

Transport system links areas of production with those of consumption. It facilitates the movement of goods, services and people at local, regional, national and international levels.

- An efficient network of transport is essential to achieve the economic prosperity and to maintain the security of the country.
- Transport takes place through three different modes - land, water and air.

25.3 RAIL TRANSPORT

Indian railway network is the fourth largest in the world after Russia, the U.S.A. and Canada. In a vast country like India, it has brought the people of the farthest corners of the country closer to one another. Railways are ideal for carrying goods and people over long distances. It employes the largest number of persons among the Central Government departments.

The first train steamed off in the country in 1853 from Mumbai to Thana, covering a distance of 34 km. During these years, Indian railways have grown into a vast network. The following table may give you an idea about the growth of the railway system during the post-independence era.

Table 25.1 Operations of Indian Railways

	1950-51	2003-04
Electrified Route in thousand km.	0.4	17.5

Total Route length in thousand km.	53.6	63.2
Originating Traffic in million tonnes	93.0	557.3
Total Goods Traffic in Billion Tonne – Km**	44.1	381.2
Passengers Originating in Millions	1284.0	5123.0
Passenger- Km+in Billions	66.5	541.2

Source : India 2006, A Reference Annual, P-805-810

*1000 million = I billion (I million = 1,000,000.00)

**1 tonne km = when 1 tonne of goods is carried over one km.

+ 1 passenger-km = when one passenger travels one km.

The above table gives us an idea of quantitative progress made by the railways over 50 years. In the first place the total route length has increased very slightly. However, nearly 28% of its route length has been electrified. It means over this track the traffic is far cleaner and faster. It also means considerable saving in transporting charges of coal which the railways consumed for their own running. To that extent the railway wagons are now free to carry commercial goods of its clients. Similarly, the route length has increased only marginally but the passenger-km traffic has increased more than eight times. Even the goods traffic in terms of tonne-km has encreased by well over ten times. This also speaks of qualitative increase in the efficiency of the railways. This has become possible by electrification of part of the route and dieselisation of the track. The number of steam or coal engines had come down to mere 45 by 2003-04 from 8120 in 1950-51. Now there are 4769 diesel engines as compared to mere 17 in 1950-51. Similarly electric locomotives have increased from 72 to 3003 by 2003-04.

As seen earlier, the new railway lines have been added only marginally. However, there has been considerable increase in running track. In 1950-51 it was about 59,000 km. By 2003-04 it rose to nearly 84,000 km. It means considerable portions, particularly the busy ones have been converted from single to double and in some cases even triple tracks. This has enabled railways to run more trains, both goods and passengers. The railways have undertaken to convert metre gauge railway tracks into broad-gauge (1.68 metres) enhancing the capacity of railways to carry more goods and more passengers with an increased speed. By strengthening trunk route railway tracks, Indian Railways run several fast trains. Earlier there were passenger and express or mail trains, the only two categories. Now there are Super fast Expresses, Rajdhani Expresses, and Shatabdi (the fastest) Expresses running between busy terminals. Now metro rail is a new concept which

Notes

provide faster transport facility in metro cities. Delhi is the first ones, where its running successfully.

Indian railways have taken several measures to improve their efficiency and usefulness to the public:

– considerable increase in railway running track.
– increase in electrification of busy trunk routes.
– conversion of metre gauge railway lines into broad gauge.
– introducing several types of fast and superfast passenger trains
– running fast goods and special foodgrain trains.
– Provide better facilities for reservation and other customer care services, introducing reservation through internet.

Let us have a glance at the regions of dense, moderate and sparse railway networks.

The Regions of Dense Network

(i) The northern plains and eastern coastal areas possess a dense network of railways. The level land, fertile soils, dense population and spread of industries are the reasons *for* this dense railway network.

(ii) The plains of Gujarat and Saurashtra, Central Tamil Nadu and Chhotanagpur Plateau are the other regions. These regions have well developed industries.

Regions of Moderate Railway Network

The whole of peninsular region except Tamil Nadu and Chhotanagpur has a moderate network. The hilly and plateau terrain provides unfavourable conditions for laying railway lines. There are long trunk routes which connect the important industrial cities and ports. The railway lines either pass through the large gaps between hills or through the tunnels.

Regions of Sparse Railway Network

(i) The Himalayan mountain region, comprising Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh have hardly a line here and there. The hilly terrain, rugged topography are the main reasons responsible *for* the very sparse network. Some *foot* hill towns such as *Jammu,* Kathgodam, Kotdwar and Dehradoon are the only rail heads touching the region. Recently, railway line has been extended from Jammu to Uddhampur in the state Jammu and Kashmir. There are few narrow gauge tracks between Kalka and Shimla and between Siliguri and Darjeeling.

(ii) The North eastern region has also sparse railway network. Only Brahmaputra valley in Assam has main railway line. All hilly states in this region are almost without a railway line. The hilly terrain, thick forest cover, heavy rainfall, low level of economy and sparse population are the main factors for the absence of railway lines.

(iii) Desert region of western Rajasthan has also sparse network of railways. There are some metre gauge railway lines which link the big cities. However, most of these metre gauge railway lines have been converted into broad gauge lines. This area is sparsely populated and has few industries. Moreover the climate is hot and dry. Dry sandy winds obstruct the railway tracks. All these factors hamper the construction of railway lines and their proper maintenance.

The Pattern of Trunk Railway Routes

If you try to trace the busy trunk route railway lines connecting Delhi, Mumbai, Chennai, Kolkata (and back to Delhi), you get a kite-shaped pattern. Further add to it the diagonal lines connecting Mumbai and Kolkata on one hand and Delhi and Chennai on the other, you get a kite or diamond shaped figure. These lines serve as backbone of the entire railway netwok in the country.

This main pattern needs two important additions one in the Sutlej Basin or the Punjab plains in the north-west and one in the Brahmaputra Valley in Assam. The former consists of lines connecting Delhi with Pathankot, Amritsar-Wagha and Firozpur. The other trunk connects North-east Bihar and Northern West Bengal with Dibrugarh in east or upper Assam.

All these lines connect Delhi with a broad gauge and the most part of them has been electrified.

The Role of Railways

The role of the Indian railways may be made further clear if you study the following table, carefully. Also see if the conclusions drawn at the end are correct objectively.

Table 25.2 Indian Railways Traffic Originating in Million Tonnes

Commodities	1950-51	2003-04
(i) Coal	20.2	271.40
(ii) Raw materials (excluding) coal) of Iron & steel industry	N.A.	44.26
(iii) Pig iron, Finished steel lifted from steel plants	–	15.24
(iv) Iron-ore for exports	Nil	36.41
(v) Cement	2.5	53.47
(vi) Food Grains	8	46.52
(vii) Fertilisers	Nil	28.75
(viii) Mineral Oil	2.7	22.00

Source : Economic survey 2005-06, p. 195

(i) Coal is the most dominating commodity transported by the railways. Railways promoted industrial growth of the coal starved areas.

(ii) Railways help to increase industrial production by carrying raw materials to industrial centres.

(iii) Railways also help in distribution of semi-finished and finished products like pig-iron and steel which in turn promote secondary industries.

(iv) Railways also help in promoting exports of commodities like iron-ore, cement and food grains to earn foreign exchange.

(v) Railways promote building activity all over the country by carrying cement over long distances.

(vi) Railways help in boosting agricultural production by carrying huge amounts of fertilisers from one region to another.

(vii) Railways carry mineral oil, an industrial input, from port cities and refineries to the interior parts of the country.

This should explain why Indian Railways constitute the major national means of transport.

INTEXT QUESTIONS 25.1

Answer the following questions briefly:

(1) Mention any two name of infrastructural services.

(i) ____________________ (ii) ____________________

(2) What is the total route length of Indian railways in 2003-04?

(i) ____________________ (ii) ____________________

(3) Mention two main advantages of railway transport.

(i) ____________________ (ii) ____________________

(4) Name two regions in India where railway network is dense.

(i) ____________________ (ii) ____________________

(5) State the most important reason for the sparse railway network in the North Eastern Region of India.

(i) ____________________ (ii) ____________________

(6) Mention the main problem is laying railway lines in the peninsular plateau regions.

(i) ____________________ (ii) ____________________

25.4 ROAD TRANSPORT

Road transport is an old means of transport. It plays a significant role in carrying goods and people in all parts of the country. Particularly, the rural economy depends upon the road transport. The importance of roads has increased with the advent of auto vehicles. The relative importance of roads is much more than that of railways. (i) Railway transport limited to the railway heads while the roads provide door to door services. (ii) Roads can negotiate higher gradient of slopes and can traverse the mountainous regions. Construction of railway lines is difficult and expensive in hilly regions. (iii) Road transport is flexible, reliable and quick, (iv) It is more suitable for carrying perishable goods like milk, fruit and vegetables. (v) Its cost of construction and maintenance is far less than that of the railway. (vi) For short distance journey, roads are more suitable. They supplement the railways by linking the interior areas with railway heads. Roads are ideal for the promotion of tourism in the country.

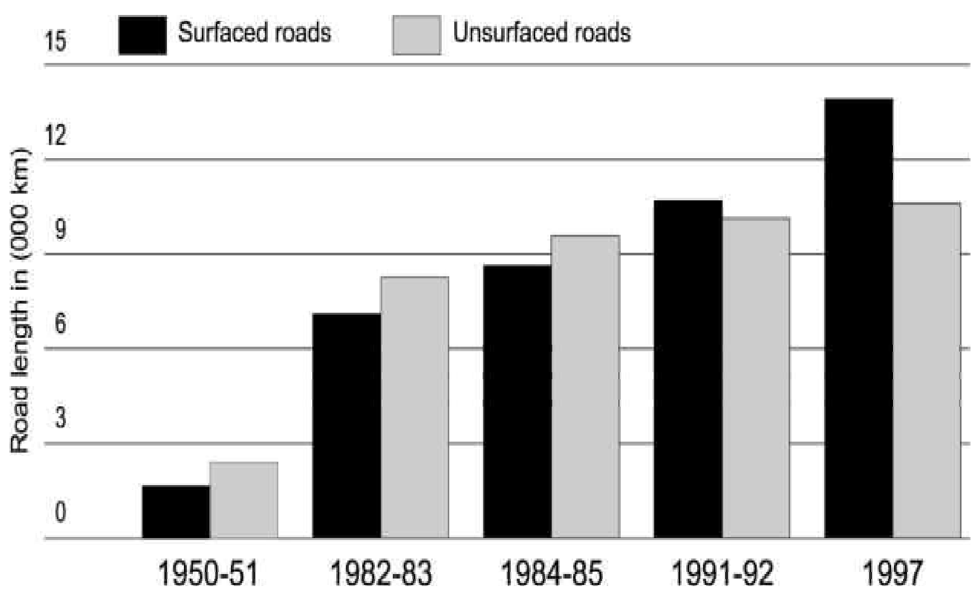


Fig. 25.1 Development of Road Length in India

With the total length of 3.32 million kilometre, India has the largest road network in the world. However, it is far from adequate or efficient.

Surfaced and Unsurfaced Roads

Surfaced roads are the metalled roads and are made up of cement, concrete or bitumen. These are all weather roads. The total route length of surfaced roads in India till march 1997 was 13,94,067 km. Unsurfaced roads are 'Kucha' roads

Notes

made up of earth. They provide tracks for the bullock carts and link the rural areas with the urban centres. They play an important role in the development of rural economy. During rainy season these roads are of little use. The total length of these roads was 10,71,816 km. till march 1997.

Development of Road Transport

There has been a considerable development in the road length after independence. Route length of surfaced roads has increased from 1.571akh km. (1950-51) to 13.94 lakh km. in 1997. The length of unsurfaced roads during the same period has increased from 2.42 lakh km. to over 10.71 lakh km.

Not only the route length of roads has increased but the number of commercial heavy vehicles, particularly the buses and trucks has also shown a tremendous increase since Independence. Vast increase in the road traffic has posed serious problems in handling it smoothly. The number of road accidents has also shown a steady increase. With increased road traffic, pollution of air has been on the rise.

Geographical Distribution of Roads

Road density refers to the average length of roads per 100 square km. area. The road density in India is still very low compared to the developed countries. High concentration of road network is found in the Northern Plains because of level land, fertile soil and high density of population. In these parts, unsurfaced roads are more common than surfaced roads. Peninsular plateau has higher proportion of metalled roads because of the easy availability of road building meterials. In the North eastern states; the road net work is very sparse due to hilly terrain, thick forest cover and heavy rains causing frequent floods. Sparse population is also the other important reason.

The pattern of road density is also uneven in the country. Tamil Nadu, Kerala, Punjab and Haryana have higher road density. It is because of the growth of agriculture, manufacturing industries, urbanization and dense population. Karnataka and Maharastra also fall in this category, reason behind this is concentration of industries and urbanization.

The states of Andhra Pradesh and Bihar have moderate density of roads. In Rajasthan, Madhya Pradesh and Chhatisgarh, the density of road is low due to low population and low economic development.

The Himalayan region and North Eastern states have very low density of road network, which is below 20 km. per 100 square km area. As regards the pattern of surfaced roads, Punjab in the north and Kerala and Tamil Nadu in the south have the highest road density. The southern states have a good network of metalled roads. The pattern of surfaced road density is more or less the same as the total density of roads.

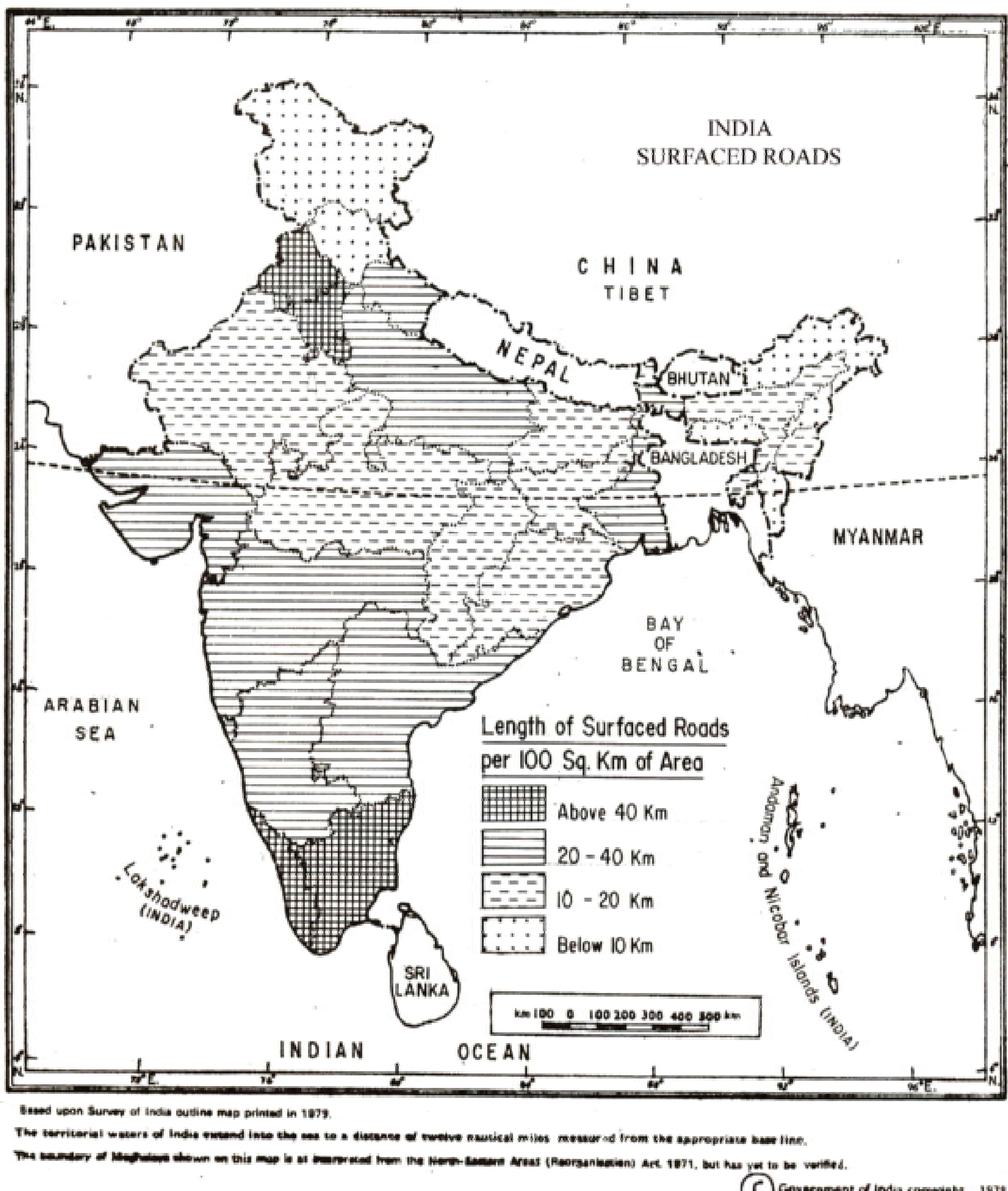


Fig. 25.2 INDIA : Surfaced Roads

Road density in India is not uniform. It varies from region to region depending upon its relief and climatic conditions, economic development and density of population.

Roads are divided into three categories: (i) National highways (ii) State highways, and (iii) District and village roads.

National Highways are the trunk roads linking major cities of the country. They are built and maintained by the Central Government. Their total length is 65,500 km. Although the national highways comprise only about 2 percent of the total length of surfaced roads in India, they carry about 40% of goods and passenger traffic.

There are 219 national highways in the country. Some of them are very important as they carry the bulk of road traffic. National Highway No.7 is the longest (2683 km) of all, linking Varanasi in the north with Kanya Kumari in the south.

The state highways are built and maintained by the State Governments. The District and village roads are looked after by the local bodies with some financial assistance coming from the states.

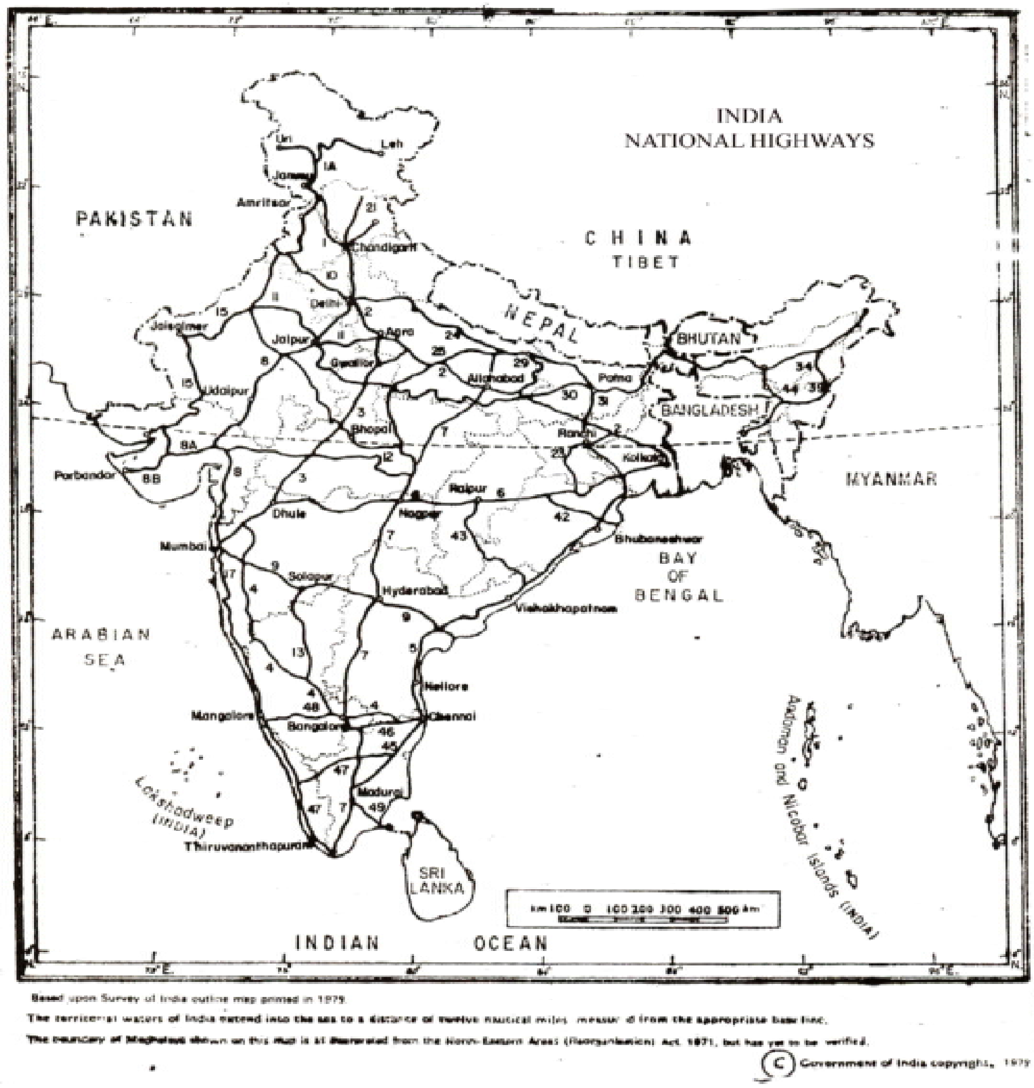


Fig : 25.3 INDIA: National Highways

Border roads have been constructed in the remote parts of the country lying close international border. They connect these areas with the interior parts of the country.

The responsibility of their construction and maintainance is on Border Road Organisation. These roads have economic as well as strategic importance. Leh and Manali Road, the world's highest road, is an example of our engineering skill and courage. The average height of this road is 4270 meters above sea level. Most of our border roads run through areas of very harsh climate and most inhospitable terrains.

- National Highways connect the major cities of the country. Their length is only 2% but they carry 40% of the total road traffic.
- The state highways join the district head quarters with state capital. District and village roads connect the villages with small towns and district head quarters.

Recent Development of Roads under National Highway Development Project (NHDP)

In order to boost economic development in the country the Government of India initiated a programme called National Highway Development Programme (NHDP). NHDP has already completed two phases and third phase is ready to be implemented. The first two phases have the following components:

(i) Gloden Quadrilateral (GQ) comprising National Highway connecting four metro cities viz, Delhi, Mumbai, Chennai and Kolkata. Total length of the Golden Quadrilateral is 5846 km. The construction has almost been completed. Out of the total 5846 km. four laning of about 4856 km. length has already been completed by 31st May, 2005.

(ii) The second major task was the construction of North-South and East-West corridors comprising the national highways connecting Srinagar to Kanyakumari including Kochi-Salem spur and Silchar to Porbundur. The total length of the corridors is about 7300 km. But very little progress has been made so far. As on 31st May, 2005 only four/six laning of 707 km. has already been completed. The Government of India has a plan to complete this massive work by December, 2007.

(iii) The third significant task was four laning of about 356 km. of highways to provide connectivity to 12 major ports and 777 km. on other highways. As on 31st May, 2005, four laning of about 69 km. roads of port connectivity and 287 km. of other National Highways have been completed.

Apart from this National Highways Authority of India (NHAI) has already planned another five phases of NHDP. These are as follows:

(i) Four laning of 10,000 km. of National Highways through Built-Operate-Transfer (BOT) basis. (Phase-III).

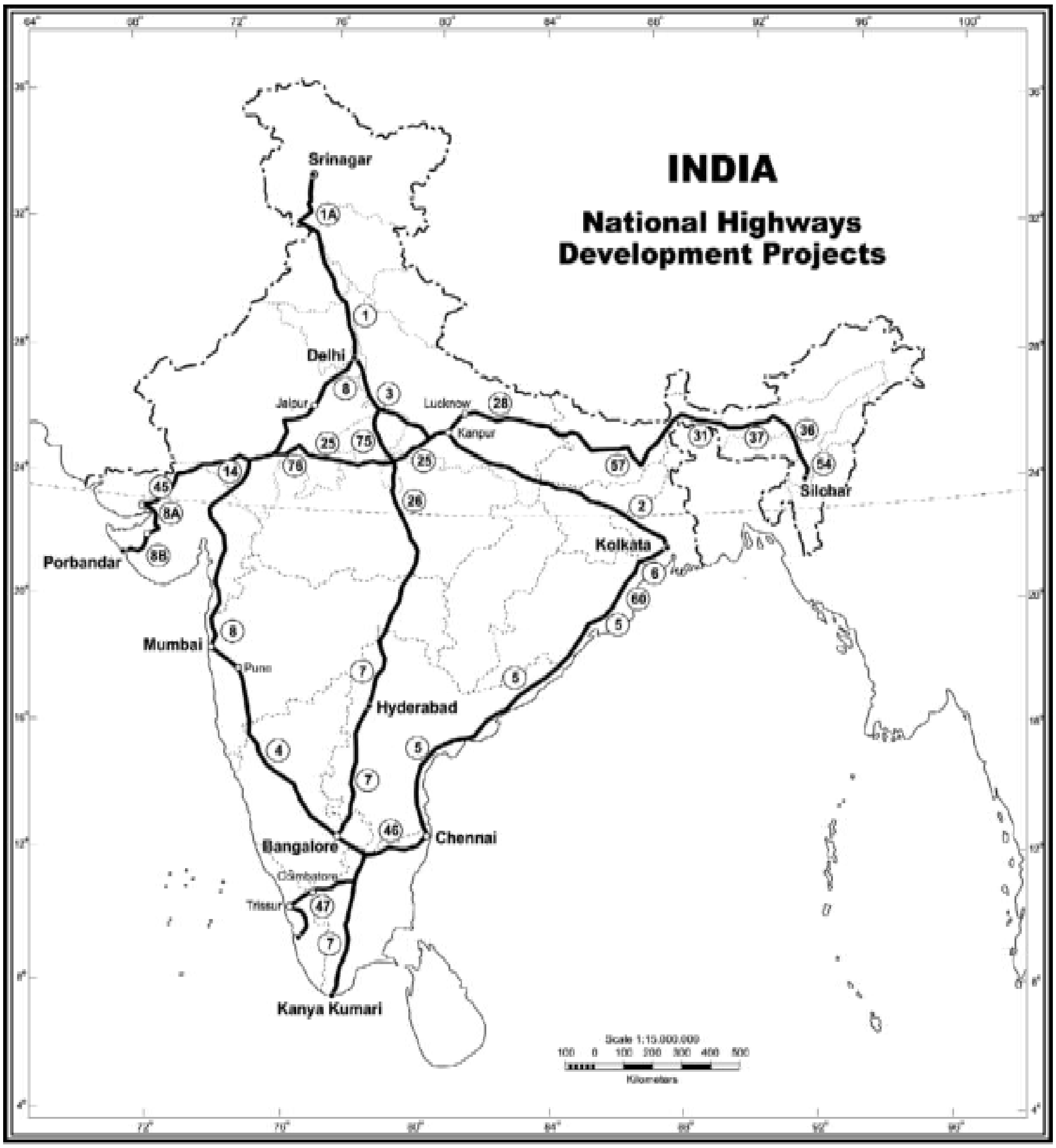
(ii) Two laning and providing paved shoulders of 20,000 km. of National Highway (Phase IV).

(iii) Six laning of 5000 km. of National Highways (Phase V).

(iv) Development of 1000 km. of Express ways (Phase VI).

(v) Construction of Ring Roads, By passes, Flyovers etc. to remove the bottlenecks on National Highways.

(vi) Apart from this, development of National Highways and other roads in the North-Eastern Region is planned under Special Accelerated Road Development Programme in NE Region (SARDP-NE).



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 25.4 INDIA : Golden Quadrilateral and North-South and East-West Corridor

INTEXT QUESTIONS 25.2

Answer the following questions briefly:

(1) What was the total length of surfaced roads in 1997?

(2) Give the names of terminal points of the National Highway No.7.

(i) ____________________ (ii) ____________________

(3) Name two states of India having the highest density of roads.

(i) ____________________ (ii) ____________________

(4) Write the terminal points of the world's highest road.

(i) ____________________ (ii) ____________________

(5) In which areas, unsurfaced roads are more important?

____

(6) Give the most important reason for the low density of road in the North-eastern region of India.

____

(7) What is the total length of Golden quadrilateral ?

____

25.5 PIPE LINE TRANSPORT

Pipe line transport has been developed recently in India. It is the most convenient mode of transport for mineral oil, petroleum products and natural gas. Pipe lines connect oil and natural gas fields with refineries and the main market centres. Now solids are also being transported through pipe lines after converting them into slurry.

There are certain advantages of pipe lines over other modes of transport (i) Pipe line can be laid through difficult terrain as well as under water. (ii) Initial cost of laying pipeline is high but subsequent cost for maintenance and operation is low. (iii) It ensures steady supply and minimises transhipment losses and delays. (iv) Pipe line operation involves very low consumption of energy.

There are some limitations of pipe line transport such as the capacity of pipeline cannot be increased once it is laid. The security of pipe lines in certain areas and the detection of leakage is difficult. Petroleum pipe lines in Assam connect oil fields with the oil refineries of Assam and Bihar. Pipe line between Kandla and Mathura is the longest oil pipe line (1220 km). There are several pipe lines in the Gujarat and Maharashtra connecting the oil fields, refineries and marketing centres. The longest gas pipe line has been laid from Hazira (Gujarat) to Jagdishpur (UP) via Bijaipur (MP). This HBJ pipe line is 1730 km in length and supplies natural gas to six fertiliser plants and two thermal power plants. Pipe line transport has reduced the burden of railways significantly. Owing to their advantages, more pipe lines have been proposed for smooth supply of oil and natural gas. Gas fired thermal power stations are being set up in the distant and remote parts due to facilities of pipeline transport.

- Pipeline transport is very convenient mode for the regular and smooth supply of oil and natural gas.

25.6 WATER TRANSPORT

The Indian mainland together with its island groups has a long coastline of over 6100 km. This long coastline is dotted with 12 major ports managed by the central government. Then there are 186 minor ports operating under the jurisdiction of the state governments. The 12 major ports handle 90% of international water borne trade of the country. These major ports alone handled 384 million tonnes of sea imports and exports.

The major ports along the western or Arabian Sea coast are Kandla, Mumbai, Jawahar Lal Nehru Port (at Nhava Sheva on the opposite side of Mumbai harbour), Marmugao, New Mangalore and Kochi. Thus all the states on the western coast have at least one major port. The remainng five ports are Tuticorin, Ennore, Chennai, Visakhapatnam, Paradeep (Paradwip) and the Joint port of Kolkata - Haldia. Thus all the coastal states on the Bay of Bengal have at least one port each. The Jawahar Lal Nehru port of Navi Mumbai is the most modern port.

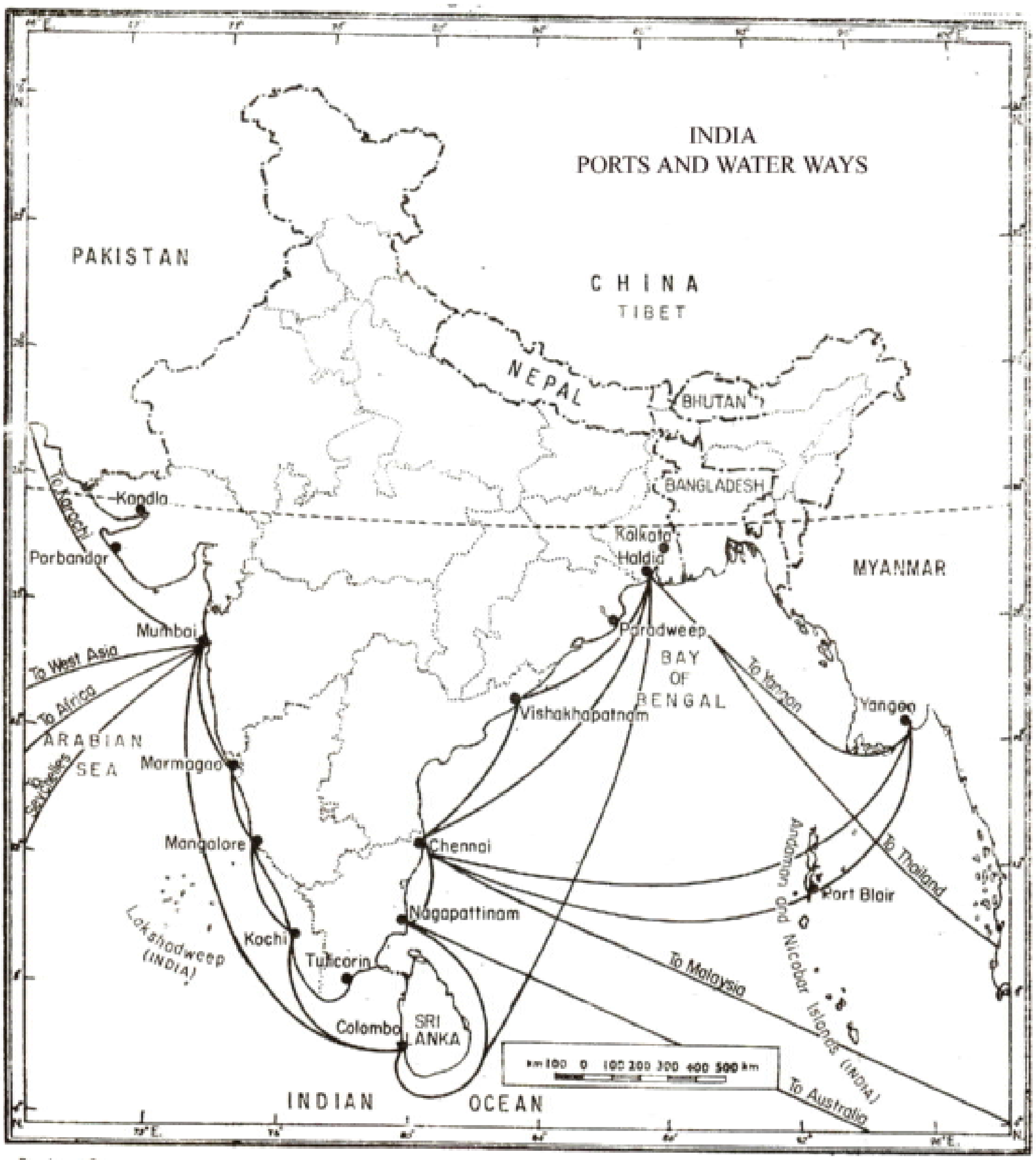
- Water transport is cheaper and helps in the promotion of foreign trade.
- Twelve major ports on the coast line handle 90% of India's sea imports and exports.

Inland Water Ways

The position of inland water ways in India is very poor. The total length of navigable water ways is only 14,500 km which can be used by mechanised boats and steamers. We are actually utilizing only about 2700 km long water ways.

Some important inland water ways are:

(i) Ganga river between Allahabad and Haldia covering a distance of about 1620 km. Big steamers and crafts can ply upto Patna. This water way is declared as National water way No.1.



Based upon Survey of India outline map printed in 1975.

Government of India copyright, 1975

Fig. 25.5 INDIA: Ports and water ways

(ii) Brahmaputra river is navigable upto Dibrugarh a distance of 1384 km. Out of which only 891km. lies in India, the rest being in Bangladesh.

(iii) The Kollam and Kotapuram stretch of west coast cannal along with Champakara and udyogmandal canals in Kerala which stretches for about 205km.

(iv) In south, the lower reaches of Godavari, Krishna and Mahanadi serve as inland water ways. Buckingham canal between Tamil Nadu and Andhra Pradesh is also an inland water way which is now hardly in use.

The following factors affect the inland water ways in India.

(i) Diversion of water of rivers for irrigation.

(ii) Silting of river beds reduces the depth of river water.

(iii) Seasonal ftuctuations in the water level of the rivers.

(iv) Presence of bridges, water falls and cataracts in the course of rivers.

(v) An unequal competition with railways and road ways.

India's inland water ways have not been developed as they can not compete with the railways and roads.

INTEXT QUESTIONS 25.3

Answer the following questions briefly:

(1) Name two main commodities which are usually carried by pipe line transport.

(i) ______________________ (ii) ______________________

(2) Which gas pipe line in India is the longest?

____

(3) Which port in India handles the largest cargo traffic?

____

(4) Name two main navigable rivers of India.

(i) ______________________ (ii) ______________________

25.7 AIR TRANSPORT

Air transport is the fastest and highly convenient mode of transport, although it is more costly than other modes. One can cover a journey between Delhi and Bangalore in about two and a half hours by an aeroplane while this distance is covered in about 42 hours by a railway express train.

Air transport becomes very important in the regions where surface means of tranport are difficult to develop. These regions may have dense forests, marshy land, hilly terrain and high mountains.

India is favourably situated on a busy international air route, connecting North America, Europe and South-west Asia on the one hand and East and South-east Asia together with Australia on the other.

In the public sector, there are Air India Indian Airlines, Air India Charters Limited (Air India Express) and Alliance Air. In the private sector, there are 7 scheduled airlines (passenger), namely, Jet Airways, Sahara Airlines, Deccan Aviation, Spice Jet, Go Airways, Kingfisher Airlines, Paramount Airways and Indigo. There is also one cargo private scheduled airline, i.e., Blue Dart Aviation. At present, there are 46 companies holding non-scheduled air transport operators permit.

Notes

Air India is the international air carrier. It handles the foreign traffic which includes both cargo and passenger services. It provides Regular and more frequent flights to the USA, Canada and and European countries.

Currently, there are 37 air crafts most of them Boeing 747 in the fleet of Air India. In 2004-05, Air India carried about 4.4 million passengers. There are eleven international airports which are located at Delhi, Mumbai, Kolkata, Channai, Thiruvananthapuram, Bangalore, Hyderabad, Guwahati, Amritsar, Jaipur and Lucknow handle the entire foreign air traffic.

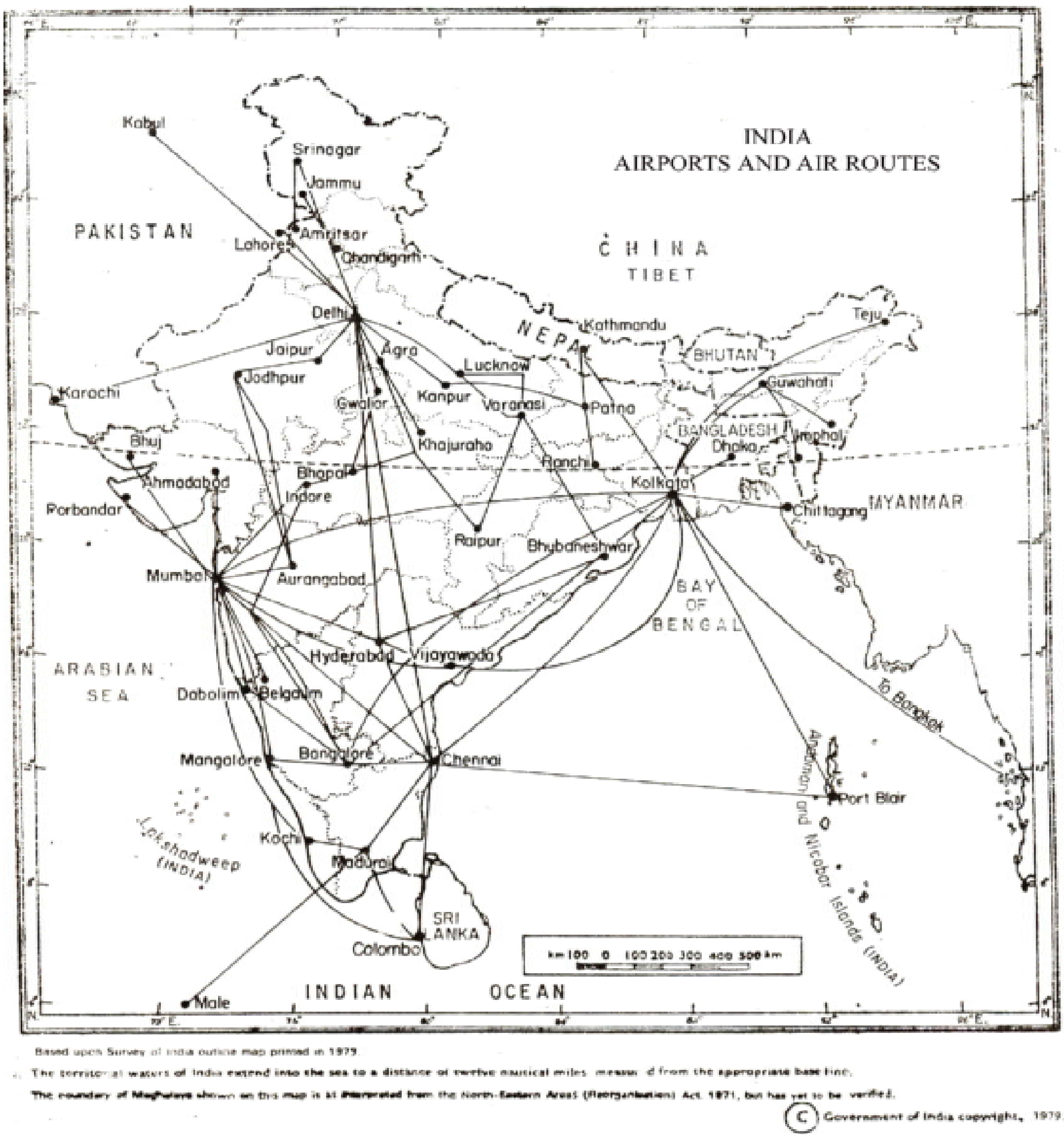


Fig. 25.6 Airports and Air routes

Indian Air Lines handles the domestic air transport. There are regular flights among the state capitals and major cities of the country. The places of tourist interest are also served by this airline. Besides it, Indian Airlines operate 55 domestic and 18 international stations. It provides services to neighbouring countries such as Sri Lanka, Nepal, Bangladesh, Pakistan, Malaysia, Singapore, Male and Middle East. Presentey Indian Airlines has a fleet of 73 aircrafts.

Pawan Hans Helicopter Ltd., a public sector company, is engaged in providing helicopter services to ONGC for its off shore operations. It's also used by various State Government.

Promotion of air transport in the North-eastern region is a necessity owing to several adverse physical factors like mountainuous terrain, thick forest cover, big rivers with frequent flood. Socially and economically too, the region needs to be drawn closer to the rest of India.

- Air transport is the fastest through costlier mode of transport. It has brought the world closer.
- Air India and Indian Air lines are the two main air carriers operating in the country. There are seven private airlines.

INTEXT QUESTIONS 25.4

Answer the following questions:

(1) Name international air carrier of India.

____

(2) Name the Public Sector air transporting company, providing domestic air transport services.

____

(3) In which region of India is the air transport a necessity?

____

(4) Name five international airports of India.

(i) ____________ (ii) ____________ (iii) ____________

(iv) ____________ (v) ____________

(5) In which two ways, does the air transport differ from other modes of transport?

(i) ____________ (ii) ____________

Notes

(6) Name any two private sector air transporting company.

(i) ________________ (ii) ________________

25.8 COMMUNICATION

Communication system contributes to the development of the economy, social relationships and also helps in promoting cultural unity. Internationally, it brings diverse people of the world close to one another

In the event of any impending calamity, accident or emergency instant means of communication flash the news across the globe so that relief can be rushed to the spot immediately.

Postal Services

It is the most commonly used mode of communication in India. The postal services play a vital role in the rural areas of the country. About 99% of the villages are enjoying postal services to day.

At present about 1.55 lakh post offices are providing postal services covering every part of the country. In tune with the rest of the world the Indian postal services are also being modernised.

(1) (Postal Index Number) PIN has facilitated the prompt delivery of mail (ii) Speed post service has been introduced for fast and quick delivery of post (iii) Quick Mail Service (QMS) is another step in this direction.

Besides these, satellite money order scheme was introduced in 1994 as a pilot project for providing services to hilly, backward and remote areas from six principal cities. International mail services carried by air and sea is an important step in linking the foreign countries with India.

Telecommunication

It is the modern device for the communication at individual and mass level. Telegraph, Telephone; Talex and Fax are the main means of tele communication. By the end of 2004-05, India was the 10th largest telecom network in terms of number of phones.

(1) Telegraph: is comparatively an old mean for providing quick communication in event of any emergency. At present about forty thousand telegraph offices have been working in the country.

(2) Telephone: There has been a very fast progress in telephone facilities. As on 31 March 2006, the network comprises of 142.09 million telephone connections and over 2.34 (February, 2006) million Public Call Office (PCOs). There are over 62.90 million cellular subscribers in the country and the cellular custormer base is growing at the rate of over two million per month. Telephone services have been expanding very rapidly in the country. STD (Subscriber Trunk Dialing) facilities are available to all the big and small towns of the country. Fully automatic Interantional Subscriber Dialling (ISD) service is available to almost all the countries.

(3) **Telex:** Telex services make possible to send information in printed form. More than 200 cities of India enjoy the service. Use of satellite has revolutionized the Tele communication system to day.

Mass - Communication

Radio and television are the electronic media of mass communication. They play an important role in individual and social life.

Radio is a powerful medium which provide all sorts of useful information, news and variety of entertainment. There are about 223 radio broad casting stations in the country and provide services to 91.42% of the area and 99.13% of the total population. Now, FM Radio services have given a new face to radio transmission.

Television service was started in 1959 in India. However, the real expansion of T.V. Service began after 1980. Only recently several channels on television have been made available to private parties. This has promoted keen competition to improve the quality of programme even of Doordarshan. Doordarshans network consist of (i) 64 Doordarshan Kendra (studio centres); 1400 transmitters (1134 transmitters for DD1, 153 transmitters for DD News, 109 transmitters for regional services and 1 digital transmitters each at Delhi, Chennai, Kolkata, and Mumbai). DD1 provide services 79% of area and about 91% of the total population.

Cinema is yet another mean of mass communication. It entertains millions of people everyday.

Print media

Newspapers, periodicals and journals fall in the category of print media. Print media expanded very rapidly after independence. There were 62,550 daily newspapers, periodicals and different journals in Indian languages on 31^{st} March, 2006. These were 6,800 dailies, 369 tri/bi-weeklies, 21,453 weeklies, 8,227 fortnightlies, 18,545 monthlies, 4,340 quarterlies, 584 annuals, and 2,232 of the other periodicity. The largest number of newspapers and periodicals registered in any Indian language is in Hindi (24,017), second is English (8,768).

INTEXT QUESTIONS 25.5

Answer the following questions:

1. Write the fulform of these abbreviations :

   (i) PIN, (ii) QMS, (iii) STD, (iv) PCO, (v) ISD.

(i) ________ (ii) ________ (iii)__________ (iv) ________ (v)______

2. Name three means of mass-communication.

   (i) _______________ (ii) ________________ (iii) ________________

3. What is print media?

   ____

25.9 TRADE

The services which involve the activities of buying and selling of goods are termed as trade. Like transport, communication, banking etc. it is also a tertiary service and an important infrastructure for the development of economy including agriculture and industry in the country. Trade may take place at various levels -local, regional, national or international.

The growth of trade depends on accessibility of a well developed market and well advanced communication system.

International Trade

It involves selling and buying various commodities at the international level. International trade may be multilateral or bi-lateral; depending upon the number of parties involved. India's international trade has grown very rapidly after Independence. India's total international trade in the year 1950-51 stood at Rs. 1,214 crore. Since then this has witnessed continuous increase with occasional down twins. During the year 2004-05 the value reached at Rs. 8,37,133 crores. Though, India has trade relations with all the major trading blocks and all the geographical regions of the world, the major trade partners are the USA, Russia, countries of West Europe, Japan and Oceania. In dollar terms, Asia and Oceania accounted for 47.41% of India's total exports followed by west Europe (23.80%) and America (20.42%) during 2004-05. India's imports were highest from Asia and oceania (35.40%) followed by west Europe (22.60%) and America (8.36%) during the same period.

Export

During the colonial era major commodities of our exports were either raw materials like cotton, jute, leather, spices, minerals or food items like wheat, tea, coffee and spices etc. All the trade was channelised through Britain. After Independence there has been significant changes in the items of export because of the rapid industrial development in the country. Now India exports nearly 7500 commodities. There has been a appreciable growth in exports since 1950-51 when it was worth only of Rs. 607 crores. It has increased to Rs. 3,56,069 crores by 2004-05.

While there are year to year variations, some of the major commodities whose exports have been increasing over the last few years and also in 2004-05 include engineering goods, gems and jewellery, chemical and related products, textiles, petroleum products, agriculture and allied products, and ores and minerals.

There has been a significant change in the export products since Independence. The largest value of exports is now obtained manufactured products.

Imports

After Independence, there has been a sharp increase in the value of imports in India. We now import about 6000 commodities. During pre-Independence period, main items of imports were machinery, manufactured goods, textiles, chemicals, medicines etc. After independence in the early decades, India's import consisted mainly of food grains because of the partition of the country.

India's total value of import in 1950-51 was of Rs. 581 crores which had increased to Rs. 4,81,064 crores in 2004-05. There has been significant increase in the imports during the last 55 years.

In the year 2004-05, bulk import as a group accounted for about 40% of the total imports. This group includes fertilizers, cereals, edible oils, news print and petroleum products. But only crude petroleum and products have 71% share among the bulk products import and about 28% share among the total import.

The other principal imports consists of pearls, precious and semi-precious stones, machinery, project goods, medicinal and pharmaceutical products, organic and inorganic chemicals, coal, coke and briquettes, artificial resins etc.

The Recent Trends in Foreign Trade of India

At the time of Independence, India's foreign trade was very limited. India was the main exporter of primary commodities and imported manufactured products and machinery. After independence there has been a rapid progress in the field of industry and agriculture. The international market has also expanded. The commodities of export and import have shown a great change in the last decades. India has developed trade relations with the countries of Asia, Africa and Oceania for the promotion of her exports. Incentives such as, providing export credits at lower interest, and by removing restrictions and controls on the exports has helped in the promotion of export. Main stress is given to export of value added commodities.

We have also adopted a policy of liberalisation of imports. Adoption of new import policy has strengthened the economy of the country. Some commodities which help in the manufacturing industries can now be imported on easy terms.

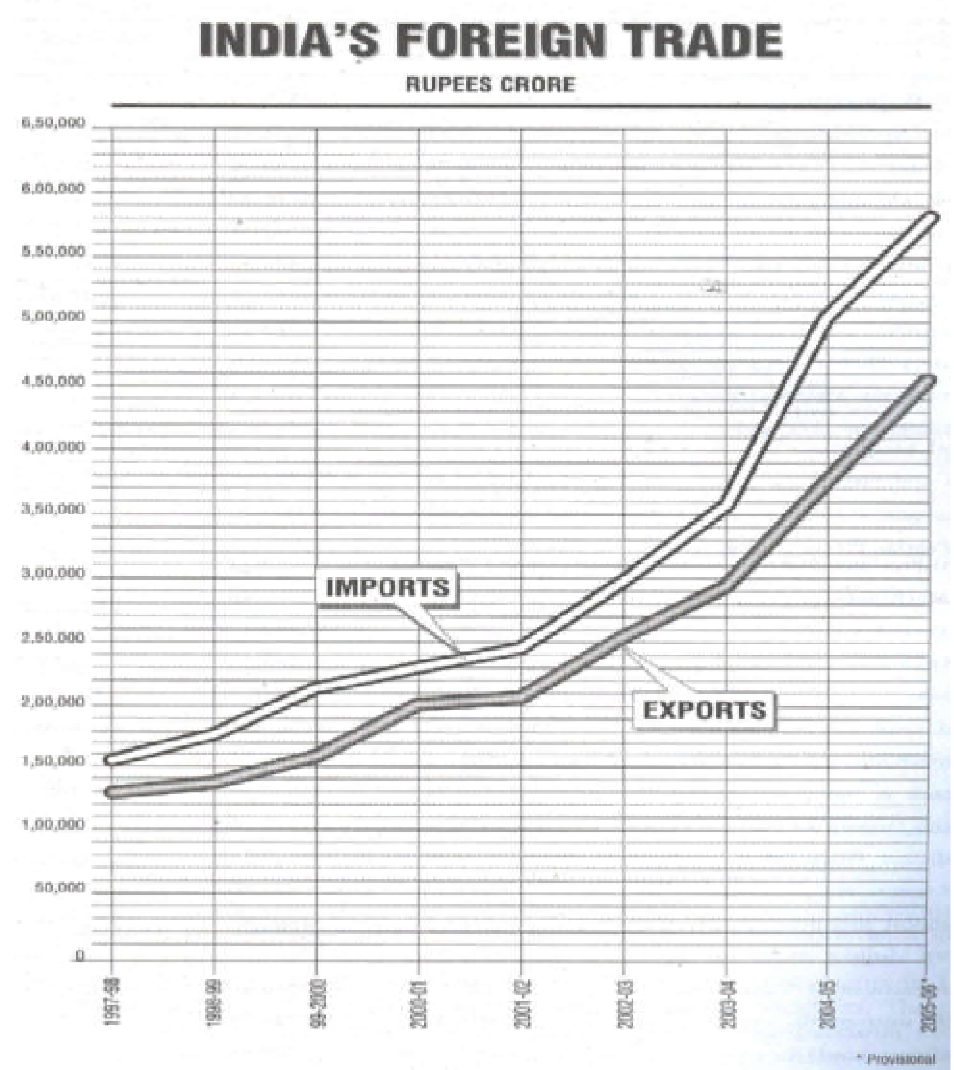


Fig. 25.7 Recent Trends in Foreign Trade in India

- During the past two decades, India's imports have shown a considerable change.
- India's foreign trade has risen rapidly from Rs. 1214 crores in 1950-51 to Rs. 837133 crores in 2004-05.
- There has been a great change in the foreign trade of India-especially in the commodities of export and imports.

Balance of Trade

Difference between value of exports and imports is termed as balance of trade. When the value of exports and imports of a country is equal it is a situation of balanced foreign trade. If exports exceed the imports, It is favourable; and on the other hand when imports are more than exports, it is unfavourable trade.

At the time of Independence, our foreign trade was favourable but after Independence, in the first two decades, the imports of India increased rapidly due to the imports of food grains. At present the imports of the country exceed the exports. Thus, our foreign trade has become unfavourable. In rupee terms, the trade deficit in 2004-05 was Rs. (-) 123995. It is worth noting that our exports and imports have increased in volume and value remarkably. But over the past 55 years our share in world trade has decreased considerably. It is not even one per cent of the world trade.

INTEXT QUESTIONS 25.6

Answer the following questions.

(1) Name the two components in which foreign trade is divided.

(i) ______________________ (ii)____________________________

(2) What is the important change in India's exports since independence?

(i) ______________________ (ii)____________________________

(3) Name two most important trade partners of India.

(i) ______________________ (ii)____________________________

(4) Name the commodity which has the largest share of our imports.

(i) ______________________ (ii)____________________________

(5) Name the policy India has adopted for promoting foreign trade.

(i) ______________________ (ii)____________________________

(6) What is balance of trade?

(i) ______________________ (ii)____________________________

WHAT YOU HAVE LEARNT

The term infrastructure denote the essential elements forming the bases of a system or structure. Transport, communication and trade are important infrastructural resources of economy. These services provide support for the development of entire economy, particularly agriculture and industries.

Railways, roads and pipe lines are the means of land transport. They play an important role in strengthening the national unity. They also promote social and economic prosperity in the country. Water transport is an inexpensive but slow means of transport. The development of inland water transport is limited only to the eastern part and eastern coastal plains. India is ideally situated on the busy Suez route joining Australia and south-east Asia and Europe. The air transport is the fastest through costliest means of transport. It is also suitable in the areas where construction and maintenance of surface transport is difficult, such as Northeastern region. All these means of transport have brought the world closer. Rail transport provides services particularly for long distance and carries bulk of traffic at one time. Northern plains, eastern coastal plains, and Gujarat plains have dense network of railways; while the Northeastern region, Western Rajasthan and the Himalayan region have sparse railway network. Road transport provides door to door services. It is flexible and is suitable for short distances. Punjab, Kerala and Tamil Nadu have the highest density of surfaced roads.

Communication involves sending or receiving messages at individual or mass level. It includes postal services, telegraph, telephone, teleprinters, radio, television and print media. Radio and television belong to electronic telecommunication media. Transport and communication are interrelated and they strengthen and supplement each other.

The trade relations of India have grown very rapidly after Independence. India has bilateral trade with many developed and developing countries. There has been a significant change in the commodities of export and import after independence. India has now adopted the policy of liberalisation of trade removing restrictions on imports. Despite phenomenal growth in foreign trade India's share in world trade is very low - not even one per cent.

TERMINAL QUESTIONS

Answer the following questions:

1. Define the term infrastructure.
2. Explain two merits of railway transport.
3. Explain two main reasons for the development of dense railway network in the Northern plains of India.
4. State two main advantages of road transport.
5. Why is air transport more favourable in the northeastern region of India?
6. Distinguish between:
   (i) National high way and state high ways.
   (ii) Surfaced and Unsurfaced roads.
   (iii) Exports and Imports.
7. Examine the role of postal services as a means of communication in India.
8. Explain briefly the recent changes in the trade of India with other countries, giving suitable examples.

ANSWER TO INTEXT QUESTIONS

25.1

1. Transportation, Electricity transmission and distribution, Communication (any two) 2.63.2 Crore Km. 3. (a) Suitable for passengers covering long distances (b) carry the heavy goods in bulk. 4 Northern plains and plains of Gujarat and Saurashtra 5. Hilly terrain/Forested cover/heavy rain 6. Hills and mountain ranges having rough terrain.

25.2

1. 13,94,061 Km. 2. Varanasi and Kanyakumari 3. Punjab and Kerala 4. Leh to Manali Raod 5. Rural sector 6. Sparsely populated, poor in natural resources/Hilly terrain/ Heavy rain with thick forest 7. 5846 Km.

25.3

1. Petrol and Natural gas (2)HBJ Pipe Line Hazira, Bijaipur, Jagdishpur (3) Mumbai (4) Ganga and Brahmaputra

25.4

(1) Air India (2) Indian Air Lines (3) Northeastern part of India (4) (i) Mumbai (ii) Delhi (iii) Kolkata (iv) Chennai and (v) Thiruvananthapuram (5) (i) Fastest mode (ii) Costler 6. Jet airways, Sahara Airlines, Kingfisher Airlines (any two)

25.5

1. (i) Postal Index Number (ii) Quick Mail Service
   (ii) Subscriber Trunk Dialling
   (iii) Public Call Office
   (iv) International Subscriber Dialling
2. (i) Radio, (ii) Television (iii) Cinema
3. Newspapers, periodicals and journals fall in the category of Print Media.

25.6

(1) Exports and Imports (2) Switch over from primary to secondary products (3) The USA and Russia (4) Petroleum & Petroleum products (5) Liberalisation of trade and reduction in import restrictions (6) A difference between the value of exports and Imports.

HINTS TO TERMINALS QUESTIONS

1. Refer to section 25.1
2. Refer to section 25.3
3. Reasons for dense railway network – the level land, Fertile soil, dense population and spread of Industries (any two). For more detail rafer to section 25.3
4. Refer to section 25.4
5. Refer to section 25.7
6. (i) Refer to section 25.4
   (ii) Refer to section 25.4
   (iii) Refer to section 25.9
7. Refer to section 25.8
8. Refer to section 25.9

26

POPULATION DENSITY, DISTRIBUTION AND GROWTH IN INDIA

So far we have had a look at the natural resources of India. They include land, soil, water, forest, mineral and wild life resources. We have also noted the distribution of these above mentioned resources as well as direction and pace of their exploitation and utilization for development. All these aspects are to be studied in relation to people living in the country. By people we mean not only their numbers as consumers but also as developers or managers of natural resources. For this purpose, we look at their educational and health status, their vocational, technical, and social skills and above all their aspirations, value system including work habits or "work ethics". In this context you would realise that people are not mere consumers but also constitute the most important resources of a country. In this lesson, we will examine the size of India's population in the world context. We will study distrubution and density of population and various factors influencing them. Finally, we will also analyse trends in population growth, their determinants and consequences.

OBJECTIVES

After studying this lesson, you will be able to:

- explain the size of Indian population in the world perspective;
- analyse factors responsible for uneven distribution of population;
- locate areas of dense, moderate and sparse population on a map;
- interpret the data about distribution, density and growth of population;
- explain the trends in population growth during the last hundred years (i.e. 1901-2001);

- identify factors responsible for rapid growth of population;
- define various demographic terms such as birth rate, death rate etc:
- appreciate the need for lowering the growth rate of population, and
- analyse causes and consequences of in and out migration in the country.

Notes

26.1 POPULATION OF INDIA

India is the second most populous country in the world next only to China. On March 1, 2001 the total population of India was at 1027 million. This accounted for 16.7% of the world's total population. In other words, about every sixth person in the world there is an Indian. China, the most populous country of the world, is a step ahead of us as every fifth person in the world there is a Chinese. While India possesses only 2.42% of the world's total land area, she is required to sustain almost 17% of the world's population.

In terms of area, India stands seventh preceded by Russia, Canada, China, the United States of America, Brazil and Australia. Barring China, the total population of these large five countries is far less than that of India. The total area of these five countries is over sixteen times whereas their total population is much less than that of India. This may partly explain how handicapped we are because of our huge population. It can also be revealed from the fact that the total population of North America, South America and Australia added together is less than the population of India. On the top of it, we are adding over 17 million people each year. It is more than the total population of Australia. In fact the net addition to Chinese population each year is less than ours.

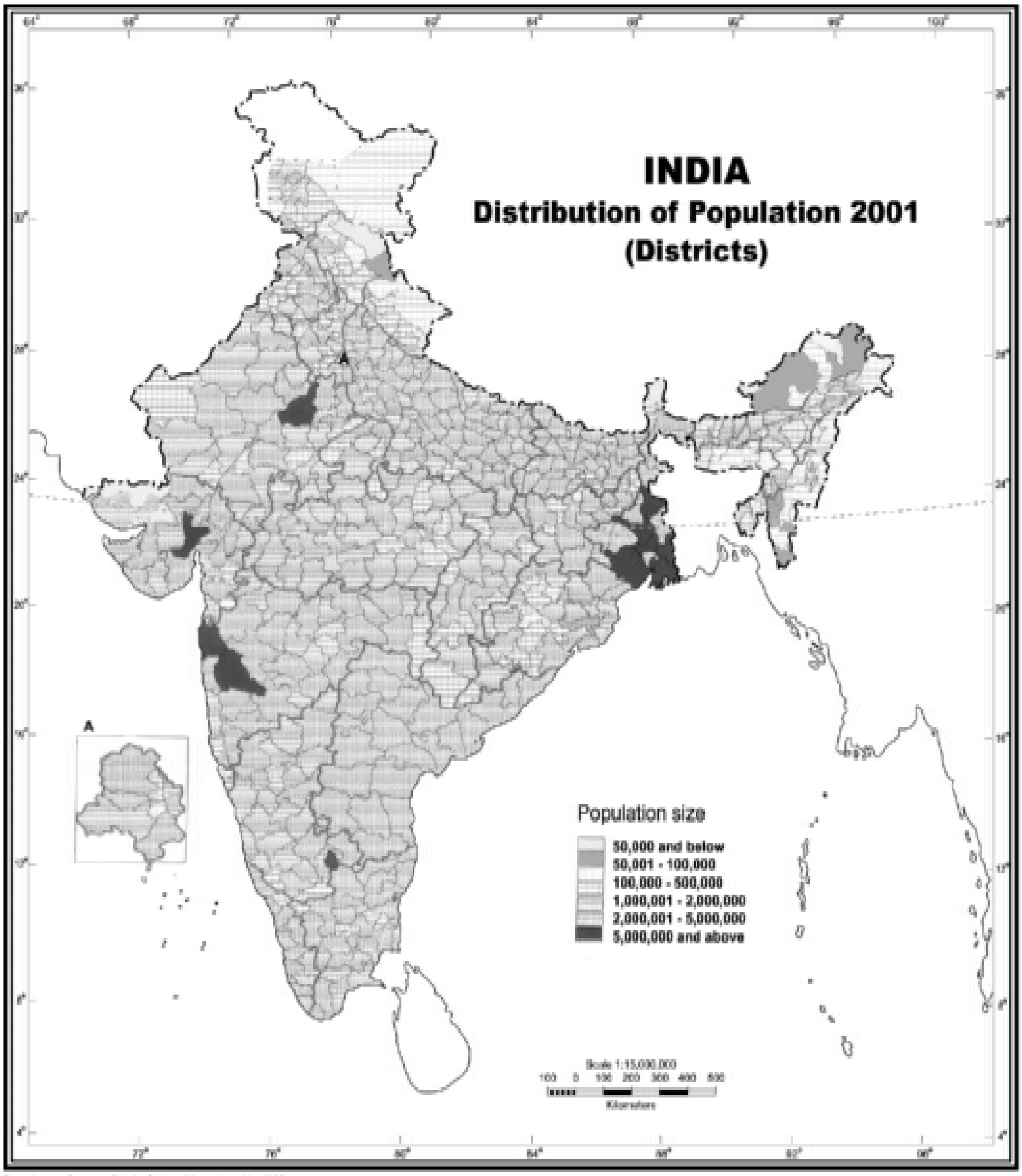
26.2 DENSITY AND DISTRIBUTION OF POPULATION

Population of the world or of any country is not uniformly distributed. The same is true about India also. Some parts of the country are densely populated, some parts moderately populated and some parts are sparsely populated. (see figure 26.1)

The size of population of different areas can be compared in many ways. One of the ways can be to compare the absolute size of the population. But it does not provide any idea about the relationship of population with the area or resource base of the country. This type of comparison is therefore not adequate. For example, population of Singapore is 4.2 million and that of Peoples Republic of China is 1,300 million. Indeed one is too small and the other is too big. Now take into consideration that the area of Singapore is just 630 sq. km; whereas China has an area of 9.5 million sq.km. This helps us to know how crowded Singapore is as compared to China. Therefore, the population of various countries are generally compared in terms of density of population. This is a method of comparing the man-land ratio of different regions. For this purpose, the population of a region is assumed to be distributed evenly in all its parts and the number of people per square kilometre is thus calculated. This is called arithmatic density of population.

Notes

Which can be calculated by dividing the total population of a country or a region by the total area. Therefore the density of population is expressed as the number of persons per square kilometre. According to 2001 census, the density of population in India is 324 persons per square kilometre. Over the last 100 years density has increased more than four times. It has increased from 77 in 1901 to 324 in 2001. When we say that the density of population of India is 324 persons per square kilometre, this does not mean that population is exactly 324 persons in each and every square kilometre.



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 26.1 : INDIA : Distribution of Population 2001

In reality, the distribution of population in India is highly uneven. The uneven density of population in India is clear from the fact that in Arunachal Pradesh the average number of population is only 13 persons per square kilometre, whereas it is 9,294 persons per square kilometre in Delhi as per 2001 census.

- Comparison of populations of different countries or region becomes more meaningful if it is done by comparing the average density of population of each area.
- This is an expression of man-land ratio.
- The density of population can be expressed as

$$\text{Density} = \frac{\text{Total number of people of a country}}{\text{Total area of the country.}}$$

26.3 FACTORS INFLUENCING DISTRIBUTION AND DENSITY OF POPULATION

As we discussed earlier, the spatial spread of population in India is not uniform. There are very wide regional variations. Let us see what factors are responsible for these variations. All such factors affecting the population distribution and density may broadly be grouped into two major categories. They are (A) physical factors and (B) socio-economic factors.

(A) Physical Factors

Physical factors play a vital role in the density and distribution of population. Physical factors include landform, climate, soil, etc. Though there is a lot of improvement in technology but the patterns of population distribution all over the world continues to reflect the influence of varied physical factors.

(i) Landforms : it influence the distribution pattern of population. The most important attributes of landforms which determine population density and distribution are the altitude and slope. The most striking evidence of the influence of altitude and slope on population density and distribution have been observed between mountains and plains. For example, take the case of most densely populated Indo-Ganga plains on the one hand and a highly mountainous state of Arunachal Pradesh on the other.

Other than this, factors like drainage, and water table have also been affecting population distribution.

(ii) Climate : is one of the essential elements of the physical factors which influence the spatial distribution of population through temperature conditions and the amount of precipitation. Take the case of hot and dry deserts of Rajasthan and the cold and wet Eastern Himalayan region where very low temperature and heavy precipitations prevail. This is the reason for uneven distribution and low density of population here. Almost even distribution and high density of population are found in plains of Kerala and West Bengal where rainfall is high. It is low in the regions of Rajasthan, and lee-ward sides of Western Ghats.

(iii) Soil: is another factor which affects the density and distribution of population. One may be tempted to question the validity of the role of soil in the present day highly industrialised society. But even today about 75 percent of population in India lives in villages. People in villages earn their livelihood from agriculture which depends upon the quality of soil. That is why alluvial region of northern plains and coastal and deltaic regions of India continue to support high densities of population. On the other hand, it may be worth mentioning that vast tracts of land in desert areas like Rajasthan, Rann of Kuchchh in Gujarat,Terai region in Uttarakhand have been suffering from problems like soil erosion and soil effloresce which support only low density of population.

In any region, the density and distribution is influenced by more than one factor. Take for example North-Eastern region of India. Here several factors are responsible for low density of population. These factors are high rainfall, rough terrain, dense forests and poor quality of soil.

(B) Socio-Economic Factors

Like physical factors, socio-economic factors also play an equally important role in density and distribution of population. However, there may not be a perfect agreement upon the relative importance of these two determinants. In certain places physical factors play a vital role whereas in some places socio-economic factors have a greater impact. It has generally been agreed that the role of socio-economic (non-physical) determinants increases. Various socio-economic factors which have impact upon the population are (i) socio-cultural and political factors; (ii) exploitation of natural resources.

(i) Socio-Cultural and Political Factors : Mumbai-Pune industrial complex is a good example to show how social, cultural, historical and political factors collectively have contributed to its rapid growth of population and its density. Less than 200 years ago, there were small insignificant islands of the Thana Creek on the western coast. The adventurous Portuguese seamen claimed these islands for their monarch. They in turn gifted these islands to the Royal Family of England by way of dowry. These couple of sleepy fishing village located on these islands could never guess that they would shortly turn into India's largest population conglomeration. East India Company of England set up a trading centre on these islands and later made it the capital city of Bombay Presidency. Enterprising trading and business communities of Parsis, Kuchchhis and Gujaratis played a leading role in setting textile mills, development of water power and laying roads and railways across the Western Ghats connecting it with its hinterland. Unexpectedly, the Suez international navigation canal made Mumbai the nearest Indian port to Europe. Availability of educated youth from Mumbai and Pune and inexpensive and disciplined labour from Konkan also contributed to the rapid population growth. The discovery of Bombay High oil and natural gas fields gave boost to its petro-chemical industry. Today, Mumbai is known as commercial capital of India backed by international and domestic airports, major sea ports and national road and rail terminals. Simillar is the case with other cities like Kolkata and Chennai which were established by the colonial rulers.

(ii) **Availability of Natural Resources :** The Chhotanagpur Plateau region has all along been a rocky and rugged terrains. This rainy and forested region has been a home of several tribes and was one of the sparsely populated parts of the country. However, a string of industrial towns and centres have sprung up over the past century soon after rich minerals such as iron-ore, manganese, limestone, coal etc. were found in unusual abundance and close to one another. The rich coal and iron fields have attracted heavy industries particularly iron and steel, heavy engineering, metallurgy and transport equipment industries. The region has also important super-power thermal stations from where power is supplied to far off areas. After liberalisation, many multi-nationals as well as national companies have been establishing their industries in large numbers.

26.4 POPULATION DENSITY AT STATE LEVEL

Population data can be plotted and described or interpreted in a couple of ways depending upon its purpose. For finding out a broad distribution pattern, population is collected and plotted on the basis of large units like states or their major parts. If information is needed for more accurately, the smaller units like districts or even tehsils are used. Let us first find out a broad pattern of population distribution and density in India.

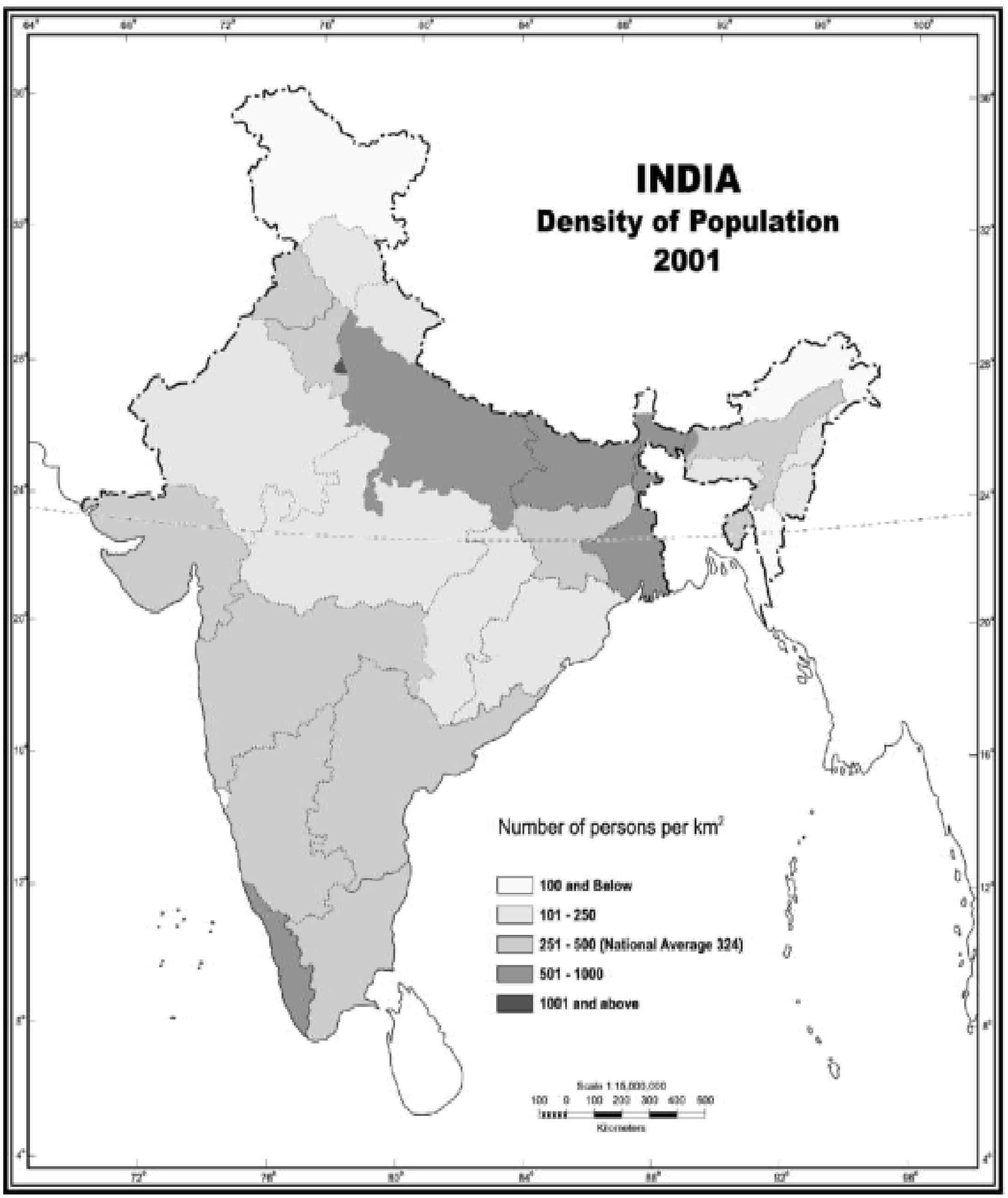
On the basis of availability of state level data, the density of population in India can be broadly divided into three zones : the areas of high density, the areas of moderate density and the areas of low density.

(i) Areas of High Density

In the map given above (Fig. 26.1) the areas having a density of population of more than 400 persons per square kilometre are included in this category. These areas have a high density due to fertile land and high amount of precipitation e.g. Kerala, West Bengal and Tamil Nadu. In these regions, a larger number of people can be provided sustainance per unit of area due to availability of fertile land which can produce more food for a large number of people. But the situation is entirely different in the case of Union Territories like Delhi, Chandigarh and Pondicherry. These regions are highly urbanised and offer job opportunities in industrial and service sectors. Thus we can say that the areas having fertile soil and those having good employment opportunities are densely populated. Find out which are the other states which have high density of population.

(ii) Areas of Moderate Density

States and Union Territories in which the density of population ranges between 100 and 400 persons per square kilometre are called areas of moderate density of population. They are Andhra Pradesh, Assam, Dadra & Nagar Haveli, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Orisa, Rajasthan, Tripura, Jharkhand, Chhattisgarh, Jammu and Kashmir, Uttarakhand, Himachal Pradesh, Nagaland, Manipur and Meghalaya. This region includes largest part of the country in terms of area. Broadly speaking moderate density of population is characterised by the areas in which the agriculture is handicapped by rugged topography, lower amount of precipitation and paucity of water for irrigation. The scope for developing primary and secondary activities is quite large if the facilities are provided in this area. For example, at the time of independence Chhotanagpur region was a sparsely populated area but development in the field of mining and industries in this part of the country has been mainly responsible for moderate density of population in this region.



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Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 26.2 INDIA : Density of population

(iii) Areas of Low Density

All the remaining parts of India having a density of population less than 100 persons per square kilometre may be classified under this category. The States and Union Territories falling under this category include Arunachal Pradesh, Mizoram, Sikkim and Andaman and Nicobar Islands. Low density population areas are characterised by rough terrain, low rainfall or unhealthy climate. Due to the above reasons the prospects of earning livelihood is low in these areas. Agriculture cannot be developed in too dry or cold areas. Uneven topography and poor agricultural resources put a limit on urbanisation and industrialisation. Therefore, the number of persons that can be supported per unit area is low in such regions. Difficulties exist not only in transport and communication in the hilly and mountainous areas but also in the over all levels of economic development. That is why the density of population in all these areas is low.

- The areas of high density include the states of West Bengal, Kerala, Bihar, Punjab, Tamil Nadu, Uttar Pradesh and Haryana and Union Territories of Delhi, Chandigarh, Lakshadweep, Pondicherry and Daman and Diu.
- All these areas provide good scope for earnig a livelihood through either agriculture or through jobs in various types of secondary and tertiary activities.
- The areas of low density of population in India include Arunachal Pradesh, Mizorm, Sikkim and Andaman & Nicobar Islands.
- These areas suffer from either low rainfall or rough terrain or harsh climatic conditions or a combinations of these factors.

26.5 POPULATION DENSITY AT DISTRICT LEVEL

But a minute observation shows that in each state there are variations in distribution of population and more than one category of population density is found. The geographical or spatial distribution becomes more clear by making an analysis of district level pattern. The great unevenness in distribution is mainly because of the diverse physical conditions as well as the variations in distribution of natural resources and stages of economic development. It varies from 2 persons per square kilometre in Lahul and Spiti district of Himachal Pradesh to 29,395 persons per square kilometre in National Capital Territory of Delhi. The top twenty districts in the country are either fully urban or highly urbanized. It includes all the nine districts of Delhi; Kolkata, Hawrah, North Twenty-Four Pargana in West Bengal; Mumbai and Mumbai (suburban) in Maharashtra; Mahe and Pondicherry in Union Territory of Pondicherry, Chennai; Bangalore; Hyderabad and Union Territory of Chandigarh. The density is generally high over two marked continuous stretches of land. They are (a) large parts of Northern plains from Punjab to West Bengal and (b) Coastal plains from Orissa coast in the east to Konkan coast in the west. A belt of moderately high densities extend over the entire Maharashtra, plains of Gujarat, Telangana, parts of Tamil Nadu, southern Karnataka and the Chhotanagpur region of Jharkhand. The areas of low density are generally found over the hilly forested and snow bound areas of the country, mainly situated in the Himalayan region, desert areas of Rajasthan specifically Jaisalmer districts and large expanse of uninhabited marshy lands of Kachchh districts of Gujarat.

INTEXT QUESTIONS 26.1

1. Name three states having a high density of population

   (i) ______ (ii) ______ and (iii) ______

2. Name any three Union Territories in India which fall under the areas of high density of population

   (i) ______ (ii) ______ and (iii) ______

3. Name any three sates falling under the category of areas of low density of population

   (i) ______ (ii) ______ and (iii) ______

4. Name any one Union Territory having a low density of population

   ______

5. Fill in the blanks with most appropriate words given in the brackets.

   (a) Areas receiving ample precipitation and having fertile soils are likely to have a ______ density of population. (high, moderate, low)

   (b) Areas suffering from droughts and having a rough terrain are likely to have a ______ density of population. (high, moderate, low)

26.6 GROWTH OF POPULATION

The growth of population in a region depends upon fertility, mortality and migration. Fertility or the birth rate is measured in terms of total number of live births per thousand population per year. Generally, the fertility rate is affected by various social, economic and demographic factors. Mortality or the death rate is measured in terms of total number of deaths per thousand population per year. The difference between these two rates (i.e. fertility and mortality) is called the natural growth rate. The term migration refers to the movement of people from one area to the other or from one country to another. The rate of migration affects the growth of population of a region by increasing or decreasing the number of people living there.

The growth rate of population may be positive or negative. A positive growth rate of population mean an increase in the number of people living in a region, whereas negative growth rate means declining population. A positive growth rate occurs when the number of births and in migration exceeds the number of deaths and out migration; the negative growth rate means just opposite to positive growth rate.

Table 26.1 INDIA : POPULATION GROWTH (1901-2001)

Census Year	Population in Million	Absolute change in Millions	Change in%	Average annual growth in%
1901	238.40	–	–	–
1911	252.09	+ 13.70	5.75	0.56
1921	251.32	-0.77	-0.31	-0.03
1931	278.98	+27.66	11.00	1.04
1941	318.66	+39.68	14.22	1.33
1951	361.09	+42.43	13.31	1.25
1961	439.23	+78.15	21.64	1.96
1971	548.16	+108.92	24.80	2.22
1981	683.33	+135.17	24.66	2.22
1991	843.39	+163.06	23.86	2.14
2001	1027.02	+180.63	21.34	1.93

District level Pattern

The district level analysis reflects that there are as many as 19 districts where the growth rate is very high i.e. more than fifty percent. On the other hand there are 58 districts where growth rate is very low i.e. less than ten percent. Out of the 19 very high growth rate districts five belong to Nagaland and four to Delhi. Similarly, out of 58 very low growth rate districts, as many as forty districts are in the southern part of India. Out of these forty districts as many as twenty are in Tamil Nadu, eleven in Kerala, five in Andhra Pradesh and four in Karnataka.

If we look at the district level pattern, it has been marked that higher growth rates are visible in almost the entire Indo-Gangetic plains extending from Haryana in the west to West Bengal in the east. High growth rates are also observed in the regions north of Satpura Ranges, spreading across the Malwa plateau, entire Rajasthan including the great Indian desert, Western Maharashtra and parts of North-Eastern states. On the other hand relatively low growth rate is observed in Godavari basin, Chhatisgarh plains, Chhotanagpur plateau and western part of West Bengal and Orissa. Very low growth rates are observed in Punjab, Uttarakhand, and in the southern regions of the Deccan plateau.

Look at the table 26.1, you will find that the total population of our country (as per political frontiers today), was 238 million. By 2001, it had risen to a phenomenal figure of 1027 million. About 788 million persons were added in the last century.

The rise is of about 4.3 times since 1901. If we look at this 100 years population growth then, it can be broadly grouped under the following four categories.

1. Period of stagnant growth rate (before 1921)
2. Period of steady growth rate (1921-1951)
3. Period of rapid growth rate (1951-1981)
4. Period of declining growth rate (after 1981)

Let us discuss each phase briefly.

1. Before 1921 the increase in population was sporadic, irregular and slow. This was mainly due to high birth and death rate. Therefore, the natural growth was insignificant. In 1911-21 the absolute increase declines marginally due to famines, epidemics etc. After 1921 the population has been increasing. Therefore, 1921 is known as demographic divide in the population study of India.

2. Since 1921 to 1951 there was a steady increase in population. This is because of steady delcline in death rates. The decline was mainly due to improvement in sanitation and medical facilities. Other factors which helped were development in road facilities which helped in meeting the exigencies of food shortage and substantial improvement in agricultural economy. Therefore, the population growth during this period was known as mortality induced growth.

3. This is a very crucial phase as far as population growth of India is concerned. The population was almost doubled during these three decades. During this period there was a rapid decline in death rate whereas the decline in birth rate was marginal. Look at the table, you will find birth rate was reduced from 41.7 to 37.2 whereas death rate was reduced from 22.8 to 15.0 during this period. Therefore the difference between birth rate and death rate was very high and as a result natural growth rate remains very high. This was due to acceleration in developmental activities further improvement in medical facilities, improvement in living conditions of the people etc. This period of growth is termed as fertility induced growth.

4. In the last two decades i.e. 1981-91 and 1991-2001, the rate of growth started declining gradually. It signals the beginning of a new era in the demographic history of India. During this period birth declined significantly, from 37.2 in 1971-81 to 24.8 in 1991-2001. Whereas the decline in death rate continued in a slower rate. The death rate has declined from 15.0 to 8.9 during this period. This declining trend is a positive one and may be attributed to effective government role in promoting family welfare programmes and peoples awareness.

Table 26.2 Annual Birth Rates, Death Rates and Natural Growth Rates 1901-2001

Decade	Birth rate per thousand	Death rate per thousand	Natural Growth per thousand	Natural growth (in percentage)
1901-11	49.2	42.6	6.6	0.60
1911-21	48.1	47.2	0.9	0.09
1921-31	46.4	36.3	10.1	1.01
1931-41	45.2	31.2	14.0	1.40
1941-51	39.9	27.4	12.5	1.25
1951-61	41.7	22.8	18.9	1.89
1961-71	41.2	19.0	22.2	2.22
1971-81	37.2	15.0	22.2	2.22
1981-91	32.7	11.7	21.0	2.10
1991-2001	24.8	8.9	15.9	1.60

- Growth rate of population is a function of fertility, mortality and migration. The difference between the fertility and mortality rates is called natural increase of population.
- The population of India has been increasing steadily since 1921. The major factor responsible for it has been a very rapid decline in the death rate.

26.7 STATE LEVEL PATTERN OF POPULATION GROWTH

The actual growth rate of population is not uniform in all parts of the country. The rate is higher in some parts than in others. The average decadel growth in the country was 21.39% during 1991-2001. If we look at inter-state differences, then it has been observed that Kerala has the lowest growth rate i.e. 9.42%, whereas the state of Nagaland has the highest growth rate of 64.41%. The broad state level pattern which emerges reflect that there is a clear cut north-south divide. All the northern and north eastern states have recorded high growth rates whereas all the southern states have low growth rates. This is mainly due to differences in the level of socio-economic development which include high literacy rates, better primary health care facilities, more urban population, more development economy etc.

INTEXT QUESTIONS 26.2

1. Tick (√) Mark the most appropriate answers

   (a) The major reason for the high growth rate of population in India is

   (i) rapidly rising birth rate

(ii) rapidly falling death rate
(iii) high in-migration from outside
(iv) very high birth rate and death rate

(b) the growth rate of population in India has been constantly rising right since
(i) 1901
(ii) 1921
(iii) 1951
(iv) 1981

2. Name the State where the growth rate of population is the highest.

____

3. Name the states where the growth rate of population is the lowest.

____

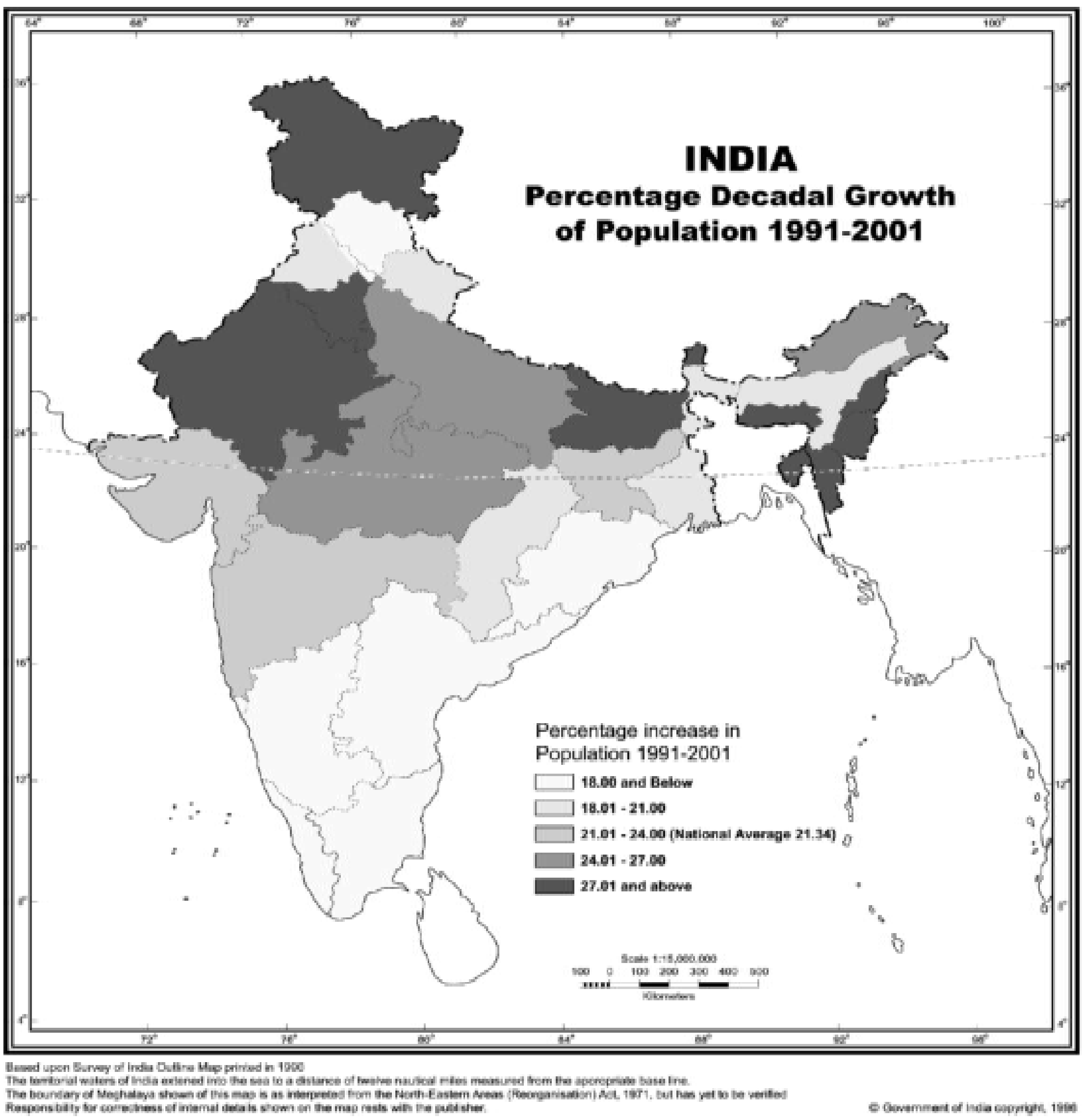


Fig. 26.3 INDIA : Growth of Population 1991-2001

26.8 MIGRATION

We have discussed earlier that the growth of population depends upon the birth rate, death rate and migration. Movement of people from one area to the another area is called migration. Migration can be of a number of types. According to the nature of movement, this can be divided into (i) permanent and (ii) temporary. Permanent migration involves movement of people from one place to the other and these people do not go back to their original place. A common example of this type of migration is provided by the movement of the people from rural to urban areas for permanent settlement. In case of temporary migration, the people move from one place to the other for some duration and then return to their original place of living. An example of this movement is seasonal migration. Migration of agricultural labourers from Bihar to Punjab and Haryana during the harvesting season is a temporary migration. Migration can be on daily basis also. You might have observed that a large number of people commute to the cities every day in the morning from the surrounding areas to work and they all go back in the evening. This is called daily or diurnal migration.

It is seen in mountainous regions that many people move from valleys to the higher reaches of mountains along with their cattle during summer and come back to the valleys during the winter. These people have their permanent homes in the valleys and they move to the higher areas to graze their cattle there. When the higher reaches of the mountains become too cold, they come back to the lower valleys. Their annual movement is always along some fixed routes and generally their grazing areas are also fixed. This type of altitudinal migration is called trans-humance. Gaddi tribes of Himachal Pradesh and Bakrawals in Jammu & Kashmir practises this type of migration.

On the basis of source of origin and destination of migrant population, migration can be divided into four types.

(a) Rural to Rural

(b) Rural to Urban

(c) Urban to Urban

(d) Urban to Rural

- Movement of people from one area to the other is called migration.
- Migration can be called permanet, temporary and daily.
- Seasonal movement of people along with their cattle between two areas along fixed routes is called trans-humance.

26.9 MIGRATION TRENDS IN INDIA

Out of 1.02 billion people in the country, 307 million (30%) were reported as migrants by place of birth. Migrants by place of birth are those who are enumerated at a village/town at the time of census other than their place of birth. This proportion i.e. 30% as reported in 2001 census (excluding Jammu and Kashmir) is slightly more than what was reported in 1991 i.e. 27.4%. Infact, there has been steady increase in number of migrants over successive censuses. If we compare between 1961 and 2001 then it has been observed that it has increased between 1961 and 2001 from 144 millions to 307 millions. During the last ten years (1991-2001), the number of migrants (excluding J&K) rose by 32.9%. Further break of the migrants in terms of sex and on the basis of source and destination are given below.

Table 26.3 India : Total Migrants and their Break-up 2001

Types of Migrants	No. of Population (in millions)
Total Migrants	307.1
Males	90.4
Females	216.7
• Intra-district	181.7
• Inter-district	76.8
• Inter-state	42.3
• From Abroad	6.1

If we look at their movement patterns, it has been observed that Maharashtra received largest number of migrants (7.9 million) followed by Delhi (5.6 million) and West Bengal (5.5 million). On the other hand Uttar Pradesh followed by Bihar and Rajasthan are the three top contributors of out migrants. But if we look at the net migration i.e. the differences between in-migrants and out-migrants Maharashtra stands at the top of the list with 2.3 million net migration followed by Delhi (1.7 million), Gujarat (0.68 million) and Haryana (0.67 million).

Let us know their profile in details. We have discussed below the age profile of the migrants and duration of stay of the migrants. In census, the first one is termed as migrants by place of birth by age and migrants by place of last residence.

(i) **Migrants by age:** We will see age profile of inter-state migrants and intra-state migrants. Out of the total migrants numbering about 258 millions who migrated within the state, 17.4% are in the age group of 15-24 years, 23.2% in 25-34 years and 35.6% in 35-59 years. In the case of inter-state migrants, out of which 42 millions (18.5%) is in the age group of 15-24 years, 24.7% is in the age group of 25-34 years and 36.1% is in 35-59 years. In both the groups i.e. inter-state and intra-state migration we find high proportion of migrants are in the older and economically active age group. The details of inter and intra-state migration will be discussed in the successive paragraphs.

(ii) **Migrants by Place of Last Residence :** This data is collected to understand the population of migration. It is likely that after one moves out of place of birth, one may continue to migrate from one place to another. Study of migration by place of birth is like studying one time event. Data on migration by last residence reveals recent migrations over the years and therefore more informative. The data on migration by last residence in India as per 2001 census shows that the total number of migrants were 314 millions.

If we look at their duration of stay it has been observed that a substantial proportion among the total migrants i.e. 101 million out of 314 million had migrated at least 20 years back. About 98.3 million had migrated over the last decade (i.e. duration 0-9 years). We will analyse in details about the migration that took place in the last decade in two broad categories. (a) Intra-state and (b) Inter state migration within these two broad categories analysis will be made in terms of migration by streams and by sex.

(a) Intra-State Migration

The majority of the migrants belong to this category. According to 2001 Census, 80.73 millions of people are intra-state migrants. Among these migrants, overwhelming population i.e. 60.5 percent were rural to rural migrants whereas only 12.3 percent belonged to the category of urban to urban migrants. The remaining 17.6 percent migrants belonged to the category of rural to urban and 6.5% belonged to the urban to rural areas. The rest 3.1 percent is unclassified which means that the respondents have not mentioned any stream.

Among intra-state migrants about 70 percent were females. This high percentage was mainly due to marriages. About 69% of the female migrants were from rural to rural migration. 9.7 percent of female migrants moved from one urban centre to another, 13.6 percent moved from rural to urban areas and only 5.6 percent from urban to rural areas. The rest 2.6 percent is unclassified.

In the case of male migrants, 41.6 percent belonged to the category of rural to rural migrants, 18.3 percent belonged to urban to urban, 27.1 percent belonged to rural to urban and 8.6 percent were urban to rural. The major chunk of population who moved from rural to rural areas are mainly moved out in search of employment.

(b) Inter-State Migration

In India inter-state migration is limited in comparison to intra-state migration. According to 2001 Census, 17 million people were inter-state migrants. Out of these 17 millions people, 26.6 percent belonged to the category of rural to rural migrants, 26.7 belonged to the category of urban to urban, 37.9 belonged to rural to urban and 6.3 percent belonged to urban to rural. The rest 2.6% is unclassified.

About half of all inter-state migrants were males. Among them 26.6% percent moved within the rural areas, 26.7 percent moved within the urban areas. 37.9 percent of migrants moved from rural to urban areas and 6.3 percent from urban to rural areas.

26.10 CAUSES OF MIGRATION

Migration is a result of an inter-play of a large number of factors. Generally factors affecting migration can be grouped in to two categories of Push and Pull factors. The push factors are responsible for making people move from their original place of living. The pull factors are responsible for attracting people to some particular areas. Unless both these factors are operating simultaneously, no migration of people can be possible. The push and pull factors include the economic, social and political components. A brief description of these factors is given below.

- Migration is the result of inter-play of a number of factors. These factors can be grouped as push and pull factors.
- The push and pull factors can be economic, social and political in nature.

(a) Economic Factor

The people generally like to live in those areas where they can make their livelihood. Thus they would like to move away from areas of poor soils, less developed means of transport, low levels of industrialization and less job opportunities. These are the push factors. On the other hand, the areas offering good employment, better living standard attract large number of people. These are the pull factors. Thus all areas of fertile soil, deposits of minerals, better means of transportation and communication and higher levels of development of industries and urban areas provide more means of making a living. You might have observed that a large number of people move to the cities like Delhi, Mumbai, Kolkata and Chennai from neighbouring and different parts of the country like Bihar, Orissa, Uttar Pradesh where opportunities are less. The most important factor for which they move is the expected improvement in their economic conditions. Many are attracted by an apparent glare of city life with all its modern comforts and attractions.

- The important economic pull factors causing migration are fertile soils, availability of minerals, good means of transport and communication, high levels of industrialization and urbanization and more job opportunities.
- The important economic push factors are poor soils, lack of developed means of transport and communication, low levels of industrialization and urbanization and lack of job opportunities.

(b) Socio-Political Factor

Man is a social being and he likes to live with his kith and kin. Generally the people having a common religion or language or social customs like to live together. On the other hand a person would like to migrate to some other place if he is living among the people belonging to some other culture or customs. Many people migrate to places of religious importance. Migration of people to places like Badrinath, Tirupati and Varanasi though generally temporary is due to religious factors. The impact of the social factors is more clearly seen in the concentration of people belonging to a particular community in one locality of urban area or in a particular city. Religious or social suppression of the minority communities can be an important push factor if the majority community is not tolerant to the other community.

(c) Demographic factor

Age is the important demographic factor. Young population is more mobile than the children and old age population. This is because young people mostly move either for work/better opportunities or further study.

Political factors related to the government policy are responsible for migration. This factor is becoming increasingly important in the modern times. Government can influence the incidence rates and directions of the migrations to a great extent. In some cases the minority communities are discriminated against and they are thus forced out of the countries. Partition of India into India and Pakistan at the time of independence resulted in large scale migration of people between the two countries.

- People like to live with those following the same religion or customs.
- Suppression of the minorities at the hands of majority community can be an important push factor leading to migration.

26.11 CONSEQUENCES OF MIGRAITON

Consequences of migration are as diverse as the causes. The consequences are felt in both the regions i.e. the areas of origin of the migrants and the areas of destination. The consequences of migration can be grouped as economic, social and demographic.

(a) Economic Consequences

Among the economic consequences, the effects on the resource-population ratio is most significant. This ratio undergoes change in both the areas involved. The resource-population ratio may be such in an area which might be called either under populated or over populated or adequately populated or optimum populated. The condition of under population means a condition of too low a population to allow development and utilization of its resources. On the other hand, over population is a condition, when the pressure of population on resources is very high and generally results in low standards of living. A country having enough number of people to enable development and utilization of its resources without lowering the quality of life is called adequately populated. If the people are moving from an area of over-population to an area of under population, the result is in the direction of balancing the resource-population ratio. On the other hand if the migration is from an area of under population to over populated or adequately populated, the consequences may be harmful to both the areas.

Migration affects the occupational structure of the population in both the regions. Generally the proportion of working population in source areas is lowered and the same proportion in the receiving areas is increased. Thus the population of the receiving areas tends to become more productive and in the source areas it results in increasing the dependency ratio by reducing the proportion of the working people in the population. One of the serious consequences of migration is 'brain drain'. This refers to the migration of the skilled persons from the poorer countries to the developed countries in search of better economic opportunities. An example can be of the migration of the doctors and engineers etc. from India to the USA, the UK and Canada. This type of migration does not alter the resource-population ratio significantly as the number of people involved in migration is not very large. However the quality of human resources in the source region suffers a lot. The resource of the source regions, which are generally poorer countries can not be developed fully because of the huge size of the population.

(b) Social Consequences

Migration involves interaction of different cultures. The receiving areas might receive through migration people belonging to different cultures and this might lead to cultural enrichment. India is a country which received migrants belonging to different cultural groups and the modern culture of India is a result of this inter-mixing of different cultures, Sometimes people, coming together having different cultures might result in cultural conflicts also.

Many migrants (mainly male member) those who stay alone in the city involve in extramarital and unsafe sexual practice. Some of them start taking drugs through infected syringes. Due to these unsafe practices, many of them got HIV infected. But this does not stop here. When these people go back to their home, they infect their spouses. HIV is also transmitted to their unborn child. Why does this happen?

- Due to lack of awareness
- Due to unsafe practices
- Curiosity about sex
- Experimentation with drugs and alchohol

- Migration may generally result in cultural enrichment in the receiving areas although at times it may also lead to cultural conflicts.
- The resource-population ratio in both source regions and receiving regions is altered through migration.
- Brain-drain is also a serious consequence of migrations.

(c) Demographic Consequences

Due to migrations, the characteristics of the populations in both the regions undergo changes not only the age and sex structure of the population but also the rate of growth of population is altered. Generally the proportion of the old, children and females is increased in the source areas due to migration. On the other hand the proportion of these persons in the population of the receiving areas is generally lowered. So this is one of the reason for high sex ratio in source areas and low sex ratio in the receiving areas. This happens because it is the youthful male population which is mostly involved in migration. Thus not only the number of people but also the structure of population in both regions involved in migration is changed. This results in changes in rates of fertility, mortality and consequently in the growth of population. The source regions are depleted of the youthful population and this results in lowered rates of births and comparatively lower rates of growth. An inverse impact is observed in the case of population structure of the receiving areas.

- The proportion of the children, women and old people become more in the source areas of the migration and these proportions are lowered in the receiving areas. This results in change of age and sex structure and the growth rates of population of both source and receiving regions.

INTEXT QUESTIONS 26.3

1. Fill in the blanks with suitable words choosing the appropriate words given in the bracket.

   (a) Movement of people from one place to the other is called ________________ (migration/transhumance)

   (b) Daily movement of people to cities from neighbouring areas is called ___________ migration. (diurnal/seasonal)

   (c) Seasonal movement of people with their cattle along some fixed routes is called ________________. (trans human/seasonal)

   (d) Due to migration the proportion of the youth in the total population of the source region is likely to ___________ (increase/decline)

   (e) The proportion of working population in the areas of immigration is likely to __________________ (increase/decrease)

   (f) Migration of the skilled people from the developing countries like India to the developed countries is known as __________________ (emigration/ brain drain)

   (g) Who among the migrants dominate __________________ (male/female)

WHAT YOU HAVE LEARNT

Human resource is the most important resource in an area. It is the quality rather than quantity of this resource which is important for the economic development of a country.

India is the second most populous country of the world after China. The distribution of population is generally studied in terms of density. The density of population in India is not uniform. On the basis of density of population, India can be divided into three broad regions of high density, the areas of moderate density, and the areas of low density. The factors which affect density and distribution can be grouped into two categories. They are physical factors and socio-economic factors.

The population of India has been increasing very rapidly since 1921 and the rate of growth has been increasing. The growth rate of population is determined by the birth rate, death rate and migration of an area. Like density and distribution, the growth rate is also not uniform throughout the country.

Migration is an important factor for the growth rate of population. Migration can be divided into various types. It can be divided as permanent and temporary. On the basis of source of origin and destination of migrant population, it can be divided into rural to rural, rural to urban, urban to urban and urban to rural. These four types can be grouped under two categories i.e. inter-state migration and intra-state migration.

People move from one place to other under the influence of economic, socio-political and demographic factors. The causes of migration can be studied in terms of push and pull factors. The consequences of migrations are numerous and they can be studied in terms of economic, social and demographic consequences. The migrants involve themselves in extra marital relation and drug abuse due to their loneless since they have left their family at their source.

TERMINAL QUESTIONS

1. Discuss in brief the distribution of population in India. Outline some of the areas of high, moderate and low density of population.
2. What are the major trends in population growth in India? Discuss the factors responsible for it with suitable examples.
3. What is meant by migration? Define various types of migration with suitable examples.
4. Explain the major causes and consequences of migration.

ANSWERS TO INTEXT QUESTIONS

26.1

1. West Bengal, Kerala, Bihar, U.P. Punjab, Tamil Nadu and Haryana (Any three)
2. Delhi, Chandigarh, Pondicherry, Lakshadweep and Daman & Diu (Any three)

3. Sikkim, Mizoram, Arunachal Pradesh
4. Andaman and Nicobar Islands
5. (a) High
   (b) Low

26.2

1. (a) (ii)
   (b) (ii)
2. Nagaland
3. Kerala

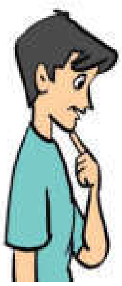
26.3

1. (a) Migration
   (b) Diurnal
   (c) Trans-humance
   (d) Decline
   (e) Increase
   (f) Brain-drain
   (g) Male

HINTS TO TERMINAL QUESTIONS

1. The distribution of population in the country is highly uneven. India can be divided into three major regions on the basis of the density of population the areas of high density, the areas of moderate density and the areas of low density. Give the main characteristics of these regions in terms of the density of population. Name the area of high, moderate and low density (For details refer to sections 26.2 and 26.4).
2. The growth rate of Indian population has been increasing since 1921. Highlight this fact and provide the causes of this in brief (For details refer section 26.6).
3. Migration is the movement of people from one place to the other. It can be temporary, seasonal and permanent on the basis of the duration of movement and the period of time for which people migrate. Migration can be called internal and international also on the basis of whether it occurs within the country or between two or more countries (For details refer to section 26.8).

4. Discuss briefly causes and consequences of migration (For details refer to section 26.10 and 26.11).



Point to Ponder

Protection from HIV infection

HIV is :	AIDS is :
Human	***Acquired***
Immunodeficiency	***Immunodeficiency***
Virus	***Syndrome***

There is a lot you can do to protect yourself from HIV infection:

- *Learn the facts about growing up and HIV/AIDS.*
- *Do not feel shy about taking about your doubts and fears. Get these clarified.*
- *Do not let peer pressure force you into unsafe activities.*
- *Avoid taking alcohol or other drugs when you engage in sexual activities; this might cloud your judgement and lead you to engage in unsafe sexual practices.*
- *Practise abstinence. Postpone sex as long as possible. Many other activities such as hugging, cuddling, kissing, and fantasizing feel good and are safe.*
- *If you are not ready for abstinence, at least make sure that you practise safe sex. Have sexual intercourse with only one faithful, uninfected partner.*
- *Use a condom every time you have sex unless you are 100 percent sure that you partner is not infected with HIV or any other Sexually Transmitted Infection (STIs).*
- *If you use needles, syringes, or other instruments that pierce the skin, make sure that these are sterile.*
- *Make sure that blood is tested before transfusion. Use blood that is certified 'HIV free'.*

27

POPULATION COMPOSITION IN INDIA

In the previous lesson we studied distribution, density and growth of population of India. We also looked into the causes and consequences of distribution and density of population. We pondered over the causes and consequences of rapid growth of population for the past hundred years. We also took note of causes and consequences of migration of various types. In this lesson we will study composition of Indian population along certain dimensions. Firstly, we would like to note the location and size of settlements in which people prefer to live and why they do so. This constitutes the rural and urban composition of population. Next we will find out if males and females are equal in number and more importantly in status. Age structure composition of Indian population and its implication would be yet another focal point of our inquiry. Then we would move away from purely demographic to socio-cultural dimensions of our population composition. This will help us to know the linguistic and religious composition of our society. Finally, we have a glance at scheduled caste and scheduled tribes with regard to their numbers, location and distribution. Last but not the least important focal point of our study would be the literacy rates of our society and its major social components. All these analytical aspects would help us to look at our population not only as mere numbers but as a human resources as well.

OBJECTIVES

After studying this lesson, you will be able to:

- analyse the rural-urban, male-female (Sex ratio) and age composition of Indian population;
- establish the relationship between literacy rate and population growth rate;
- show the areas of tribal population on the outline map of India ;
- analyse the reasons for concentration of scheduled tribes and scheduled castes population in specific areas;

- explain the reasons for the high concentration of scheduled castes population in the area of very low concentration of scheduled tribes and vice versa.
- describe the important features of religious and linguistic composition of population.

27.1 RURAL-URBAN COMPOSITION

Population is divided into two parts-rural and urban on the basis of the size and occupation of settlements. The rural population consists of small sized settlements scattered over the countryside. Urban population is one that lives in large size settlements i.e. towns and cities. However, more importantly this division is based on occupational structure. In India, rural area is defined as one where three-fourths or more of its population is engaged in primary occupations such as farming, animal rearing, forestry, fishing, quarrying etc. On the other hand, urban area is one where three-fourths or above of its population is engaged in non-agricultural activities such as manufacturing, trade, transport, communication, banking and social services like health, education, administration etc.

Table 27.1 Rural and Urban Population in India (1901-2001)

Census year	Percentage of total Population	
	Rural	Urban
1901	89.2	10.8
1911	89.7	10.3
1921	88.8	11.2
1931	88.0	12.0
1941	86.1	13.9
1951	82.7	17.3
1961	82.0	18.0
1971	80.1	19.9
1981	76.7	23.3
1991	74.3	25.7
2001	72.2	27.8

Source : Census of India

The total population of India spreads over more than 5.8 lakhs of villages and 4,615 towns. India, proverbially, is considered to be a country of villages. Even today, about 72% of the total population of India lives in villages. But the proportion of rural population has been decreasing in each successive census (See Table No 27.1). Consequently the proportion of urban population to total population has been increasing slowly but steadily. It was as low as 10.8% in 1901 and rose to

27.8 by 2001. The question arises why is it so? It is because the rate of growth of urban population is higher than that of rural population. In contrast to an average growth rate of about 21.34% in 2001 the urban population has registered a growth rate of 31.13 percent. However all this growth is not a result of only the natural increase of population. Infact, much of the growth of urban population is due to high rate of migration of people from rural to urban areas. We have discussed in details about the various causes of rural to urban migration in the previous lesson. This also indicates a slow change in the occupations of people from primary to secondary and tertiary activities. Very often limits of municipal or city Corporation areas are extended to cover neighbouring villages or suburbs.

Fig. 27.1 India : Distribution of Metropolitan cities 2001

Half of the total urban population of India lives only in five states. These five states are Maharashtra, Uttar Pradesh, Tamil Nadu, West Bengal and Andhra Pradesh. Gujarat, Karnataka, Madhya Pradesh, Bihar, Rajasthan and Union Territory of Delhi, have about 32 per cent of urban population of the country. Rest of the urban population (about 18%) is spread over the remaining states and Union Territories.

According to 2001 census, 35 cities have more than 1000000 population each. They are called the metro-politan or million plus cities. These 35 metropolitan cities alone account for 37.8% of the total population. If this trend continues, India will have more than 50 metropolitan cities in India at the time of 2011and will have half of the urban population of the country. This highly rapid growth of metropolitan cities will brings several problems like supply of housing, electricity, water, school, dispensaries, ration shops etc.

Let us now find out the distribution of these metropolitan cities in India. All the 35 metropolitan cities are arranged in terms of descending orders of population. These are GreaterMumbai, Kolkata, Delhi, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Jaipur, Lucknow, Nagpur, Patna, Indore, Vadodara, Bhopal, Coimbatore, Ludhiana, Kochi, Vishakhapatnam, Agra, Varanasi, Madurai, Meerut, Nasik, Jabalpur, Jamshedpur, Asansol, Dhanbad, Faridabad, Allahabad, Amritsar, Vijaywada and Rajkot.

- About 27.2% of the total population of India lives in urban areas.
- The proportion of urban population to the total has been increasing steadily at a faster pace.
- The rate of growth of urban population in the country is higher than the rate of growth of rural population.
- The cities which have a population of more than 1,000,000 each are called metropolitan cities. There are 35 metropolitan cities as per 2001 census.

INTEXT QUESTION 27.1

1. Fill in the blanks with suitable words from those given in the bracket (secondary and tertiary, increasing, 35, lower, primary)

   (a) The growth rate of rural population is ————than the growth rate of urban population in India.

   (b) The rural population is mainly engaged in ———— activities whereas the urban population is primarily engaged in ———— activities.

   (c) Proportion of urban population has been ——— since 1921.

   (d) Altogether there are——— "million cities" in India according to Census of India, 2001

Notes

27.2 SEX-RATIO

Sex Ratio refers to the number of females per thousand males of an area. According to the Census of India 2001, there are only 933 females per thousand males. So sex composition in India is unfavourable. It means there are less number of females than the number of males. When the number of females is more than the males it is said to be favourable. As far as states are concerned only Kerala has favourable sex ratio (1058). It has the highest sex ratio in the country. The lowest sex ratio among states is found in Haryana (861). Among the Union Territories, Pondicherry has the highest sex ratio in the country with (1001) females per thousand males, whereas the lowest sex ratio is found in Daman and Diu where there was 709 females per thousand males. The significant trend with regard to the sex ratio in the country is that it has been a steadily declining except some marginal increases in the 1951, 1981 and now in 2001 censuses (see Table 27.2)

Table 27.2 Sex Ratio in India (Female per 1000 Males 1901 - 2001

Year	Sex Ratio
1901	972
1911	964
1921	955
1931	950
1941	945
1951	946
1961	941
1971	930
1981	934
1991	927
2001	933

Source : Census of India

District Level Pattern

An overview of the district level data reveal that, out of 593 districts in the country, 324 districts record sex ratio above the national average i.e. 933 and 4 districts have the sex ratio equal to the national average. In other words, there are 55% of the total districts recorded sex ratio above the national average. Out of these 324 districts, there are as many as 78 districts spread over sixteen States/Union Territories have recorded sex ratio above unity. Unity means Females are more than thousand per thousand males. The largest number of such districts are from Tamil Nadu (15) followed by Kerala (13) and Uttarakhand (8) while Chhatisgarh and Orissa have 7 districts each. Mahe in pondichery recorded highest sex ratio

(1148) in the country followed by Almora in Uttarakhand (1147) and Ratnagiri in Maharashtra (1135). If we look at their spatial distribution, it has been observed that there are three regions where sex ratio is favourable. First region is southern India consisting of majority districts of Tamil Nadu, Pondicherry, almost all the districts of Kerala and a few coastal districts of Karnataka. The second region is hills and plateau region of adjoining Orissa, Chhatisgarh, Andhra Pradesh and Madhya Pradesh dominated by tribals. The Third region is the Hill states of Uttarakhand and Himachal Pradesh.

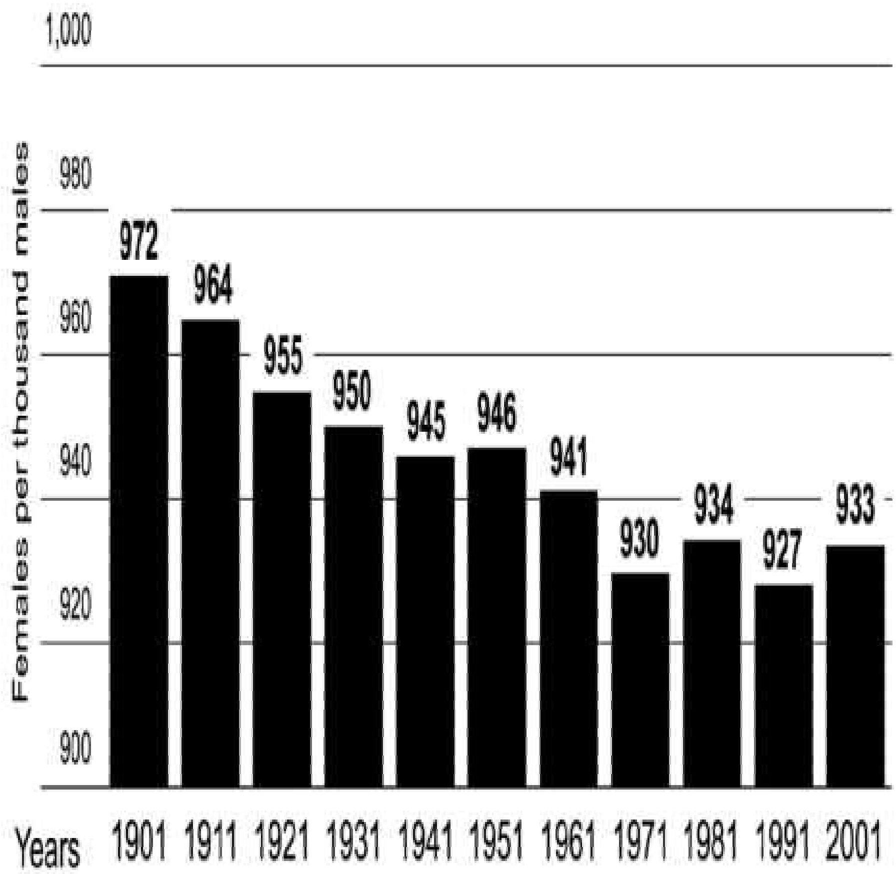


Fig. 27.2 India : Sex Ratio 1901-2001

On the contrary, there are 265 districts where sex ratio is below national average. Out of these 265 districts, there are 42 districts where sex ratio is below 850. **Where are these districts located?** Uttar Pradesh and National Capital Territory of Delhi has 8 districts each followed by Haryana (6). But within these 42 districts 10 districts are located in major cities 8 in NCT Delhi, 1 in Maharashtra i.e. Mumbai and the other one is Union Territory of Chandigarh. The very low sex ratio in these cities may be due to the inflow of male migrant seeking work in the industrial, commercial, construction, informal and unorganised sectors of the economy. But the lowest sex ratio in terms of district is recorded in Daman district (591) followed by West Kameng (749) in Arunachal Pradesh and North districts (752) in Sikkim.

Why is there a decline in the sex ratio in India? The major reasons for the declining sex ratio in India are the higher rate of maternal mortality and a high child mortality among the female children. These two causes are related to the comparatively lower status of the women in our society. Apart from this our socio-religious values and beliefs like male preference in our society are responsible for the declining sex ratio. The female mortality rate is likely to be reversed with the improving status of the women and also due to better medicare facilities and education particularly of the females. The improved medicare facilities have helped in checking the rate of child mortality and the deaths of mothers during child birth.

- The Sex ratio in India is unfavourable. On an verage there are 933 females per thousand males in the country. The highest sex ratio of 1058 females per one thousand males is in Kerala and the lowest of 709 females per one thousand males is in Daman and Diu.
- The major reasons for the declining of sex ratio in India are high child mortality among the female children and low status of women in our society.

Project Work

Select 20 households in your neighbourhood. Visit each household and note down total number of males and females in each household. After visiting all the 20 households, add all the male and female members. (1) If the ratio is 1:1 then the sex ratio is balanced. (2) If female ratio is more than one then sex ratio is favourable and vice-versa. (3) Try to find out the reasons for favourable or unfavourable sex ratio by interviewing the families concerned.

INTEXT QUESTIONS 27.2

Answers the following questions in brief:

(a) Name the state having the highest sex ratio in India.

____

(b) Name the state having lowest sex ratio in India.

____

(c) What is the sex ratio of India according to Census of India, 2001?

____

(d) Define sex ratio.

____

27.3 AGE COMPOSITION

Age-sex pyramid refers to the composition of population in terms of the age and sex of people. It gives an indication regarding the growth rate of population and the nature of population in terms of working and non-working sections. As per the census of India 2001, children up to 14 years of age account for 35.3% of the total population. The age group of 15-59 years accounts for 56.9% of total population and the age group of 60 years and above for 7.4% of population. The age structure has been under going some gradual changes during the recent decades.

One of the trends is that proportion of the younger population i.e. in the age group of 0-14 years is declining and the percentage of persons on the working age group, i.e. 15 to 59 age group as well as old age population i.e. 60 years and above is increasing. But in 2001 Census, the percentage of persons in the age group of 15-59 declined from 57.7% in 1991 to 56.9% in 2001 Census. However, the proportion of people in old age group has increased from 6.6% in 1991 to 7.4% in 2001 census. The proportion of young population i.e. 0-14 years declined from 36.5% in 1991 to 35.3% in 2001 census.

Table 27.3: Percentagewise Distribution of Total Population by Age and Sex in India 2001

Age group	Total Person	Male	Female
0-4	10.7	10.7	10.7
5-9	12.5	12.5	12.4
10-14	12.1	12.3	11.9
15-19	9.7	10.1	9.3
20-24	8.7	8.7	8.8
5-29	8.1	7.8	8.4
30-34	7.2	7.0	7.4
35-39	6.9	6.8	7.0
40-44	5.4	5.6	5.2
45-49	4.6	4.7	4.5
50-54	3.6	3.7	3.4
55-59	2.7	2.6	2.8
60-64	2.7	2.6	2.8
65-69	1.9	1.8	2.1

70-74	1.4	1.4	1.4
75-79	0.6	0.6	0.7
80 and above	0.8	0.7	0.8

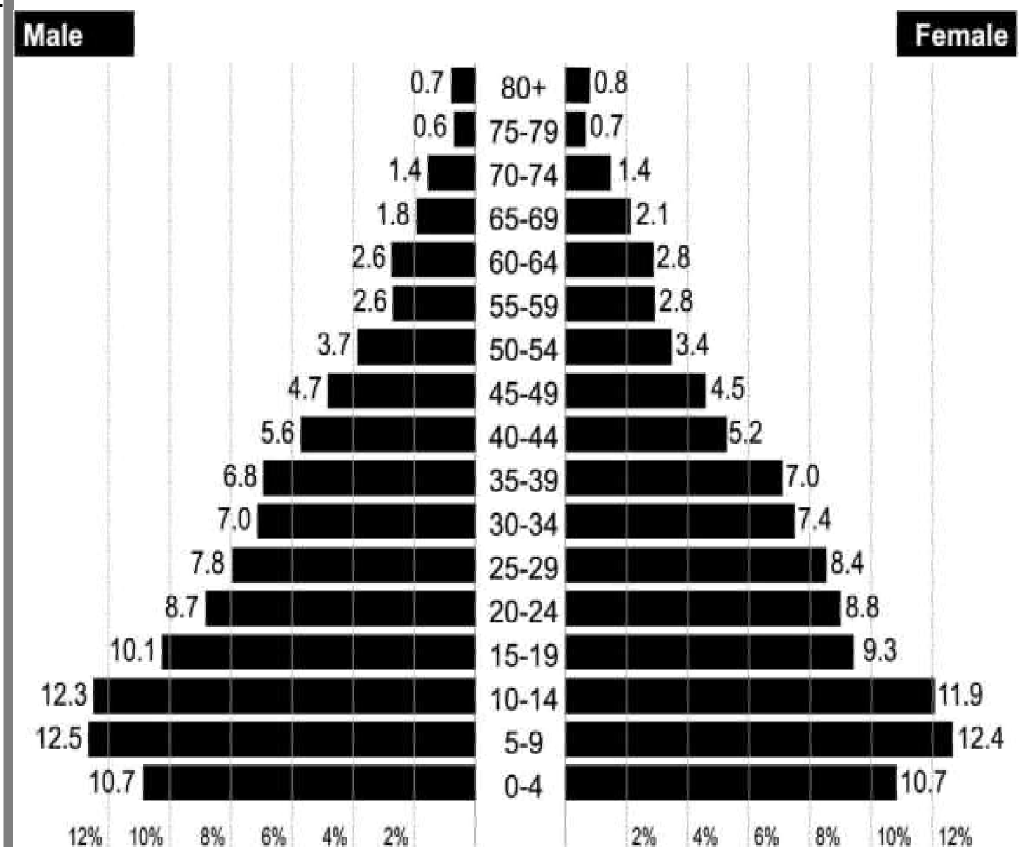


Fig. 27.3 INDIA : Age and Sex Structure 2001

27.4 LINGUISTIC COMPOSITION

India has also great deal of linguistic diversity like physical environment. The languages spoken and their dialects number is in hundreds. In 1961 census, 1652 languages were listed as mother tongues in India. Out of these only 23 languages together accounted for 97% of total population of the country. Out of these 23 numerically major languages, Constitution of India recognizes only 18 languages besides English in the Eighth Schedule of the Constitution. These languages are Assamese, Bengali, Hindi, Telugu, Tamil, Malayalam, Kannada, Marathi, Gujarati, Oriya, Punjabi, Kashmiri, Sanskrit, Konkani, Sindhi, Nepali, Manipuri, Urdu. Out of these above mentioned 18 languages, Hindi is spoken by most of the people whereas Sanskrit is spoken by the least. The languages also vary slightly in terms of the meaning of different words and their pronunciation. Thus the people speaking one particular languages speak it with some difference in vocabulary and pronunciation from one place to the other. Such variations in the way of speaking of a language lead to emergence of dialects of language. Thus, a dialect is something akin to a part of some language and they can be thought as regional language also. Some of the examples of the dialects of Hindi Rajasthani, Harayanavi, Bhojpuri or Poorvi dialects etc.

Language is an important constituent of culture and various languages and their dialects are spoken in different parts of India. It makes Indian culture rich and diversified. Also, the languages have an almost complete regional identity in the country and the distribution of major languages has been considered as a basis for re-organization of states after independence. On the basis of numerical strength, India can be divided into twelve principal linguistic regions. So linguistic region is an area in which most of the people speak a common language. The languages forming linguistic regions in India are; Kashmiri, Punjabi, Hindi/Urdu, Bengali, Assamese, Oriya, Gujarati, Marathi, Tamil, Telugu, Kannada and Malayalam.

CLASSIFICATION AND DISTRIBUTION OF INDIAN LANGUAGES

Though all the languages spoken in India seem to be different from each other, they can be grouped into four Linguistic families on the basis of their roots and genesis. The four linguistic families are : Austric Family (Nishada), Dravidian Family (Dravida); Sino-Tibetan Family (Kirata) and Indo-European Family (Arya).

The speeches of the Austric family are spoken by tribal people in Maghalaya, Andaman & Nicobar Islands and in parts of Central Indian tribal belt, especially in the districts of Santhal Praganas, Ranchi and Mayurbhanj. The languages and dialects of Sino-Tibetan family are spoken by tribal people in North-Eastern region of the country and in the Sub-Himalayan region in the north and north west. These languages are spoken by people living in Ladakh (Jammu & Kashmir), parts of Himachal Pradesh and Sikkim also.

The speakers of the languages of Dravidian family are more numerous in southern part of India. Tamil Nadu, Andhra Pradesh, Karnataka and Kerala are the states where these languages are spoken by the majority of population. A large number of tribals living in peninsular plateau region also speak speeches of this family.

The speaker of the languages of Indo-Aryan family are concentrated more in northern part of the country and also in central parts. The entire north Indian plain is inhabited by the speakers of this family. Maharashtra and Madhya Pradesh also have large population of speakers of these languages.

The proporation of the speakers of languages of different families in the total population varies significantly. While the Aryans (Indo-European Family) languages are spoken by more than 70% of the people, the Sino-Tibetan languages are spoken by only about 0.85 percent of the population and Dravidian languages are spoken by about 20 percent of the people.

- Languages spoken in India belong to four major linguistic families. These families are *Austric family, Dravidian Family, Sino-Tibetan Family, and Indo-Europen Family.*
- Languages belonging to different families have their major concentrations in different parts of the country. Austric Family in the North-Eastern part, Dravidian Family in the southern parts, Sino-Tibetan in the Sub-Himalayan region and Indo-Europen Family in the Northern and Central part of the country.
- The language of Indo-Aryan Family are spoken by the largest number of people in India. The languages of Sino-Tibetan Family have the smallest number of speakers. More than 70 percent of the people in India speak languages and dialects of Indo-Aryan Family.

INTEXT QUESTIONS 27.3

Fill in the blanks with the most appropriate words out of those given in the brackets

1. (a) One of the languages belonging to the Austric Family of languages is —————— (Santhali, Hindi, Bengali)

   (b) Hindi is a languages belonging to the ——— family of languages (Dravidian, Aryan, Austric)

   (c) Speakers of Austric languages are concentrated primarily in ——— —(tribal areas of central India, western Himalayas, Konkan region)

27.5 RELIGIOUS COMPOSITION

Indian society is divided into a large number of religious communities. But, broadly there are seven major religions. The majority of people follow one of these seven major religions. These are Hinduism, Islam, Christianity, Jainism, Budhism, Sikhism and Zoroastrians. Hindus are the largest religious community in India. According to 2001 census, 80.5% percentage of population follow this religion. Followers of this religion are more concentrated in the northern plains and the northern parts of the plateau region. However they are sufficiently numerous in all parts of the country except a few north-eastern states and union territory of Lakshadweep. But the distribution of the other religious communities is less continuous and there are only some pockets in which they have larger concentration.

The largest number of muslim population is in Uttar Pradesh followed by West Bengal and Bihar. But the muslim population make a large proportion of the total population in Jammu and Kashmir and Union Territory of Lakshadweep. Apart from these above mentioned states and Union Territory, other states where muslims have significant presence (more than national average) are Assam and Kerala. If we look at spatial distribution, then it is observed that most of these states stretch over northern great plains except Kerala and Jammu and Kashmir.

The largest concentration of Christians is found in the state of Kerala followed by Tamil Nadu and Andhra Pradesh. But if we look at the proportion to total population, then it is found in some of the north eastern states namely Mizoram, Meghalaya and Nagaland. As far as Sikhs are concerned more than ¾th Sikh population are found in Punjab alone. Besides Punjab, neighbouring districts of Haryana and Rajasthan also have concentration of Sikh population. Apart from these states, Terrai region of Uttarakhand and National Capital Territory of Delhi have significant number of sikh population.

As far as Buddhists and Jains are concerned, Maharashtra has the largest number of population belong to both the religion. Apart from Maharashtra, traditional pockets of Buddhists are Ladakh area of Jammu and Kashmir, Dharamsala (Mcleodganj) and surrounding districts of Himachal Pradesh, Sikkim, Arunachal Pradesh and Tripura. Similarly, besides Maharashtra, Jains have significant presence in the states of Rajasthan, Gujarat, Madhya Pradesh and Chhatisgarh. Zoroastrains are as such very few in numbers and most of them are found in and around Mumbai in Maharashtra.

Table 27.4 Population by Religion in 2001

Religious Groups	*% to total population*
Hindus	80.5
Muslims	13.6
Christians	2.33
Sikhs	0.86
Buddhists	0.76
Jains	0.40
Others	0.53

- There are seven major religions and to which most of the Indians subscribe. Hindus are the largest group followed by Muslims, Sikhs and Christians. Concentration of differeent religions occur in various parts of the country

INTEXT QUESTIONS 27.4

1. In which part of India do most of the Zoroastrians live?

2. In which states do most of the Indian Christians live?

3. Name one state having a large concentration of Muslim population of India.

____

4. In which states of India do most of the Indian Budhists live?

____

27.6 SCHEDULED CASTES AND SCHEDULED TRIBES COMPOSITION AND DISTRIBUTION

Th Constitution of India recognises a number of castes and tribal groups. These castes and tribes are called Scheduled Castes (SC) and Scheduled Tribes (ST) respectively. They are the major constituents of the population of India. According to the census of India 2001 Scheduled Castes and Scheduled Tribes constitute 16% and 8.2% respectively. Their distribution is very uneven throughout the counry.

(A) Scheduled Castes

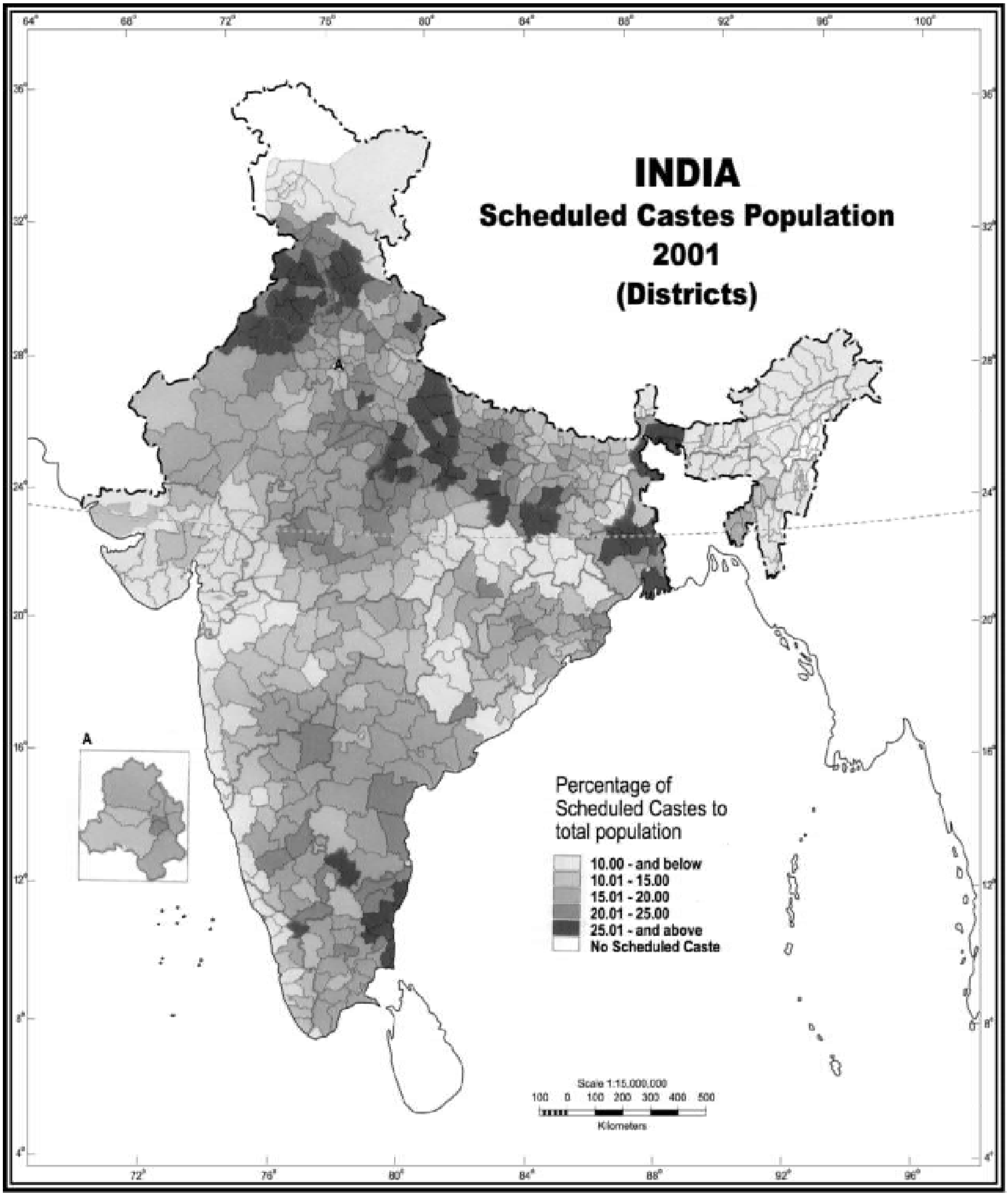
Numerically they have the largest concentration in Uttar Pradesh followed by West Bengal and Bihar. Mizoram has the least SC population i.e. 272 person (in terms of percentage it is almost negligible). The state of Nagaland and Union Territories of Lakshadweep and Andaman & Nicobar Islands do not have any notified SC Population. In terms of the proportion of the total population of a state they are most numerous in Punjab where they account for more than 28.85% percent of its total population followed by Himachal Pradesh (24.7%) and West Bengal (23.3%). The Scheduled Castes are by and large landless agricultural labourers, cultivators with small land holdings and small commodity producers or artisans. Due to the association with agricultural activities, their main concentrations are found in the alluvial and coastal plains of the country. That is why, the major concentrations are found in the states like Punjab, Uttar Pradesh, West Bengal, and Bihar. On the other hand the hilly and forested tracts and the tribal belt of the central and north east India have only a small population of the Scheduled Castes.

The analysis at districts level pattern leads to the identification of the following three zones.

(i) **Areas of High Concentration:** There are two major areas with high concentration of Scheduled Castes. They are Indo-Ganga plain and the eastern coastal plain. Both these plains are endowed with fertile soil, adequate water supply and climate suited to the cultivation of a large variety of crops. These opportunities help to develop intensive agriculture which supports a large population.

(ii) **Areas of Medium Concentration :** The Scheduled Castes are moderately concentrated in the districts adjoining the zone of high concentration which has already been discussed above.

(iii) **Areas of Low Concentration:** Low concentration of Scheduled Castes is found in the central Vindhyas, Chhotanagpur region, the western dry region



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extened into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 27.4 Distribution of Scheduled cast population 2001

Notes

of Rajasthan, the hilly tracts of the North-East and the coastal parts of Karnataka and Maharashtra.

(B) Scheduled Tribes

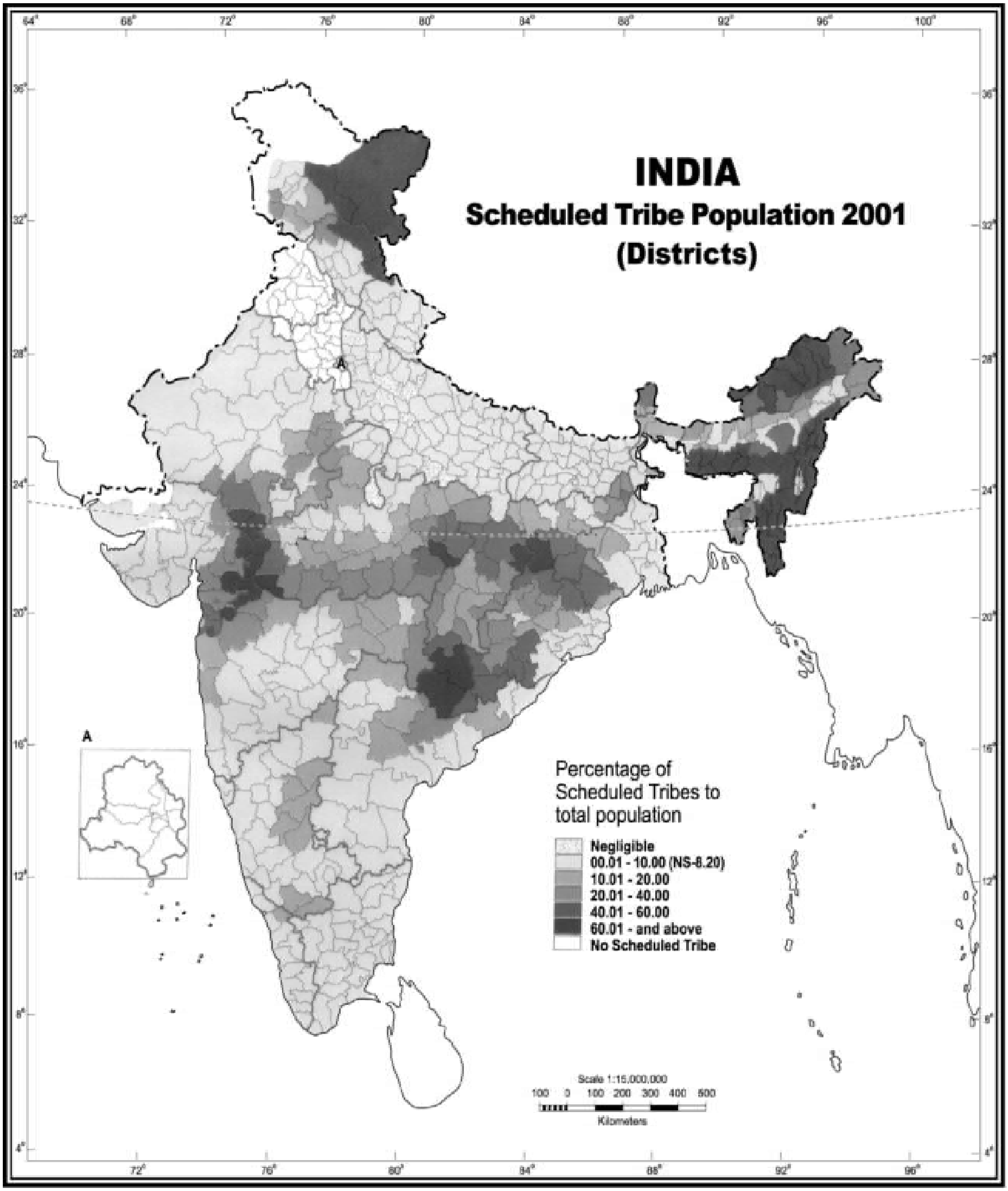
The tribal people have a number of distinct characteristics which set them apart from the rest of the people. Generally, they live in isolation in the forested and hilly regions and they profess very old religious beliefs. Most of these groups are il-literate and do not have script of their languages. Most of them belief in super natural powers and super natural beings.

The Scheduled Tribes are not uniformly distributed all over the country. There are three main regions in which most of their population lives. These regions are (i) the Central Indian belt comprising parts of Rajasthan, Gujarat, Madhya Pradesh, Chhatisgarh, Jharkhand, Orissa and West Bengal, (ii) the North-Eastern region comprising the hilly areas of Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Arunachal Pradesh and (iii) the southern region comprising the hilly tracts of Tamil Nadu, Andhra Pradesh and Andaman & Nicobar Island.

It is evident from the above discussion and also from the map that the tribal population of India is more concentrated in a few specific regions. It will also be clear after a close study of the map that most of the tribal people live in the forested and hilly regions and areas of lower agricultural productivity. Most of these areas suffer from natural difficulties like rough terrain and climatic difficulties and the level of economic development in all these regions is very low. The natural resources have not been developed much and there is little development of means of transport and communication and this factor is also responsible for the low levels of development.

Some times it is thought that the levels of economic development in areas of tribal population is low because these areas are inhibited by the tribal people. This, however, is not true. These areas suffer from lower levels of development party due to in hospitable life in these regions is difficult and therefore these areas are occupied by the tribal people.

In fact the tribal people originally did not settle in these areas of harsh environmental conditions by their own choice. They were rather pushed by the expanding modern civilization into these areas. Under the pressure of the successive invaders and the migrants, the earlier settlers of the country who could not fight with new powerful comers had to migrate into remote areas to save their cultural identify.



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The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 27.5 INDIA : Distribution of Scheduled Tribe population 2001

District Level Pattern

Like Scheduled Castes, district level analysis of Scheduled Tribes reveals that there are different levels of concentration. These levels can be grouped into three categories. They are (i) areas of high concentration; (ii) areas of medium concentration and (iii) areas of low concentration.

(i) **Areas of High Concentration:** There are 40 districts in the country where Scheduled Tribes hold a dominant position. In these 40 districts the share of Scheduled Tribes population to total population ranges from 75.01% to 98.09%. Among them, eight districts are in Mizoram, seven each in Nagaland and Meghalaya, six in Arunachal Pradesh and five in Manipur and the rest seven districts are spread over four states i.e. Jammu and Kashmir, Gujarat, Madhya Pradesh and Chhatisgarh. Serchhip district of Mizoram have highest concentration of tribal population in the country i.e. 98.09% followed by West Khasi hills of Meghalaya having 98.02% of tribal population.

(ii) **Areas of Moderate Concentration :** In these regions the share of tribal population varies between 25.01% to 75.00% of total population. This include 85 districts belonging to 17 states and Union Territories of the country. Spatially, the major occupancy is constituted by the districts from the states of Madhya Pradesh and Orissa (14 each), Chhatisgarh (10), Jharkhand (8) and Arunachal Pradesh and Gujarat (7 each).

(iii) **Areas of low concentration :** In this region the proportion of tribal population varies from 5.00-25.00 percent. This holds the highest number of 140 districts in the country. These districts are distributed among 18 States/ Union Territories. The spatial pattern of districts in this region may be seen in Madhya Pradesh (18), Maharashtra and Rajasthan (17 each), Karnataka (14), Assam (13), Andhra Pradesh, West Bengal and Orissa (10 each), Jharkhand (8), Jammu and Kashmir (6) and Chhatisgarh (5). Remainng are scattered in Gujarat and Sikkim (3 each) Uttarakhand (2), and Manipur, Kerala, Daman and Diu, and Bihar (One each).

Apart from this there are as many as 143 districts spread over 18 States and Union Territories where tribal population are found whose range varies between 0.5% to 5.00%.

27.7 LITERACY

Literacy is generally defined as a person's ability to read, write and able to understand as well as to do some simple calculation. Despite this liberal definition, the rate of literacy in India is not very high. According to the Census of India 2001, the average literacy rate in India is 65.38 percent. This percentage does not include the population below 7 years of age-group.

The rate of literacy varies a great deal from one part of the country to the other. On the one hand, it is the state of Kerala having literacy rate as high as the 90.92 percent and on the other extreme is the state of Bihar, where this rate is only 47.53 percent. In the Union Territories, Lakshadweep has the highest rate of literacy where it is 87.52 percent and the lowest rate is in Dadra & Nagar Haveli (60.03 percent).

The rate of literacy varies between males and females also. The average rate of literacy among the males in India is 75.85 percent which is higher than the females (54.16). Kerala has the distinction of highest literacy among both, males and females (94.20 and 87.86 percent respectively), whereas Bihar has the lowest literacy rate among both males and females (60.32 and 33.57 percent respectively). From the literacy point of view of rural-urban population there is a huge difference between rural and urban area. The literacy rate in urban areas is 73.01 percent where as in rural areas it is as low as 44.54 percent.

Though the rate of literacy in India is low, it is increasing in each successive census. In 1911 it was less than 6 percent and it could rise to only about 16.7 percent by1951. The most noteworthy progress in this regard has been made after 1951 census. In 1961, the literacy rate was about 24 percent which rose to 65.38 percent by 2001. The most significant development in this regard has been the rate of increase in female literacy. The proportion of literate among the females was only 1.1 percent in 1911 which has increased to 54.66 percent in 2001. To a great extent, this is a result of the policies of the government, emphasising upon the universalisation of Elementary Education. The extended facilities of schools in the rural areas have helped considerably in raising the literacy rate in the country, especially among the females.

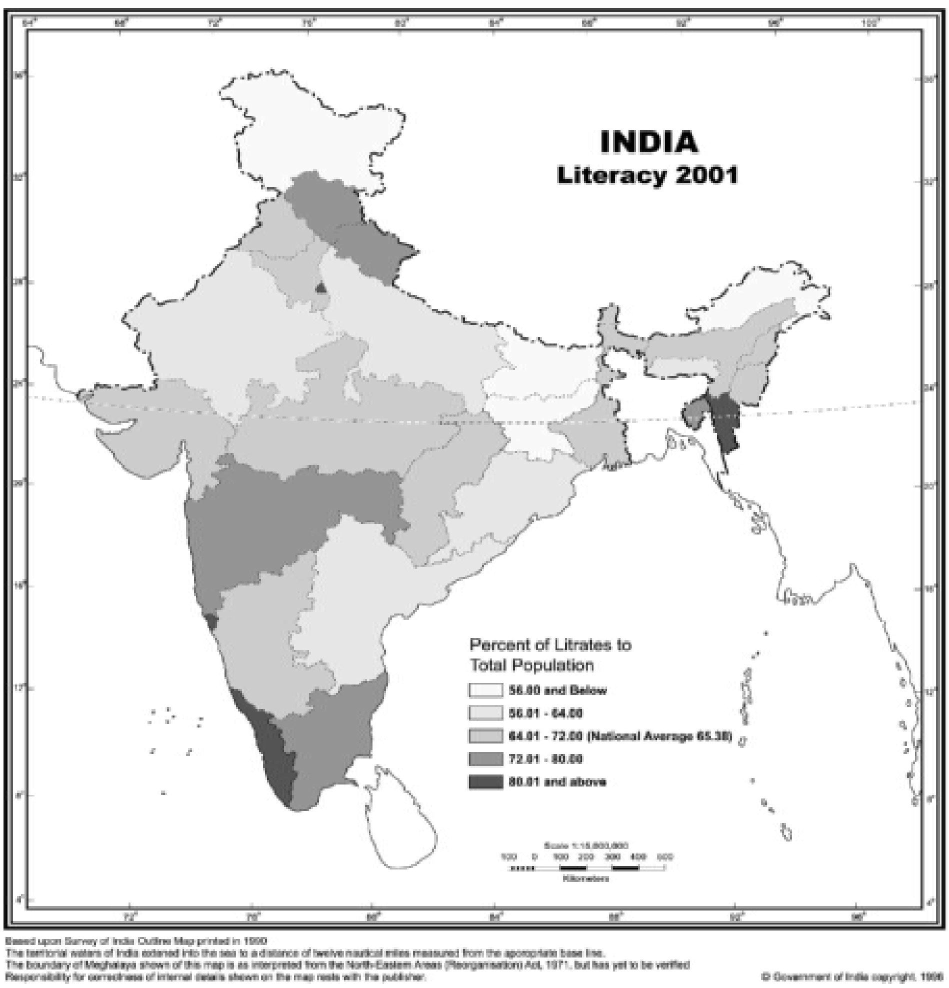


Fig. 27.6 India : State wise distribution of literacy 2001

Though the literacy rate is increasing percentage wise in successive censuses, the number of illiterate is also increasing in absolute number in each successive census. For the first time in 2001 census, there is a decline in number of illiterates in comparison to previous census i.e. 1991. However their number is still very high. To solve this problem, Government has taken up various programmes like National Literacy Mission, Sarv Shiksha Abhiyan, etc.

District level Pattern

District level pattern analysis of literacy reveals that the literacy rates vary between 96.64 percent in Aizwal districts of Mizoram to 30.01 percent in Dantewara districts of Chhatisgarh. Out of 591 districts in India, 59 districts have literacy rate of more than 80 percent. Majority of these districts are located in southern parts of India. It includes all the 14 districts of Kerala, 4 districts in Tamil Nadu, 3 districts of Pondicherry, 2 districts in Karnataka and one district each in Lakshadweep and Andaman and Nicobar Islands. Apart form southern India, north-eastern region has 10 districts. Out of these 10 districts, 7 districts are in Mizoram, 2 districts in Nagaland and 1 district in Manipur. In western part, there are 11 districts out of which 9 districts are in the state of Maharashtra. In the northern part of India, there are also 11 districts, out of which six districts are in National Capital Territory of Delhi. The remaining 3 districts are in Himachal Pradesh and one each in Chandigarh and Uttarakhand. Eastern India has only two districts, one each in West Bengal and Orissa. The Central part of India has not got a single district in this category.

On the contrary there are 26 districts in the country where literacy rate is below 40%. These districts are scattered in seven states. Of these 26 districts, 11 are in Bihar, 5 in Uttar Pradesh, 4 in Orissa, 3 in Jharkhand and one each in Chhatisgarh, Madhya Pradesh and Jammu & Kashmir.

- A person who can read and write with an understanding in any one language is called literate.
- According to 2001 census the rate of literacy in India is 65.38 per cent.
- The highest rate of literacy is in Kerala (90.92%) and the lowest rate is in Bihar (47.53%).
- The rate of literacy is higher among the males than among the females and in Urban areas than the rural areas.
- The rate of literacy is rising rapidly in India since independence.

INTEXT QUESTIONS 27.5

1. Fill in the blanks with the most appropriate words out of those given in brackets.

   (a) One of the areas of large concentration of tribal population in India is __________________. (Punjab, Haryana, Jharkhand)

(b) According to 2001 census, the share of the scheduled casts population is approximately __________% to the total population of the country (16.15, 8,7).

(c) Scheduled castes population constitute the most significant proportion of the total population in the state of ____________________.
(Uttar Pradesh, Bihar, Punjab)

(d) According to the census of India 2001, the average literacy rate of India is ___________ percent. (65.38,64.44, 68.01)

2. Name any two programmes taken by Government of India to increase literacy rate.

(i)________________________ (ii)________________________

3. Which state having highest literacy among both males and females?

____

WHAT YOU HAVE LEARNT

The development of a country depends upon both quality and quantity of the human resources. The quality of human resource depends upon the population composition. They are rural - urban, sex - age, linguistic, religious, scheduled Castes, Scheduled Tribe, literate-non literate composition. India is proverbially known as the country of villages. Till today more than 72 percent of people live in rural areas. The rate of urbanisation is however increasing. The growth rate of urban population is higher than the average growth rate in the country. This is mainly due to migration of people from rural to urban areas. There are 35 metropolitan cities in India having population more than 10,00,000.

On the other hand, sex ratio in India is unfavourable. The highest number of females per one thousand males in Karala (1058) whereas it is lowest in Haryana (861). If we take Union Territory into account then the lowest sex ratio in the country is in Daman and Diu (709). The sex ratio has been gradually decreasing in each successive censuses except some marginal increase in the 1951, 1981 and 2001 census. You will know about the status of sex ratio in your area by conducting the project work.

The rate of literacy in India is not very high (65.38%). It is the highest in Kerala where the literacy rate is as high as 90.92% and on the other extreme is the state of Bihar where literacy is as low as 47.53% percent.

India is a land of great social diversity. It is the home of people belonging to different racial stocks, languages and religions. The tribal people are the nearest relations of some of the original racial stocks. The Schedule Castes are inter-mixture of various racial stocks. According to 2001 census, Scheduled Castes and Scheduled Tribes constitute 16.00% and 8.20% respectively of the total population. The concentration of these population are found in the plain areas due to their profession. Whereas Scheduled Tribes generally live in isolated forested and hilly tracts. They are pre-industrial stage of development and believe in super-natural powers. India is a unique country in terms of language and religion. Here all the major religions of the world are found. There are 18 major languages and hundreds of dialects are spoken in the country.

TERMINAL QUESTIONS

1. Discuss in brief the following characteristics of Indian population.

   (a) age structure (b) rural-urban ratio and (c) sex ratio.

2. Give an account of literacy in India.
3. What are the factors responsible for the decline in sex ratio? Discuss in brief.
4. Discuss the regional distribution of tribal population in India.
5. To which major linguistic families do most of the Indian languages belong? Give a brief account of the distribution of various linguistic families in the country.

ANSWERS TO INTEXT QUESTIONS

27.1

(a) lower

(b) primary, secondary and tertiary

(c) increasing

(d) 35

27.2

(a) Kerala

(b) Haryana

(c) 933

(d) It refers to the number of females per thousand males in an area.

27.3

(a) Santhali

(b) Aryan

(c) Tribal areas of central India

27.4

1. in and around Mumbai.
2. Tamil Nadu, Kerala, Andhra Pradesh & North-East region
3. Uttar Pradesh
4. Maharashtra & Arunachal Pradesh

27.5

1. (a) Jharkhand

   (b) 16%

   (c) Punjab

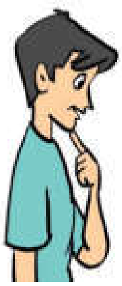
   (d) 65.38
2. National Literacy Mission, Sarva Siksha Abhiyan
3. Kerala

HINTS TO TERMINAL QUESTIONS

1. Outline briefly the spatial and temporal pattern of age structure, rural-urban ratio and sex ratio (for detail refer to sections 27.3, 27.1 and 27.2 respectively).
2. Refer to section 27.7
3. The decline in sex ratio are due to low life expectancy among the females, child mortality, especially female children and socio-religious belief like male preference.

4. Refer to section 27.6(B)

5. Refer to section 27.4



Point to Ponder

Adolescence (Age 10-19 years)

The term adolescence comes from the Latin verb adolescere, meaning 'go grow into maturity'. In this sense, 'adolescence is a process rather than a time period, a process of achieving the attitudes and beliefs needed for effective participation in society'. The World Health Organisation (WHO) defines adolescence as the period from 10 to 19 years of age characterized by development and changes in physical, psychological, and social areas. According to census of India 2001, the number of persons in the age group 10 to 19 years was 21.8%.

28

HUMAN DEVELOPMENT

Whenever, we think about development, we normally tend to think about the material and economic development. Materials may include house, landed property, motor vehicle, jewellery etc. Again all these material assets are converted in terms of money, whenever or wherever the need arises. Till today, the entire world is divided into two groups of countries - developed and developing. This classification is mostly based on level of economic development. Though this trend is still continuing but a change in thinking about development was introduced and that was a change in emphasis on measurement of development from purely economic to human. In 1990 two economists - Prof. Mehbub Al Haque and Prof. Amartya Sen introduced the concept of Human Development. From 1990 onwards, United Nations Development Programme (UNDP), each year calculate Human Development Index (HDI) and publish as a report which is known as Human Development Report (HDR). This report, is published each year in which almost all the countries are placed under three categories, high, medium and low based on the defined parameters.

In this lesson, we will learn about the concept and process of measuring human development index. We will also find out India's position among the various countries in the world. Simultaneously, we will also analyse position of various states of India as far as human development index is concerned. At the end, we will suggest certain measures to improve human development in our country.

OBJECTIVES

After studying this lesson, you will be able to:

- define the term human development;
- explain the term human development index;
- describe the regional patterns of human development index in the states of India; and
- highlight the need for improvement in human development index in Indian contex.

28.1 HUMAN DEVELOPMENT INDEX

The Human Development Index (HDI) is a composite index that measures the average achievements in a country in three basic dimensions of human development. These basic dimensions are a long and healthy life, knowledge and a decent standard of living. The above mentioned dimensions are measured by the following indicators.

1. A long and healthy life is measured by life expectancy at birth
2. Knowledge is measured by the adult literacy rate (with two thirds weight) and the combined primary, secondary and tertiary gross enrollment ratio (with one third weight)
3. A decent standard of living is measured by GDP per capita in purchasing Power Parity (PPP) US Dollars.

But we should know that the purpose of its construction is not to give a complete picture of human development rather to provide a measure which goes beyond the traditional measurement of development i.e income. Therefore, HDI is a barometer for changes in human well-being and for comparing progress in different regions. Human development concept is based on the idea of development as a freedom. It is about building human capabilities - the range of things they can do and what they can be. Individual freedoms and rights matter a great deal. But these freedoms and rights are restricted for some because they are poor, ill, illiterate, discriminated against, threatened by violent conflict, or denied a political voice, etc. That is why in the inagural issue of Human Development Report - 1990, the authors defined these above mentioned indicators as essential choices and the absence of which can block many other opportunities. Therefore, they defined human development as a process of widening people's choices as well as raising the level of well-being". To achieve this there is a need for re-orientation of our process of development. In other words, development must revolve around the people, not people around the development.

The basic difference between economic development and human development is that economic development entirely focuses on the increase of income whereas the human development believes in expanding and widening of all aspects of human life be it economic, social, political, cultural, etc. In economic aspect human development is one of the essential elements. The basic idea behind this is that it is the use of income and not the income itself that decides the human choices. Since, the real wealth of a nation is its people, therfore, the goal of development should be the enrichment of human life.

Apart from Human Development Index (HDI), the other four indicators of human development have been selected which were used by the Human Development Report. These are:

(i) Human Poverty Index for developing countries (HPI-1)

(ii) Human Poverty Index for selected DECD Countries (HPI-2)

(iii) Gender - related Development Index (GDI)

(iv) Gender Empowered Measurement (GEM)

Out of these given, HDI, HPI-1 and GDI are calculated by three common dimensions - a long and healthy life, knowledge and a decent standard of living. But some of indicators are different within these dimensions. Let us know their similarities and differences from the table given below.

Table No. 28.1: A comparative analysis of Dimensions used in HDI, HPI-1 and GDI

Sl. No.	Indices	HDI	HPI-1	GDI
1.	A long and healthy life	● Life expectancy at birth	● Probability at birth of not swimming at age 40	● Life expectancy at birth
2.	Knowledge	● Adult literacy rate (with two third weight) and ● The combined primary, secondary and gross enrolment (with one third weight)	● Adult literacy rate ● Percentage of the population without sustainable access to an improved water source	● Adult literacy rate ● Combined primary, secondary and tertiary gross enrolment ratio
3.	A decent standard of living	● GDP per capita (adjusted to purchasing power parity in US$)	● The percentage of children under weight for age of one year.	● Estimated earned income (PPP in US $)

28.2 WHY HUMAN DEVELOPMENT

Paul Streeten, a development economist identified six reasons in favour of the human development. The reasons are as follows:

1. The ultimate purpose of the entire exercise of development is to improve the human conditions and to enlarge people's choice.
2. Human development is a means to higher productivity. A well nourished, healthy, educated, skilled alert labour force is the most productive asset. Therefore investments in these sectors are justified on ground of productivity.
3. It helps in reducing the rate of growth of population.
4. Human development is friendly to the physical environment also. Deforestation, desertification and soil erosion decline when poverty declines.
5. Improved living conditions and reduced poverty contribute to a healthy civil society and greater social stability.
6. Human development also helps in reducing civil disturbance in the society and in increasing political stabililty.

Till now you might have understood the importance of human development. Let us now have a closer look at India's position at international level as far as human development is concerned. We will also try to find out the reasons for low levels of human development in India

28.3 INDIA : TRENDS OF HDI

According to Human Development Report 2005, India's rank was 127 out of 177 countries of the world. All the 177 countries are grouped under three categories. These are high, medium and low. The countries which had value between 0.800 and above are termed as high. The countries which had value between 0.500 to 0.799 were ranked under medium categories and countries which had value less than 0.500 were ranked as low human development countries. India was placed almost at the bottom of the table in the medium level category. Our neighbouring countries like China (85), Sri Lanka (93), Maldives (96) remained well above the India's position. Other neighbouring countries like Myanamar (129), Bhutan (134), Pakistan (135) and Nepal (136) were placed just below India. The countries which lied below India were mostly from Africa and rest few countries were from Asia. If we look at India's situation over the time we can definitely say that it has improved a lot over the last thirty years (Table 28.2)

Table No. 28.2: INDIA : Human Development Index Trends in India 1975 - 2005

Years	1975	1980	1985	1990	1995	2000	2005
India	0.412	0.438	0.476	0.513	0.546	0.577	0.602

Source: Human Development Report, 2005, p.225

This improvement is not sufficient enough. There are many small countries of Asia and Africa like Fiji, Mongolia, Tunisia, etc. are well above India. India has to work very hard to be placed among the top countries in the medium human development category (0.501 - 0.800). If the present trend continues it needs minimum 30 years to enter the high human development category. And for this, a rigorous effort particularly in the social sector like education, health and economic sector particularly reduction of poverty are required. The following are the reasons to keep India at the bottom of human development (a) rapid increase in population (b) large number of adult illiterates and low gross enrolment ratio (c) high drop-out rates (d) inadequate government expenditure on education and health, (e) large proportion of under weight children as well as under nourished people (f) very poor sanitation facilities and low access to essential life saving medicines.

Apart from HDI, the performance of India is also not very encouraging as far as Gender Development Index (GDI) and Human Poverty Index (HDI) are concerned. According to Human Development Report, 2005, India's position in GDI was 98 out of 140 countries and in HPI-1 was 58 out of 103 countries.

INTEXT QUESTIONS 28.1

1. What is Human Development Index?

   ____

2. Name the three dimensions and their respective indicator used for measuring HDI.

   (i) ______________________________

   (ii) ______________________________

   (iii) ______________________________

3. Differentiate between human development and economic development

   ____

4. How do we measure Human Poverty Index (HPI-1)for developing countries (HPI -1)

   (i) ______________________________

   (ii) ______________________________

   (iii) ______________________________

5. What is India's position in Human Development Index according to Human Development Report - 2005. Name any two neighbouring countries of India who are doing better than India.

   ____

   ____

   ____

28.4 SOCIO-ECONOMIC INDICATORS

Let us now have a brief discussion about the various socio-economic indicators of India that are responsible for human development. As mentioned earlier, we will discuss health and education under social indicators and general economy with reference to per capital income and poverty.

Health Situations in India

As you know health is one of the three dimensions of human development. Though under health life expectancy is considered as the indicator, but we should know other health related demographic indicators like birth rate, death rate, total fertility rate, infant mortality rate, etc as well as about health facilities like hospital, dispensary, beds in the hospital, number of doctors and nurses, etc. to have a holistic view about the health situation in the country. Definitely, today the health situation has improved a lot since Independence.

Today, there have been significant demographic changes and epidemiological shifts have occurred. India has been able to control various communicable diseases. However, under communicable diseases Vector Born Disease and AIDS continue to be critical areas of concern. With the decline in death rates, increase in life expectancy and changing life styles, there has been an increase in non-communicable diseases like cardio-vascular ailments, cancer, cataract induced blindness, diabetes etc. In all the above mentioned diseases, the disease of AIDS pose unique challenge, because no cure is available for till today. Secondly, India ranks second in the world, next only to South Africa with an estimated population of 5.206 million persons infected by HIV/AIDS by December 2005. Recently, according to UNAIDS estimate, India has the largest number of HIV/AIDS population, surpassing South Africa. Though India is placed among the list of low prevalence country, our problem is the large population base. Specifically in the active reproductive age group of 15-49 years. You can find out the total number of infected persons from the age-composition table no 27.3 in the previous lesson. If we really want young people to prevent HIV infection, we have to enhance our life skills in the following ways.

- Understand and feel good about yourself. Have faith in yourself. Understand your own strengths and weaknesses. Maintain your self-respect and self-confidence.
- Be positive in your attitude towards life. Be ready to learn from experiences even if they are not pleasant.
- In difficult situations, try to identify the cause of the problem. Identify the best solutions available and then follow them.
- Share your concerns with others and seek timely help when needed.
- Adopt a healthy lifestyle.
- Make responsible decisions.
- Seek reliable information and make informed choices and decisions.
- Think of the consequences of your decisions and actions, do not act hastily and impulsively.
- Learn from the experiences of others; we can benefit from the mistakes of others.
- Manage your stress by sharing your concerns with others and by seeking help from parents, teachers, friends, and counselors.
- Have the courage to say ‘no’ to peer pressure.
- Be caring and empathetic towards people who need special care such as people living with HIV/AIDS (PLWHA).
- Seek out and share information on sensitive reproductive health issues.

Study the following table to know health related indicators.

Table 28.3: INDIA : Selected Health Indicators (1951–2003)

Sl.No.	Indicator	1951	2003
1.	Birth Rate (per thousand)	40.8	24.8
2.	Death Rate (per thousand)	25.1	8.0
3.	Infant Mortality Rate (per thousand live births)	146 (1951-61)*	60
4.	Child (0-4 years) Mortality Rate (per thousand children)	57.3 (1972)*	17.8 (2002)*
5.	Total Fertility Rate	6.0	3.0 (2001)*
6.	Life Expectancy Rate (Male)	37.2	63.9 (2001-06)*
	(Female)	36.2	66.9 (2001-06)*

Source: Economic Survey 2005-06, Ministry of Finance, Govt of India, p-25

Note: The figure given in the brackets refer to the year which is different from the reference year mentioned in the particular columns of the table

I am sure you have read the table carefully. As we said earlier that there has been significant improvement in each health indicator. But the desired result has not been achieved in reducing birth rate, infant mortality rate as well as total fertility rate. There is a need for sustained effort particularly in remote rural areas where health care system is almost non-functional. As far as health care facilities in the country are concerned it has increased in leaps and bounds.

Table 28.4: INDIA : Trends in Health Care Facilities 1951-2004

Sl.No.	Facilities	1951	2004
1.	Sub centre, Primary Health centre, Community Health Centre	725	1,68,986
2.	Dispensaries and Hospitals	9,209	38,031 (2002)
3.	Beds (Private and Public)	1,17,198	9,14,543 (2002)
4.	Nursing Personnel	18,054	8,36,000
5.	Doctors (Modern System)	61,800	6,25,131

Source: Economic Survey 2005-06, Ministry of Finance, Govt of India, p-212.

During 50 years (1951-2001) population has increased alarmingly from 36.10 crores to 102.70 crores. Simultaneously number of patients as well as problems related to birth, infant child and mother care has increased significantly. Therefore the health system is still at cross roads with a wide gap between demand and supply. Therefore the health system is still at cross roads with a wide gap between demand and supply. Looking at the distribution of medical facilities we find there is highly unequal distribution and most of the facilities are concentrated around major cities and towns. To reduce the inequality Government of India started an ambition project of National Rural Health Mission. (NRHM). This programme was launched on April 12, 2005 for a period of 7 years. The vision and target outcome of NRHM is given below. A part from NRHM, Government of India has also launched many programmes related to health aspect of women and children like Janani Suraksha Yojana (JSY), Balika Samridhi Yojana (BSY) and Kishori Shakti Yojna (KSY) etc.

Table 28.5: National Rural Health Mission (NRHM): Vision and Target Outcome

Vision of NRHM	Target outcome
● To be implemented throughout the country with special focus on 18 states with weak public health indicators and/or weak infrastructure	● IMR to be reduced zero per thousand live births by 2012
● To improve the availability and access to quality health care	● IMR to be reduced to 100 per 100,000 live births by 2012
● To build synergy between health and determinants of good health like nutritions, sanitation, hygiene and safe drinking water	● TFR reduced to 2.1 by 2012 ● Malaria mortality to be reduced by 50% by 2010 and 60% by 2012 ● A complete elimination of Kala Azar mortality by 2010
● To streamline the Indian Systems of Medicine to facilitate comprehensive health care	● Filaria to be reduced by 70% by 2010, 80% by 2012 and complete elimination by 2015
● To increase the absorptive capacity of the health delivery system to enable it to handle increased allocations.	● Dengue mortality to be reduced by 50% by 2010 and sustaining it at that level till 2012
● To involve the community over the planning process.	● Cataract operations increasing to 46 lakh per annum.
● To upgradate the infrastructure	● Leprosy prevalence rate to be reduced from 1.8. per 10,000 in 2005 to less than 1 per 10,000 thereafter
● To assist in capacity building ● To increase the fund allocation for health sector.	● TB DOTS series - Maintains 85% cure rate through entire mission period

Source: Economic survey, 2005-06, Ministry of Finance, Government of India, p-217

Knowledge Indicators

Knowledge is always considered as power that empowers human being in various ways. An individual with certain levels of knowledge will have economic freedom and will have wide choice for growth and development. Today's soceity is moving towards knowledge society and a major chunk of population derived their sustenance that is based on knowledge economy. Due to these factors, knowledge was considered as one of the integral parts of human development index. But knowledge is a qualitative aspect and has many dimensions to it. In HDI two dimensions of knowledge were taken into consideration. As mentioned earlier, they are (a) adult literacy rate and (b) combined primary, secondary, and tertiary gross enrollment ratio.

Therefore, in this lesson, we will not discuss about the trend and regional patterns of literacy rather we will specifically discussed about adult literacy. It's because of the fact that we have already discussed about literacy in details in the lesson no-27. The other fact for detailed discussion about adult literacy is that it is taken as one of the indicators to measure the knowledge component. According to NSSO 52nd Round (1995-96) and as reported in selected Educational Statistics (1997-98), 54.38% of adults are literate. According to the Human Development Report 2005, the adult literacy in India, is 61.0% in 2003. But if we make statewise analysis, the pattern has not changed much.

The regional pattern of adult literacy varies considerably. It may be observed that states below the national average are Bihar (including Jharkhand), Rajasthan, Uttar Pradesh (including Uttaranchal), Arunachal Pradesh, Andhra Pradesh, Madhya Pradesh (including Chhatisgarh), Jammu and Kashmir and Orissa. Therefore, there is a need for improvement of adult literacy in these states.

Gross Enrollment Ratio (GER)

It indicates the proportion between the total number of learners in a particular age group that are supposed to be in that particular class and classes the total number of actual learners enrolled in that particular class/classes. Sometimes GER is more than 100% due to admission of below the age group and above the age group in that class/classes. In HDI, aggregate GER of primary, secondary and tertiary education is calculated. Here we will restrict our discussion about GER of primary education (from Ist to Vth class).

According to Economic Survey, 2005-06 the GER has increased progressively from 32.1% in 1950-51 to 84.91 in 2003-04 in the age groups of 6-14 (from Ist to Vth class). Simultaneously drop-out rates at primary level declined from 39.0% in 2001-02 to 31.4% in 2003-04. As on October 2005, number of out of school children, as reported by states/UTs was reduced to 95 lakh from 320 lakh in 2001. But still 95 lakh out of school children at primary level is a very high number. If we look at state-wise GER, it has been found that it varies from 116.77% in Manipur to 55.82% in Bihar. The states which have GER below the national average are Uttar Pradesh, Bihar, Andhra Pradesh, Assam, Haryana, Punjab, Jammu and Kashmir, Jharkhand and Nagaland.

To improve the educational attainment particularly enrollment and retention at elementary level and reduce the adult illiteracy Government of India has started various new programmes and also strengthened existing programmes.

Economic Indicators

Human development has also placed a great significance to economic productivity and growth. This provides means to progress apart from education and health. Economic growth is generally found out with the Gross Domestic Product (GDP), Gross National Product (GNP), per capita income, etc. Here we won't discuss in details all these above mentioned economic indicators but we will discuss only about per-capita income.

According to Economic Survey 2005-06, per-capita income has increased from Rs 3,687 in 1950-51 to Rs 19,649 in 2004-05. Though per-capita income has increased significantly but disparities are very wide both at region level and local levels. Even at the rural and urban levels there exists very high disparity in per capita income. Such variation is also reflected through those persons who are below the poverty line.

Poverty is not only an economic phenomena but also social and psychological deprivation. This is reflected through poor quality of life, malnutrition, low human development, etc. According to Planning Commission estimate in 1999-2000, there were 26.10% of population living below poverty line. This ratio is 27.09% in rural areas and 23.62% in urban areas. While rural poverty is linked with landless and marginal farmers, urban poverty is expressed in terms of sprawling slums in cities. The states with population below the poverty line from the national average include Orissa, Bihar (including Jharkhand), Madhya Pradesh (including Chhatisgarh), Uttar Pradesh (including Uttarakhand), all the north-eastern states except Mizoram and West Bengal.

INTEXT QUESTIONS 28.2

1. Name the three demographic indicators which need to be improved to achieve the desired result.

   (i) ______________________________

   (ii) ______________________________

   (iii) ______________________________

2. Name any three health programmes related to women and children launched by Government of India.

   (i) ______________________________

(ii) ____________________

(iii) ____________________

3. Define Gross Enrollment Ratio

____________________.

4. Name any three states in which people are living below poverty line.

(i) ____________________

(ii) ____________________

(iii) ____________________

28.5 HUMAN DEVELOPMENT INDEX - A STATE LEVEL ANALYSIS

In accordance with UNDP Human Development Report, the Planning Commission of India came out with a similar kind of report in 2001. The report analysed human development situation in major states of India which include the then undivided Bihar, Madhya Pradesh and Uttar Pradesh in the given Table : 28.6. HDI values of India as well as 16 selected major states are given below.

Table No. 28.6 : India : Human Development Index of Major States, 2001

States	HDI
Andhra Pradesh	0.416
Assam	0.386
Bihar	0.367
Gujarat	0.479
Haryana	0.509
Karnataka	0.478
Kerala	0.638
Madhya Pradesh	0.394
Maharashtra	0.523
Orissa	0.404
Punjab	0.537
Rajasthan	0.424
Tamil Nadu	0.531
Uttar Pradesh	0.388
West Bengal	0.472
India	**0.472**

Source: National Human Development Report, 2001, P.25

If we analyse the pattern given in the above Table 28.6, it is concluded that there is a north south divide barring a few exceptions. All the southern Indian states are doing well except Andhra Pradesh. On the other hand most of northern states except Punjab and Haryana are doing badly in human development index. These northern states are given an accronym "BIMARU" (whcih stands for Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh). Apart from north-south divide, there exists a east - west divide also. Western states like Gujarat and Maharashtra are doing fairly well in comparision to eastern states – Orissa, and Assam. Both these states are below national average. West Bengal is exactly positioned at the national average. Therefore there is a need to pay a greater attention to those states which are not doing well in HDI. An efforts should be made in these states to improve human development index.

In the following paragraphs we will make a detailed discussion at the states level in India based on the development radars suggested in the National Human Development Report - 2001 prepared by Planning Commission of India. Development Radars are diagrammatic representation of progress in HDI prepared, separately for rural and urban areas on eight distinct social indicators for two points of time, i.e. early 1980 and early 1990. Development Radars were constructed for all the states. The indicators have been included with a view to reflect attainments on three critical dimensions of well being - longevity, education and command over resources. At the same time development radar (DR) highlights the progress in meeting out the basic human needs of accessibility to safe drinking water and shelter. The social indicators selected for the construction of Development Radars (DR) are as follows;

(i) Per-capita consumption expenditure.

(ii) Incidence of poverty as captured by the head count ratio.

(iii) Access of safe drinking water.

(iv) Proportion of households with pucca houses.

(v) Literacy rate for the age group of 7 years and above.

(vi) Intensity of formal education (indicators based on weighted enrolment in successive classes adjusted for non enrolled children in the age group of 6–18 years)

(vii) Life expectancy at the age of one year; and

(viii) Infant mortality rates.

The indicators scale through a magnitude from zero to five. Here, zero corresponding to least achievement while five given to maximum achievement.

INTEXT QUESTIONS 28.3

1. Name any three states of northern India which are below national average in HDI.

   ____

2. What is Development Radar.

   ____

3. In which two indicators still substantial gaps are there as far as rural - urban differences are concerned.

   ____

WHAT YOU HAVE LEARNT

The concept of Human Development Index (HDI) was propounded by Prof Mehbub Al Haque and Prof. Amartya Sen in 1990. From 1990 onwards Human Development Report is published by UNDP annually which reflects the status of human development in almost all the countries across the world. HDI is a composite index that measures the average achievements in a country in three basic dimensions of human development. They are long and healthy life, knowledge and decent standards of living. They basic difference between economic development and human development is that economic development entirely focusses on the increase of income whereas the human development stresses in expanding and widening of all aspects of human life. In HDI, economic condition is one of the essential elements. Apart from HDI, various types of indices are constructed and published by UNDP. Some of the important indices are Human Poverty Index, Gender Development Index, Gender Empowered Measurement index, etc.

According to Human Development Report - 2005, India's rank is 127th almost at the bottom of the table in the medium level category. The reasons which keep India at the bottom of human development are rapid increase in population, large number of adult illiterates, low Gross Enrollment Ratio, inadequate government expenditure on education and health, large proportion of under - weight children as well as under nourished people, very poor sanitation facilities and low access to essential life saving medicines etc. Therefore, there is an urgent need to improve in health situation, educational attainment and increased standard of living and reduction of poverty level. If we look at the situation since independence to till date, we find that there has been a significant improvement. However there has been increases in HIV/AIDS patients to check the menace of HIV/AIDS, the youngesters have been suggested to develop certain life skills. But there is a need for further improvement. To improve the situation, the Government of India has implemented many programmes such as massive project like National Rural Health

Mission, Sarva Shikhsa Abhiyan, National Rural Employment Guarantee Scheme etc.

In accordance with UNDP Human Development Report, Planning Commission of India came out with a similar kind of Report titled "National Human Development Report." In this report HDI of fifteen major states were calculated. The state of Kerala has highest HDI whereas the state of Bihar has the lowest HDI. Apart from that the Planning Commission has constructed Development Radar. The Development Radar is a diagramatic representation of progress of states as a whole and for rural and urban areas separately. The Development Radar has been calculated based on eight distinct social indicators for two points of time.

TERMINAL QUESTIONS

1. Differentiate among Human Development Index, Human Poverty Index and Gender Development Index.
2. Explain any four reasons in favour of the human development.
3. Describe any four visions envisaged in National Rural Health Mission (NRHM) implemented by Government of India.
4. Write any four factors responsible for keeping India almost at the bottom of human development index table.

ANSWER TO INTEXT QUESTIONS

28.1

1. The Human Development Index is a composite index that measures the average achievements of a country in three basic dimensions of human development such as long and healthy life, knowledge and decent standard of living.
2. (i) Long and healthy life measured by life expectancy at birth.

   (ii) Knowledge is measured by the adult literacy rate and the combined primary, secondary and tertiary gross enrollment ratio.

   (iii) A decent standard of living is measured by DGP per-capita purchasing power parity in US Dollar.
3. Economic development entirely focusses on the increase of income. The human development stresses in expanding and widening of all aspects of human life.
4. (i) Probability at birth of not swimming at the age of 40

   (ii) Adult literacy rate

(iii) (a) Percentage of the population without sustainable access to an improved water source (b) the percentage of children underweight for age of one year.

5. 127 out of 174 countries. Neighbouring countries who are doing better than India are China, Sri Lanka and Maldives (Any two)

28.2

1. (i) Birth Rate (ii) Infant Mortality Rate (iii) Total Fertility Rate
2. (i) National Rural Health Mission (ii) Janani Suraksha Yojna (iii) Balika Samridhi Yojna (iv) Kishori Shakti Yojna (Any three)
3. Gross Enrollment Ratio indicates the proportion between the total number of leaners in a particular age group that are supposed to be in that particular class/classes and that total number of actual learners enrolled in that particular class/classes
4. (i) Bihar (including Jharkhand), (ii) Orissa (iii) Madhya Pradesh (including Chhatisgarh) (iv) Uttar Pradesh (including Uttarkhand) (v) Assam (vi) West Bengal (vii) Meghalaya (viii) Manipur (ix) Nagaland (x) Tripura, (xi)Sikkim (xii) Arunachal Pradesh (Any three)

28.3

1. (i) Bihar (ii) Madhya Pradesh (iii) Uttar Pradesh (iv) Rajasthan (Any three)
2. Development Radars are diagramatic representation of progress of states separately for rural and urban areas on eight distinct social indicators for two points of time namely early 1980 and early 1990.
3. (i) per-capita expenditure (ii) poverty

HINTS TO TERMINAL QUESTIONS

1. Basically all the indices (i.e. HDI, HPI and GDI) are calculated on three common dimensions: a long and healthy life, knowledge and a decent standard of living. However some indicators are different within these dimensions. HDI is a composite index of life expectancy at the birth; adult literacy rate; the combined primary, secondary and enrollment; and lastly, GDP per capita income. HPI is a composite index of probability at birth; adult literacy rate; percentage of population without sustainable access to safe drinking water; and lastly, percentage of children underweight for age of one year. HDI is a composite index of life expectancy at birth; adult literacy rate; combined primary, secondary and tertiary gross enrollment ratio; and lastly, estimated earned income.

2. Refer to section 28.2
3. Refer to table 28.5
4. Refer to section 28.3

Notes

Point to Ponder

Healthy diet during adolescence

Both girls and boys need a nutritious diet during adolescence because this is a particularly important phase when their bodies are undergoing tremendous changes. It is important to take calcium and iron supplements to help this growth spurt during adolescence.

Since girls are more prone to anaemia (iron deficiency) resulting from menstruation, they require more iron supplementation in their diet. To prevent or cure anaemia, girls should cat iron-rich foods such as meat, liver, and leafy green vegetables, or they should get a prescription for iron tablets from the doctor.

Anaemia causes even more problems during teenage pregnancy, which in turn can lead to further anaemia.

29

HUMAN SETTLEMENT

In the previous lesson, we have discussed about population composition; total population; rural-urban population; population growth, etc. In this lesson, our focus will be on human settlements. Therefore, discussion will revolve around the concept of settlements meaning and nature, evolution and classification of rural and urban settlements in India.

OBJECTIVES

After reading this lesson, you will be able to:

- describe the meaning of settlement;
- identify various types of rural settlements;
- describe various house types in India;
- establish the relationship between house types with relief, climate and building materials;
- define an urban areas as given by census of India;
- analyse the distributional patterns of rural and urban settlements; and
- explain functional classification of urban settlements as given by census of India.

29.1 WHAT IS A SETTLEMENT

Though we use this term very frequently, but when it comes for defining, it is very difficult to give a clear cut definition. In simpler term we can define settlement as any form of human habitation which ranges from a single dowelling to large city. The word settlement has another connotation as well as this is a process of opening up and settling of a previously uninhabited area by the people. In geography this process is also known as occupancy. Therefore, we can say settlement is a process of grouping of people and acquiring of some territory to build houses as well as for their economic support.

Settlements can broadly be divided into two types – rural and urban. Before discussing about meaning and types of rural and urban settlement in India, we should know some basic differences between rural and urban areas in general.

(i) The major difference between rural and urban areas is the function. Rural areas have predominantly primary activities, whereas urban areas have domination of secondary and tertiary activities.

(ii) Generally the rural areas have low density of population than urban.

29.2 TYPES AND PATTERNS OF RURAL SETTLEMENTS

Before discussing types and patterns of rural settlements in India, let us have some idea about the words: – type and pattern. Type refers to a category of things having some common features whereas pattern refers to a regular form or order in which a series of things occur. When we say settlement pattern, the term is strictly applied to the spatial arrangement or distribution of settlements within a given area. It differs from settlement form. Settlement form relates more to the spatial characteristics of individual settlement. However, sometimes forms and patterns are used interchangeably. But here we will discuss about the patterns only. As far as type of rural settlements is concerned, it implies the degree of dispersion of the dwellings.

Types of Rural Settlements

Geographers have suggested various schemes of classification. If we group settlements found all over the country, these can broadly be grouped under four categories:

1. Compact/clustered/nucleated settlement
2. Semi-compact/Semi-clustered/fragmented settlement
3. Hemleted settlement
4. Dispersed settlement.

Let us discuss these types one by one along with some of the major patterns associated with each type.

1. **Compact Settlements:** As the name suggests, these settlements have closely built up area. Therefore in such settlements all the dwellings are concentrated in one central sites and these inhabited area is distinct and separated from the farms and pastures. Maximum settlements of our country comes under this category. They are spread over almost every part of the country. These settlements are distributed over the entire northern Indo-Ganga plain (from Punjab in the north-west to West Bengal in the east), Orissa coast, basins of

Mahanadi in Chhattisgarh, coastal areas of Andhra Pradesh, cauvery delta of Tamil Nadu, Maidaus of Karnataka, lower Assam and Tripura, in the valleys of Siwaliks etc. Sometimes people live in compact settlement for security or defence purpose. The greatest example of this type is in Bundelkhand region of Madhya Pradesh and Uttar Pradesh. In Rajasthan also people live in compact settlement because of the scarce availability of cultivable land and water body. Therefore, they want to make maximum use of available natural resources.

Such settlements generally range from a cluster of about thirty to hundreds of dwelling of different forms, size and functions. On an average their size various from 500 to 2,500 persons in sparsely populated parts of Rajasthan to more than 10,000 persons in Ganga plain. Very often these settlements have a definite pattern due to closely built area and intervening street patterns. As many as 11 patterns are identified. We will discuss only Five major patterns. These patterns are: (i) Linear pattern (ii) Rectangular pattern (iii) Circular pattern (iv) Square pattern (v) Radial pattern

(i) **Linear Pattern :** It is commonly found along main roads, railways, streams, etc. It may have a single row of houses arranged along the main artery. For example rural settlements found along the sea coast, river valley, mountain ranges etc.

(ii) **Rectangular Pattern :** This is a very common type which develops around the rectangular shape of agricultural fields as it is common to find a system of land measurement based on square units. Village paths and cart tracks also confirm to the rectangular field patterns and run through the village in north-south and east-west directions. Accessibility to farms and fields and connectivity to other settlements lead to rectangular shape of settlements. The settlements of coastal Maharashtra and Andhra Pradesh and either side of Aravali hills, etc. may be cited for examples.

(iii) **Square Pattern:** This is basically a varient of rectangular type. Such a pattern is associated with villages lying at the crossing of cart tracks or roads and also related to features restricting the extension of the village outside a square space. These features may include an old boundary wall, thick orchards, a road or a pond.

(iv) **Circular Pattern :** In the upper Doab and Trans – Yamuna districts, Malwa region, Punjab and Gujarat, large villages are characterized by a very high degree of compactness. The outer walls of dwellings adjoin each other and present a continuous front so that when viewed from outside, the villages look like a walled and fortified enclosure pierced by a few openings. The round form was a natural outcome of maximum aggregation for the purpose of defence during the past.

(v) **Radial Pattern :** In this type, a number of streets converge on one centre which may be a source of water (pond, well), a temple or mosque, a centre of commercial activity or simply an open space. Thus, the streets seem to be radiating from a common centre. Examples are settlements near Gurushikar, Mount Abu in Rajasthan, Vindhyachal in Uttar Pradesh, etc.

2. **Semi- Compact Settlement:** As the name suggests, the dwellings or houses are not well-knitted. Such settlements are characterized by a small but compact nuclears around which hamlets are dispersed. It covers more area than the compact settlements. These settlements are found both in plains and plateaus depending upon the environmental conditions prevailing in that area.

   Such settlements are situated along streams in Manipur Mandla and Balaghat districts of Madhya Pradesh, and Rajgarh district of Chhattisgarh. Different tribal groups inhabit such settlements in the Chhota Nagpur region. In Nagaland, such settlements may be in the form of blushing villages. Like, compact settlements, semi-compact settlements may also have different patterns. Some of the patterns are (i) checker board pattern (ii) Elongated pattern (iii) Fan shaped pattern.

   (i) **Checker Board Pattern:** This is a type of settlement found generally at the junction of two roads. The village streets meet each other at an angle or are parllel to each other. This is because of the tendency to align the dwellings along cardinal axes. This pattern is common in the northern plains.

   (ii) **Elongated Pattern:** Such settlement occurs as a result of elongation of the rectangular pattern due to influence of site features. For instance, in the Ganga plains, in areas liable to inundation, the rectangular pattern becomes unusually elongated along the high ground. Even otherwise the advantage offered by riverside location forces such a pattern.

   (iii) **Fan Shaped Pattern:** This is seen where some focal points or line is situated at one end of the village. A focal object may be a tank a riverside, a road, an orchard, a well or even a place of worship. Such patterns are common in the delta region where the dwellings simply follow the fan shaped profile of the delta as in the case of Mahanadi, Godavari, Krishna, Cauvery, etc. Such patterns are also common in the Himalyan foothills.

   (iv) **Hamleted Settlements:** These type of settlements, are fragmented into several small units. The main settlement does not have much influence on the other units. Very often the original site is not easily distinguishable and these hamlets are often spread over the area with intervening fields. This segregation is often influenced by social and ethnic factors. The hamlets are locally named as faliya, para, dhana, dhani, nanglay etc. These settlements are generally found in West

Bengal, eastern Uttar Pradesh, Madhya Pradesh and coastal plains. Geographically it covers lower Ganga plain, lower valleys of the Himalayas and central plateau or upland region of the country.

4. **Dispersed Settlements:** This is also known as isolated settlements. Here the settlement is characterized by units of small size which may consist of a single house to a small group of houses. It varies from two to seven huts. Therefore, in this type, hamlets are scattered over a vast area and does not have any specific pattern. Such type of settlements are found in tribal areas of central part of India covering Chhota Nagpur plateau, Madhya Pradesh, Rajasthan, etc. Such patterns are also common in the hills of north Bengal, Jammu & Kashmir, Tamil Nadu and Kerala.

INTEXT QUESTIONS 29.1

1. Answer the following questions in not more than one sentence

   (i) What is a settlement.

   ____

   (ii) What are the two major basis on which we differentiate between rural and Urban settlements?

   (a) ____________________ (b) ____________________

   (iii) Name the four broad categories on which rural settlements in India are grouped.

   (a) _______ (b) ________ (c) _________ (d) __________

   (iv) Which type of settlement has maximum area coverage in India?

   ____

   (v) Describe hamleted settlements.

   ____

   (vi) Where do we find dispersed settlements ? Give two examples?

   (a) ____

   (b) ____

29.3 FACTORS INFLUENCING THE TYPE OF RURAL SETTLEMENTS

There are three factors that influence the type of settlements in India. These factors are (i) Physical (ii) Ethnic or cultural and (iii) Historical or defence. Let us discuss these factors one by one.

(i) Physical Factors: These include relief, altitude, soil capability, climate, drainage, ground water level, etc. These factors influence the type and spacing of dwelling or instance, in dry regions of Rajasthan, water is a crucial factor and, therefore, houses are situated along a pond or well which guides the compactness of the settlement.

(ii) Ethnic and Cultural Factors: These include aspects like caste, community, ethnicity and religion. In India it is commonly found that the main land owning caste resides at the centre of the village and the other service providing castes on the periphery. This leads to social segregation and fragmentation of a settlement into several units

(iii) Historical or Defence Factors: In the past, mostly border areas of north-western plains were conquered or attacked frequently by outsiders. For a long time, apart from attack from outsiders, there had been continuous fight between princely states and kingdom within the country therefore, security concerns favoured the evolution of nucleated settlements.

29.4 HOUSE TYPES IN INDIA

Variations in house types or dwellings are mainly based on the building materials available. It is also based on topography and prevailing climatic conditions. In the rainy areas most of the roofs are slanting to both sides from the centre. This is also the case in areas where snowfall occurs. But the places where rainfall is scanty, roofs are flat.

As far as building materials are concerned, these can be grouped under two categories.

1. Building material used for walls
2. Building material used for roofs

However, with the advancement of building technology and financial assistance available to the people living below poverty line has changed the structure of house types in rural areas.

Let us discuss them one by one

1. Building materials used for walls

In India, building materials used for walls can broadly be grouped under five categories. These are (i) mud, (ii) stone, (iii) brick, (iv) timber, and (v) wattle

(i) Mud is the most common material, available from all types of soils, varying in texture and colour. It is also the wide spread oldest material used in houses of old civilization. These vernacular buildings, involving family labour and neighbour's co-operation and are available almost all parts of the country

(ii) Stone or basalt boulders or rock cut pieces are widely used in such areas where proximity, availability in greater amount and portability are favourable factors. Sandstone providing hilly zones, volcanic plateau zones exhibit examples of such houses in abundance

(iii) Brick walls are now covering the country side with the increased use of coal as baking material. Today brick klines are commonly found in rural areas and bake bricks are freely available. It's role in construction cost, durability, space saving and manner-variability is obvious. The oldest evidences of houses are available from the excavation of various sites of Indus valley civilization.

Mud mortar as cementing material, is widely used in country side. Various other cementing material as mortar are used since ancient times. Now cement is covering the market in countryside too. Unbaked kachcha brick is also used for low height walls but, popular in poor class owners.

(iv) Timber or wooden wall houses have been common in forest areas because woods are available in abundance there. Just near the dwellings are the major factors for using these timbers as building materials. Examples are abound in Bhil areas of Central India.

(v) Wattle wall is mainly the product of terrain and forest cover. This is due to availability of material almost without cost and skill among the owners. These houses are mostly occupied by aboriginals of Vindhyas and Satpura. Mostly Gonds and Bhils reside in such houses. Their small dwellings occupy even the slopes and summits of the hills.

2. Building materials used for roofs

These materials can broadly be grouped under seven categories. These are (i) tiles, (ii) thatch, (iii) mud and other material, (iv) tin, (v) stone slab, (vi) wood, (viii) brick and others.

(i) Tiled roofs are common throughout India. Two types of tiles-semi-cylindrical and flat are used for covering houses with varied sizes and forms. By and large, the size is larger in northern Indian plain and shorter in plateau and hilly areas.

(ii) Thatching is original shelter making skill, still prevalent in most of the poor class people. All sorts of walls are covered by thatch. Whether it is stone, timber or mud walled houses.

(iii) Mud thatching often mixed with cow dung, is common in western part of India. In western part of Uttar Pradesh such houses mark the horizon in each settlement. Its occasional plastering is enough to provide safety from rains.

(iv) Stone slabs or Flakes are being used since ancient times in mountain, hilly and plateau areas. Sandstone, and slate-slabs make durable roofs after being cut and designed according to need.

(v) Wood as roof material is common in northern mountainous region of India. within this category, there are two types. First, in the north-eastern states wooden slabs are carefully superimposed and joined with rounded corners protect house from snow and rainwater. In lower altitude particularly Uttarakhand, Himachal Pradesh, and Jammu and Kashmir the houses are covered with tin or water proof material.

(vi) Bricks make flat and smooth roof in the form lintel mixed with iron rods and cement, a practice in vogue, in modern type rural house particularly in rural market centres and commonly found in the houses of rural rich.

The use of traditional building material is decreasing and it is being replaced by building material like, iron, tin sheets, cement, etc.

INTEXT QUESTIONS 29.2

Answer the following questions briefly

(i) What are the three factors that influence the type of rural settlements in India?

(a) ____________ (b) ____________ (c) ____________

(ii) Name any three aspects of ethnic and cultural factors which influence rural settlement.

(a) ____________ (b) ____________ (c) ____________

(iii) Which is the most common and oldest material used for building walls in India?

____

(iv) Where do we found timber or woods as building material for wall in India?

____

(v) Which parts of our country stone slabs or flakes are used as building material for roof?

____

29.5 URBAN SETTLEMENTS

According to the census of India urban areas are those which satisfy the conditions given below.

(a) All places with a municipality corporation, cantonment board or notified town area committee etc.

(b) All other places which satisfy the following criteria:

(i) a minimum population of 5000;

(ii) at least 75 percent of male working population engaged in non-agricultural sector; and

(iii) a density of population of at least 4,000 persons per square kilometer.

Besides, the direction of census operation in states and Union Territories were allowed to include in consultation with the state governments and Union Territory administration and the census commissioner of India, some places having distinct urban characteristics as urban even if such places did not strictly satisfy all the criteria mentioned under category (b). Such cases include major project colonies, railway colonies, areas of intensive industrial development, important tourist centres, etc.

Therefore, there are two broad groups of town or urban settlement. The places which satisfy the conditions mentioned in category (a) are known as statutory town and the conditions mentioned in category (b) are known as census towns.

Urban agglomeration may consist of any one of the three combinations given below:

(i) a town and its adjoining urban outgrowth;

(ii) two or more contiguous towns with or without their outgrowths; and

(iii) a city and one or more adjoining towns with their outgrowths together forming contiguous streatch.

Examples of urban outgrowths are university campus, cantonment area, port area-seaport and air port, railway colonies, etc.

But, one should remember that these towns are not always permanent. In each census, towns are subjected to de-classification and re-classification based on the prevailing condition at that particular time.

29.6 TYPES OF URBAN SETTLEMENTS

Like rural settlements, urban settlements are classified on various bases. However, classification based on size and function are most common. Let us discuss them one by one

Classification based on Population Size

According to population size, census of India classifies urban centres into six classes. Classwise urban settlements and their population are given below in a tabular form.

Table 29.1 Classification of urban settlement

Class	**Population**
Class I	1,00,000 and above
Class II	50,000 – 99,999

Notes

Class III	-	20,000 – 49,999
Class IV	-	10,000 – 19,999
Class V	-	5,000 – 9,999
Class VI	-	less than 5,000

There is another classification of urban settlements. The classification is as follows:

Town	Places which have less than one lakh population
City	Urban centres having population between one lakh to one million.
Metropolitan Cities	Cities having population in between one million to five million
Mega cities	Cities having more than 5 million population

Functional Classification

This is the most popular and widely accepted classification of urban places in India as well as in other parts of the world. In India various scholars attempted to classify urban centres on the basis of functions. But the most popular and widely accepted functional classification was given by Ashok Mitra a noted demographer and the then Registrar General of India.

Ashok Mitra's Functional classification of Indian cities

Ashok Mitra's classification is based on a categories of workers classification available in the census of 1961 and 1971. Functional classification of towns and cities could not be used in 1981 census due to non-availability of town level data based on industrial classification of workers into nine industrial categories. In 1991, an effort was made to classify all urban places in terms of their functional character with slight modification by adjusting the industrial categories into five broad economic sectors. The classification is as follows:

Table 29.2 Functional Classification of urban places

	Sector		*Industrial Category*
1.	Primary Activity	I.	Cultivations
		II.	Agricultural labourers
		III.	Live stock, forestry, fishing, hunting, plantations, orchards and allied activities.
		IV.	Mining and quarrying
2.	Industry	V.	Manufacturing, processing, servicing and repairs. (a) household industry (b) other than household industry
		VI.	Construction workers

3.	Trade	VII.	Trade and commerce
4.	Transport	VIII	Transport, storage and communication
5.	Services	IX	Other services

The procedure adopted for functional classification in 1991 census was as follows:

(i) For each Urban Agglomeration/town, the percentage of total main workers in each of the five sectors was worked out.

(ii) The functional category of the UA/town was then determined on the following basis:

(a) if workers in one sector constituted, 40% or more, the UA/town was classified in the relevant mono-functional category;

(b) If the percentage in one sector was less than 40%, two sectors having the largest percentages were combined to see, if they together constituted 60% or more. If so, the UA/town was classified in the relevant bi-functional category.

(c) If no two sectors added up to 60% or more, three sectors having the largest percentage were combined and the UA/town was classified in the relevant multi-functional category.

(iii) To determine the functional category of each UA/town, in certain cases where at least 1/4th workers were engaged in one of the four activities, viz (a) forestry/fishing (including livestock, plantation, etc.), (b) mining and quarrying (c) manufacturing in household industry, and (d) construction, the respective UA/towns have been classified in the relevant sub-functional categories provided such activity happen to be the first or second leading function of those UA/town.

Using the above mentioned procedure, all the 3,697 UA/towns of India (excluding J&K) have been classified into different functional categories. Following results have been obtained by applying the above scheme.

(i) Almost half of the UA/towns (1756 to be precise) were classified in the first category i.e. primary activity, but they contains only 15.85% of the urban population of the country. Most of the towns belonging to this category were of small size. About 2/3 rds of such places were having mono-functional character while about one-fifth were multifunctional. Uttar Pradesh had the largest number, i.e. 371 such UA/towns.

(ii) 723 UA/towns had industry as the predominant function. These places accounted for almost half of the urban population. More than one third of these places were having one lakh or more population each and these places accounted for more than four-fifth population of UA/towns classified under industrial category. Less than half of such places had mono-functional character and the number of bi-functional places was quite less. Tamil Nadu had the largest number of 101 industrial UA/towns followed by Uttar Pradesh (91) and Gujarat (87) under this category.

(iii) 460 UA/towns were classified in the category of trade but these places comprised 7% of the urban population. Most of these trading towns/UA had multi-functional in nature and most of the rest towns/UA are bi-functional in nature. Uttar Pradesh has the largest number of UA/towns i.e. 123 and the rest of the states have very less number of trading towns.

(iv) Only 23 UA/towns were classified as transport accomodating less than 1% of the urban population of the country. Most of them are small towns except a few like Kharagpur in West Bengal, Mughal Sarai in Uttar Pradesh. So far as their functional character is concerned, 10 had mono-functional and another 10 had multi-functional character

(v) As many as 736 UA/towns had services as the leading function and these accounted for more than one fourth of the urban population. Most of the population (about 70%) lived in Class I towns. As far as functions are concerned majority of the towns/UA are either multi-functional or bi-functional. Uttar Pradesh had the largest number of such places (114) followed by Madhya Pradesh (82)

After a detailed discussion on functional classification of cities, the given table shows functions and few names of the cities in India that belong to that particular function.

Table 29.3 INDIA : Cities according to functions

	Functions	*Name of the cities*
1.	Administrative	New Delhi, Chandigarh, Bhubaneshwar, Gandhi Nagar, Thiruvananthpuram, Imphal, etc.
2.	Industrial	Jamshedpur, Bhilai, Salem, Coimbatore, Modinagar, Surat, etc.
3.	Transport	Port cities like Kandla, Kochi, Vishakhapatnam, etc. Road and Railway Junctions like Mughal Sarai, Itarsi, Katni, Kharagpur, Agra etc.
4.	Commercial towns	Kolkata, Mumbai, Saharanpur, Indore, Chennai, etc.
5.	Mining towns	Raniganj, Jharia, Dhanbad, Digboi, Ankaleswar, Singrauli, etc.
6.	Cantonment	Meerut, Ambala, Jalandhar, Mhow, Pathankot, etc.
7.	Educational	Roorkee, Pilani, Manipal, Aligarh, Varanasi, etc.
8.	Religious	Puri, Mathura, Madurai, Tirupati, Katra, Amritsar, Allahabad, Varanasi, etc.

9.	Tourist	Nainital, Mussorie, Shimla, Pachmarhi, Udagamandalam (ooty), Mount Abu, Gangtok etc.

INTEXT QUESTIONS 29.3

Answer the following questions briefly

(i) What is an Urban Agglomeration?

____

(ii) What are the two types of town according to census of India?

____

(iii) Define mega-cities.

____

(iv) According to 1991 census, which functional city was maximum in number.

____

(v) Name any two educational cities of India.

____

WHAT YOU HAVE LEARNT

Settlement can be defined as any form of human habitation which ranges from a single dwelling to a large city. Settlements can be broadly divided into two types – rural and urban. The basic difference between rural and urban is on the basis of function. In India rural settlements are broadly grouped under four categories. These are compact, semi-compact, hamleted and dispersed. Compact settlements have closely built up area and dwellings are concentrated in one central site. Maximum settlements of our country comes under this category and geographically it spreads almost every part of the country. There are as much as eleven patterns are found within the compact settlement. Semi-compact settlements are characterised by a small but compact nuclear around which hamlets are dispersed. Some of the important patterns bound in semi-compact settlements are checkerboard, elongated and fan-shaped. Such settlements are found in tribal areas of Chota Nagpur region and Nagaland in north-eastern states of India. Hamleted settlements are those settlements where central or main settlements is either absent or has less influence on the other units whereas dispersed settlement is a unit of small size which may consists of a single house to a small group of houses. Physical ethnic or cultural and historical or defence are some of the important factors which influence the type of rural settlements in India. There is variations in house types also. The variations are determined by topography, climate, availability of building materials, etc. As far as building materials are concerned, these can be grouped under two categories – (i) building material used for walls and (ii) building material used for roofs. Building materials used for walls are mainly mud, stone, brick, timber and wattle whereas building materials used for roofs are thatch, mud, tiles, tine, stone slab, wood, brick, etc.

According to census of India, urban settlements are (a) all places with municipality, corporation, cantonment board, or notified town area committee etc. and (b) all other places which satisfy the following criteria: (i) a minimum population of 5000; (ii) at least 75% of male working population engaged in non-agricultural pursuits; and (iii) a density of population of at least 4,000 persons per square kilometre. The places which satisfy the conditions mentioned in category (a) are known as statutory towns. The towns which satisfy conditions mentioned in the category (b) are known as census towns. Like rural settlements, urban settlements are classified on various bases. However, classification based on size and function are most common. On the basis of population size all urban settlements can be town, city, metropolitan city and mega city. On the basis of functions, cities can be grouped as administrative, industrial, transportation, commercial, mining, cantonment, educational, religious, tourist, etc.

TERMINAL QUESTIONS

1. What is a settlement ? Describe various types of rural settlement in India.
2. Explain various patterns of compact settlements of India with examples.
3. Describe various factors influencing settlement types in India.
4. Explain the building materials used for walls and roofs in India.
5. Define an urban area as given by census of 2001. Explain the procedure adopted for functional classification of cities in 1991 census.

ANSWERS TO INTEXT QUESTIONS

29.1

1. (i) Any form of human habitation which ranges from a single dwelling to large city is called settlement.
   (ii) (a) function, (b) population
   (iii) (a) compact, (b) semi-compact, (c) hamleted, (d) dispersed
   (iv) Compact settlement
   (v) Hamleted settlement is fragmented into several small units. Where central or main settlement is either absent or has very less influence on the other units.

(vi) (a) Tribal areas of central part of India, (b) hills of north Bengal, Jammu and Kashmir, Tamil Nadu and Kerala.

29.2

(i) (a) physical, (b) ethnic and cultural, (c) historical or defence

(ii) (a) caste, (b) community, (e) ethnicity, (d) religion (any three)

(iii) mud

(iv) (a) Forest areas, (b) hilly parts of the country where woods are available in plenty (Any one)

(v) (a) mountainous, (b) hilly and plateaus

29.3

(i) Urban agglomeration can be any one of the three combinations (a) a town and it's adjoining urban outgrowths (b) two or more contiguous towns with or without their outgrowths and (c) a city and one or more adjoining towns with their outgrowths together forming contiguous streach.

(ii) (a) Statutory town, (b) census town

(iii) Mega cities are the cities having more than 5 million population.

(iv) According to 1991, city work primary activity was maximum in number (1756).

(iv) (a) Roorkie, (b) Pilani, (c) Manipal, (d) Aligarh, (e) Varanasi (any two)

HINTS TO TERMINAL QUESTIONS

1. Refer to section 29.1 and 29.2
2. Refer to 1. compact settlement under section 29.2
3. Refer to section 29.3
4. Refer to part 1 and 2 of section 29.4
5. Refer to section 29.5 and Functional classification under section 29.6

30

LOCAL AREA PLANNING

Local area planning is a process of planning that is concerned with resolving local level problems and issues. Its priorities include over all welfare of the people and development of the local area. Maintenance of social services and amenities, promotion in the quality and quantity of local products and services and keeping surroundings and local environment clean and green are some of its continuous concerns. In terms of size, it is the smallest planning unit with reference to people and places. A planning which is carried out through people's participation turns out to be a dream of real situation reflecting continuous growth and development in the local area. You will learn in more details about meaning and concepts of local area planning, different approaches of local area planning adopted in India's Five Year Plans and a few success stories of local area planning efforts.

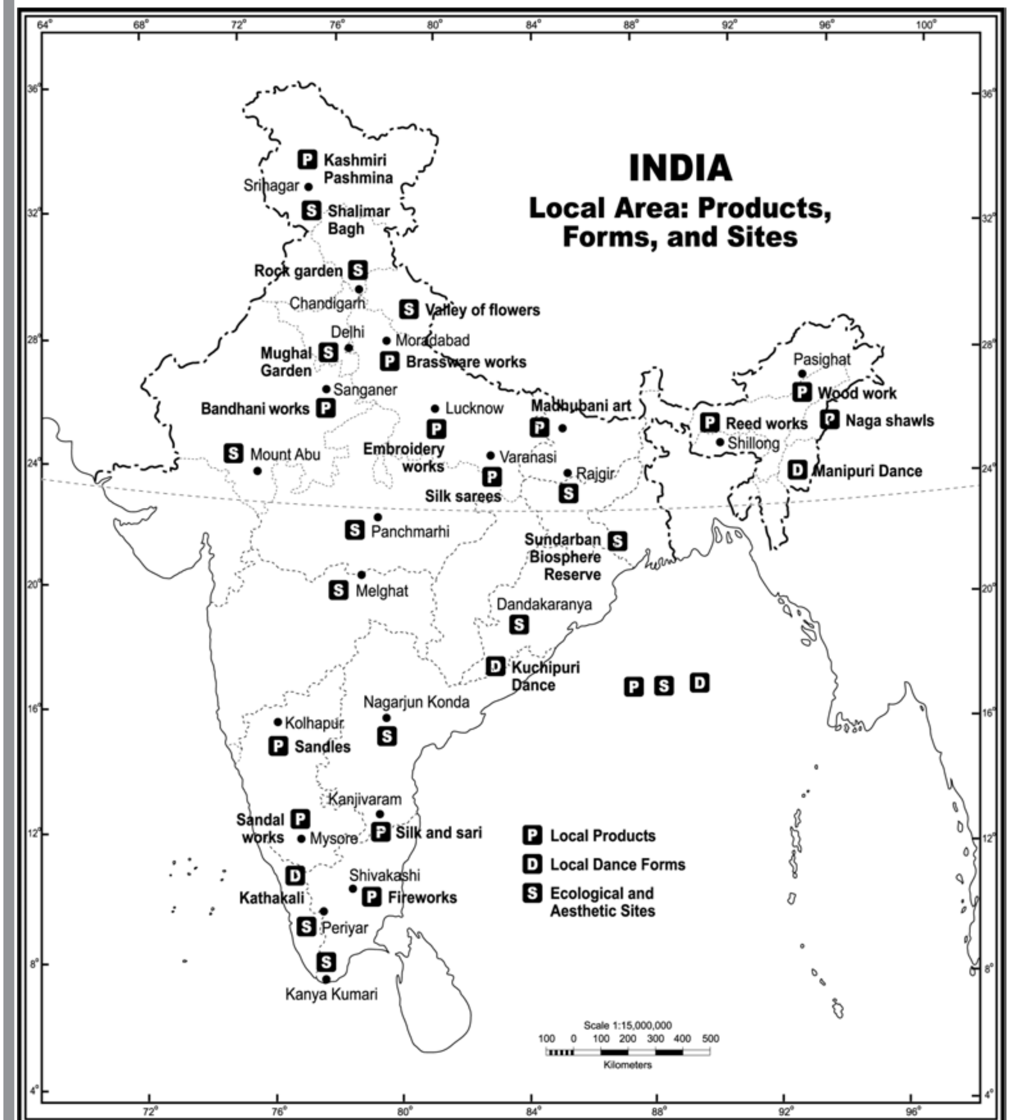
OBJECTIVES

After studying this lesson, you will be able to:

- recall the terms like local area planning, ecological and socio-economic basis of development;
- explain how planning helps in using resources to meet the local needs;
- compare different approaches and their objectives which have evolved to undertake local area development over the different Five Year Plans;
- identify on a map different planning areas in India and their unique needs;
- explain using maps how ecology, environment and resource utilisation are related to each other and managed for local area planning.

30.1 CONCEPT OF LOCAL AREA AND PLANNING

In order to understand the concepts and approaches related to local area planning, we need to understand the terms that constitute the entire idea. The term local area is used variously in ecology, economy and society. It is a site specific issue, commodity or community. In terms of attributes, local area is both a physical as well as cultural attribute like landscape of an area, surroundings of a locality, local products, folk dances, handicrafts etc.



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extened into the sea to a distance of twelve nautical miles measured from the aporopriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 30.1 Local Area: Products, Forms and Sites

The attributes of a local area reflect strong bonds of association with the location and people. With regard to non local area and people it reflects weakening bonds of association and growing variations. For example sea breeze, a local wind, exercises considerable effect along sea shore and it gets weakened away from the sea. Some times local area product or identity becomes so popular and specialized that it becomes demanding across places and regions. Sandles of kolhapur, sandal sticks of Mysore, fireworks of Shivakashi, Naga Shawls, Kashmiri Pashmina, Varanasi silk sarees, Madhubani art, Kuchipuri dance etc. are some of the local area products or specialities that are in great demand both from national as well as international markets. A well maintained locality with its clean and green environments acts as a source of attraction to the non local people and acts as an ideal for other places to follow. For example Shalimar Bagh (Srinagar), Mughal Garden (Delhi), Valley of Flowers (Uttaranchal), Rockgarden (Chandigarh), Nagarjun Konda (Andhra Pradesh), Rajgir (Bihar), Kanya Kumari (Tamilnadu) etc. are the local area sites that present a sound balance of ecological and aesthetic significance. A sense of pride and attachment to the local product, area and people is a source of unity and activity. It also leads to common understanding and identity. Ecologically, local areas may be mountainous, plateaus, plains, coastal, desert or wetlands. Functionally local areas may be pastoral agricultural, industrial, institutional or service areas. In terms of habitations, local areas may be rural, urban, nomadic or tribal. Local areas could be modern or traditional with regard to their social setup. Similarly, in terms of economic development local areas could be developed or less developed.

An effort to devise ways and means to solve the problems of places and people is termed as "planning". As a student we plan for studies, examinations and even for other routine works. We also get ourselves associated in finding solutions to the common problems at the local level where we work and live. Maintenance of amenities and public utility services, sanitation, general health and education are some of the most common problems faced by the local people. Since local areas are the smallest units of planning, it is rather easier to find solutions to their problems which are also smaller and manageable in dimension. Most of the problems that seek planning and solutions are related to the ecological imbalances, economic depressions and social tensions. To improve the general conditions of the people in a local area, provisions for basic social amenties and facilities need to be planned. The participation of local people helps in utilizing local materials, indigenous knowledge and maintaining infrastructure that are planned. Planning also aims at improving the quality of local environment through tree plantation, maintaining the local water pools like rivers, tanks, lakes etc. and managing the depletion of rocks and soils. People's participations in the local area planning and continued cooperation in their maintenance results in developing healthy local environment.

"Planning is thus, defined as conceiving, initiating, regulating and controlling environment as well as socio-economic activities by the local people and authority according to set priorities with a view to achieving objectives within a given time frame"

30.2 LEVELS OF PLANNING

Planning is carried out at various levels. Beginning from a small local area to as large area as the world planning is an integral part of human progress and area development. People have been planning their affairs, activities, habitats, etc. from early times. It is, thus a continuous process across time and areas and is aimed at the welfare of people and the environment. At the global level, planning for the whole world is taken up by the United Nations and countries provide cooperation in the implementation of the planning schemes. Various programmes such as UNEP, UNDP, etc. are initiated to deal with the global issues of environment, poverty, development, and so on. At the country level, national plans are formulated for the welfare and development of the nation. In our country, Planning Commission is the central agency to design plans for various sectors of economy such as agriculture, industry, etc; different ecological zones like mountains, deserts, coastal areas etc. and different segments of society such as women, children, tribal groups, youths, aged persons, etc. Prime Minister is the Chairman of the Planning Commission. Nation is further subdivided into several sub-units for administrative and planning purposes. It varies from country to country with different nonenclature. In our country, the nation is sub divided into states, districts and blocks. At the state level there is a State Planning Board that develops plan for the entire state. This is also known as a regional plan. Chief Minister of the state is the Chairman of the State Planning Board. Districts are the third order planning units after nation and the states. At the district level, planning and development agencies work together and District Magistrate coordinates the plan implementation. Community Development Blocks are the fourth (micro) level planning units. Each C.D. Block consists of about 50 villages. These blocks are responsible for plan implementation down to the village and household levels. Block Development Officer (B.D.O.) is the co-ordinator of the plan at this level of planning. Local area planning is meant for small localities like a village, a Basti or Mohalla. The entire community, living and working at the place, is responsible for developing plans and seeking assistance and cooperation from the Governmental Organization, Non-Governmental Organization and others. It is not the endeavour of a few people but hardwork of many that makes the local area clean, green and prosperous.

A diagrammatic presentation of various planning level is given below:

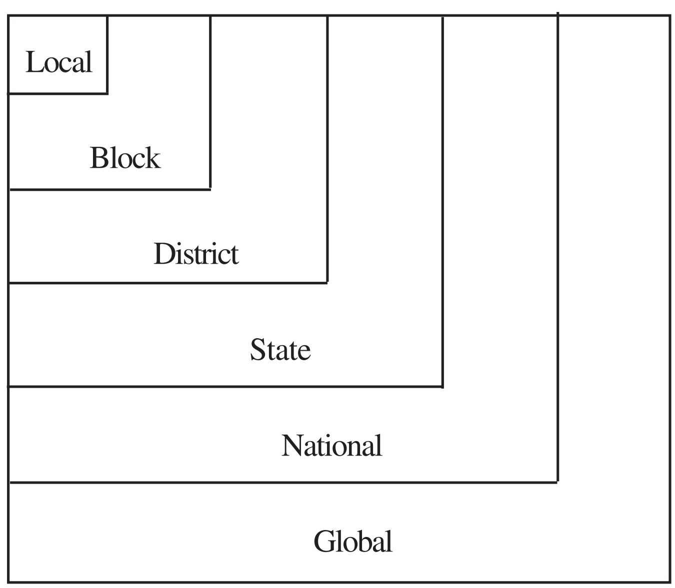


Fig. 30.2 Planning Levels

Table No. 30.1 Planning Levels

Type of planning	*Level*
Global Planning	I
National Planning	II
State Planning	III
District Planning	IV
Block or Micro Level Planning	V
Local area Planning	VI

30.3 CHALLENGES TO PLANNING

There are serious challenges to the success of a planning scheme. More often planning is initiated without giving adequate thought to its effect on the area and people for whom it is meant. Since a planning scheme moves from top to bottom, it gets obstructed at various levels before it reaches to the target area and people. Inspite of relatively higher economic development, India continues to run behind in terms of social advancement. Our country has the largest concentration of poor, malnutritioned and illiterate persons. These serious challenges can not be managed through governmental or some non-governmental agency level but one requires effective partipation and co-operation of the local people. People wish and plan that roads reach to their door steps, every child studies in a school, they have power and potable water, they have water to irrigate their fields and markets to sell their local products. Thus, infrastructure related to health and education can ensure people's awareness, effective participation and mobilization for the success of planning scheme. Ecological and economic considerations must be in perfect balance if planning has to succeed and remain sustainable.

The following are the basic requirements of local area planning:

1) Formulation of objectives or goals.
2) Fixing targets of planning and its priorities to be achieved.
3) Mobilisation of resources for the execution of plan.
4) Creating necessary social group or organization for the implementation of the plan.
5) Regular evaluation and monitoring of the progress made.

INTEXT QUESTIONS 30.1

1. Define local area and planning.

____

2. What are the various levels of planning in India?

____

3. Enumerate three challenges to planning of an area.

____

4. What are the basic expectations of the people from Planning?

____

5. What are the basic requirements of planning?

____

30.4 BASES OF PLANNING

There may be several bases of planning but here we are discussing only the bases of planning i.e. ecological and socio-economics.

A. Ecological Basis of Planning

The study which explains the interrelationships among all natural organisms with their environment is termed as Ecology. All those conditions, circumstances and influences that affect the development of an organism or a group of organisms is the environment. Thus, ecology and environment are closely related with each other in the context of organisms and systems that influence them. Geographically, the exchange of matter between land and sea is set in motion by two main physio-geographical processes.

The interaction between man and nature is inseparable. It is the highest form of interaction between life in general and the environment in particular. The diversity of life forms that has evolved over hundreds of millions of years and their adoptation to different, often extreme environmental conditions are amazing. The interaction of human beings with nature began at the time they separated themselves from the natural environment. The relations between man and nature take shape within his habitat.

The experience of man-nature interaction is an age old practice of planning. To make the best use of nature, man has been making necessary adjustments in the ecological setup. The domestication of wild animals, selection of useful plants from the natural vegetation, making terraces on the mountain slopes, taming the rivers for irrigation or flood control etc. are a few examples of planning the welfare of people while keeping a balance on the ecological setup. Human habitations were planned in close proximity to water sources, work sites and on the considerations of safety and mobility. Most of the primary persuits like agriculture, horticulture, sericulture, etc. are based on the natural considerations of productivity. Similarly, some of the secondary production systems such as software, paper, many foot loose industries etc. are also designed in a manner that causes minimum disturbance to the ecological setup. However, growing human needs and commercial considerations have caused serious damages to the ecological setup. Large scale developmental activities, deforestation, structural changes, waste generation, and so on have accelerated desertification, global warming, melting of ice caps, rise in the sea level, natural disasters, etc.

B. Socio-Economic Basis of Planning

The population of the earth is increasing rapidly and has registered above 6 billion mark. To meet the ever increasing needs of the people, utilisation of natural resources will grow. It is, therefore, necessary to maintain a balance between the scope of resource utilisation in a given ecological setup and human needs. The socio-economic planning has to remain eco-friendly for sustainable development. Besides utilising natural resources, sustained efforts need to be made to develop local surroundings, streets, drains, parks, playgrounds, open spaces, etc. with landscapes and tree plantations. The designs for tree plantations need to be developed based on the geological structure, relief, climatic conditions, soil, drainage system and natural vegetation. Depending upon the available space, growing conditions of plants, local weather and climatic conditions; indigenous varieties of dwarf, medium and large trees need to be planted. For promoting and maintaining the local environment, peoples support is essential. In turn, a healthy local ecological setup satisfies several needs of the local people besides presenting a pleasing view of green surroundings.

30.5 DIMENSIONS OF LOCAL AREA PLANNING

A Basic And Higher Needs

The welfare of "local" community depends upon fulfilling the basic as well as higher needs of the people. The basic needs include food, cloth and shelter besides safe drinking water, basic education and health care, transport and communication facilities and so on. The higher needs include still higher order amenities, services, facilities etc. While basic needs are necessary for survival, higher needs help the society to become efficient, service oriented and dynamic. The process of planning is aimed at making the necessary provisions to meet the demands of people and places. Several schemes of planning are designed to fulfill the general as well as functional needs of the people. However, dynamics of population growth and concentration of activities at specific sites pose a challenge to the planning process.

B Dynamics of Population Growth And Prospects of Planning

In places where growth of population remains normal, functional activities are largely unchanged and scheme of planning records success. For example civil lines, mall roads, cantonment settlements etc. present a striking balance between the provision of amenities and facilities with the growth of local population and concentration of functions and activities. On the contrary, the local areas where population growth is high and concentration of activities continues unchecked, the performance of planning usually remains poor. For example busy markets, industrial sites, transport junctions, slum settlements and so on. register a higher population growth and concentration of activities. It leads to the congestion and crowding reflecting the poor planning performances.

In the absence of adequate job opportunities in rural and backward regions, most of the rural youths out migrate towards cities. It leads to poor economic performance in the places of origin and unchecked concentration of population in the places of destination. While it leads to clustering in living spaces due to limited paying capacity of the migrant population, it offers adequate cheap labour to cities. The mismatch between population growth and provision of services, facilities and amenities causes unhygenic sanitary conditions, poor public health and above all degeneration of local environment. Thus, the provisions of planning falls short of the growing local demands in these areas.

C Economic Basis For Stability And Development

The economic development of an area is another dimension of local area planning. It aims at raising the production and service levels, job generation, improved marketing network, favourable price policy, efficient systems of transport and communication, etc. Economically advanced areas are usually capable of making significant investments towards natural conservation and ecological improvements. Similarly, social infrastructure and facilities can also be created if areas have a sound economic base.

Almost all areas-rural or urban are endowed with natural potentials. While primary activities dominate in rural areas, secondary and tertiary activities dominate the urban areas. The pace of economic growth is accelerated through technological innovations and institutional backup. Mechanisation of agriculture and modernisation of industries are the examples of technological innovations, while financial, educational and policy backups are the institutional roles in improving the economic base of an area. Issues such as the interests of producers, consumers, service providers and workers be taken care of in the planning. The status of income and employment generation, capcities of savings and investments will increase as a natural outcome of economic package. It has been observed that many of the economic packages turn out to be rewarding in the course of time. Reed works of Shillong, brassware works of Moradabad, silk and zari works of Varanasi and Kanjivaram, bandhani works of Sanganer, embroidery works of Lucknow, etc. are a few examples of success stories that had the backup of economic planning. Thus, the products and services of a local area mark the place identity and people's prosperity.

D People's Participation in Planning

Awareness of the people and their participation in the local area planning can safeguard the interest of the community while maintaining the local ecological situations. The chances of the failure of a planning scheme, that involves local people, remain minimum as corruption, exploitation and mismanagement is greatly checked. Besides, above people being direct beneficiaries, keep a caring attitude towards maintaining the social welfare and area development. When local people develop a plan and set their priorities, it will maximise benefits to the people and minimize the cost of planning. It is more likely that the planning augments the cycle of growth and diversities in developmental activities.

INTEXT QUESTIONS 30.2

1. Give two examples of eco-friendly planning.

   (i)____________________(ii)____________________

2. What is the need for maintaining a balance between resources and human requirements?

   ____

3. What basis should be adopted for designing tree plantations in a local area?

   ____

4. Give two examples each of basic and higher needs.

   (a) (i)____________________(ii)____________________

   (b) (i)____________________(ii)____________________

5. Enlist two effects each of technological innovations and institutional support.

   (a) (i)____________________(ii)____________________

   (b) (i)____________________(ii)____________________

30.6 NEED BASED UTILISATION OF LOCAL RESOURCES

Resources of the area are being utilised by the local people to satisfy their needs. The air, water, food, cloth and shelter are the essential needs for human survival. Both inorganic as well as organic matters of the nature satisfy the basic needs of the local people. Selection of useful plants, animals and natural sites led to the promotion of human activities such as farming, fishing, horticulture and nomadic herding. The local needs of building construction, having of streets, drains, sources of water, scenic landscapes, etc. are fulfilled by local resources. Since most of the materials are the common property of the local people, they have been utilised by all as building materials and means of livelihood. Thus need based utilisation of local resources remained eco-friendly and economically sustainable. A brief discussion about local resources is given below.

A. Land Resources : Rocks And Soils

The most striking feature of a local area is its rocks and soils. These land resources are the basis of human settlements and primary activities besides being the base for scenic landscape. The exposed rock surfaces act as natural platforms while its slopes and steps remained the basis for plant growth. The places in such a setup are developed as sites for picnic, parks and natural beauties.

Soils are the basis for a variety of human activities such as agriculture, animal herding, horticulture, etc. The fertile soils have always been a source of attraction for human civilisations and development. However, this rare gift of nature is threatened by massive erosion and degradation, and is fast converted to wastelands. Large scale deforestation and commercial uses of land have caused imbalances in soil setup. Since formation of soil, its renewability and replacements require pretty long period, there is an urgent need for soil conservation and maintenance of its natural fertility.

B. Water Resources

One of the most basic requirement for life to develop and sustain on long term basis is the availability of water. It is central to all ecosystems. Most of the early human civilsations developed near water sources especially along fertile river valleys. Both for human activities and settlements water is an essential element. Water is being used for a variety of purposes like power generation, irrigation, for domestic and industrial uses besides keeping the local area clean and green.

Misuse of water has created shortage. Water pollution have caused diseases. Droughts and floods occure in different areas. Therefore, mangement of water is an essential requirement for life. Coordinated efforts need to be made towards water harvesting, reducing wastage of water and making judicious use of water for various purposes. Recharge of water to subsurface layer of soil is essential to check the surface flow of rain water. Use of tanks, lakes, percolation pits, bunds along the sloppy surface, help in the recharge of water.

C. Plantations /Forest Resources

Plants are the basic form of life and act as the source of oxygen. They are means to livelihood and natural attraction. Due to ever increasing pressure of population, forest cover is fast declining causing serious environmental threats. Tree plantations along highways, railway tracts, hill slopes, canals have developed schemes like social forestry, farm forestry and so on.

Concerted efforts of the local people are central to plantations and their protection. It is being carried out in the form of rituals and practice of the people. For example, Bisnoi community is known for plant protection especially in parts of Haryana and Rajasthan. Similarly, Maiti is a marriage ritual practiced in Kumaon hills. During marriage ceremony bride plants a sapling and bridegroom puts water on the plant. This practice has converted many villages green in Kumaon.

Since trees provide building materials, fuel and firewood besides, a variety of fruits, flowers and green cover, protection, promotion of tree cover is basic to life support. At the local level, protection and increase of the tree cover is basic to support life.

30.7 ASSESSING THE LOCAL RESOURCES

An assessment of local resources is essential for planning. For finding solutions to the local problems as well as for the purposes of development we need to have an idea of local resources. Usually land, soil, water, forests, animals, other organisms, minerals and so on form the natural resources of an area. Similarly, human being, their educational levels, human activities, skills, health status, etc form human resources. An inventory of locally available resources need to be prepared with the help of records of the area and by conducting a field survey. For example with regard to land resources an idea of the total area (of the village or an urban locality), nature of rocks and soils, size of the land holdings, number of plots, nature and type of landuse, etc. should to be recorded. Similarly, in case of water resources, a survey of river, drains, ponds, lakes; their appromate length, width and depth of water need to be known to get an idea of water availability, water surplus or deficit positions, major problems linked to consumption water. An estimate of trees, seasonal plants, their specific use for the community in the form of fire wood, fuel, timber, fruits, and flowers need to be worked out. Similarly, human as well as animal resources should to be assessed.

A. Sources of collecting data to assess local resources

Thus for assessing local resources, we can make use of governmental and non governmental sources. Besides collecting information through secondary sources, we can also conduct field survey to collect certain informations or primary data that is not available from secondary sources.

B. Preparing a Plan and Ensuring its Implementation

Based on the assessment of local resources a plan of action need to be prepared. This should broadly cover the aspects of education, health, transport, communication, retail markets etc. The plan should also cover the promotion of agricultural and industrial activities besides community functions. The formulation of the plan must be based on the availability of local resources, requirements of the people, likely expenditures and estimated benefits to the people. The plan should be phased out with regard to time and the targets when the work is to be completed.

For ensuring the implementation of Local Area Plan, efforts should to be made to mobilise the support of local people in the form of labour, raw material, skill and guidance. In addition to it, the support of governmental, non-governmental organisations, self help groups etc. need to be obtained in the form of finances, technology and material help. Effective checks and controls should be exercised to ensure the monitoring of the work done.

It is usually observed that the maintenance of the structure once created by planning, remains poor due to misuse or careless handling of the operating/services such as buildings, tap water, public toilets etc. The local resources should not be exposed for commercial utilisation by non local people as it leads to excessive exploitation of resources and their subsequent depletion. It is, thus, necessary for the local people to be caring and remain concerned about the maintenance and upkeep of the planned projects.

It is, thus, established that need based utilisation of local resources is essential for survival and development of the community. However, balance needs to be maintained between the ecological conditions and socio-economic needs of the community. The process of planning, as such, will vary greatly with the ecological settings and socio-economic needs of the local people.

30.8 DEVELOPMENT OVER DIFFERENT FIVE YEAR PLANS

India is making planned efforts to develop its economy, society and areas. Plans are designed for a period of five years. India's First Five Year Plan began in 1951 and currently it is the Tenth Five Year Plan period. The progress made so far is a record of 55 years of planned effort in India covered through ten Five Year Plans and a few annual plans. A brief idea of different plans, their local area designs and special emphasis of development is explained through a chart given below.

Table No. 30.2
Local Area Development over Different Five Year Plans

Plan and its Period	**Design of Local Area**	**Special Emphasis on Development**
1. First Five Year Plan 1951 – 1956	Community Development Blocks Identified	Developing irrigation networks and increasing agricultural Productions
2. Second Five Year Plan 1956 – 1961	Industrial Estates were established.	Self reliance in industrial development
3. Third Five Year Plan 1961 – 1974	Intensive Agricultural District Programme (IADP)	Achieving higher output levels both in agricultural and Industrial sectors of economy.
4. Fourth Five Year Plan 1969 – 1974	Balanced Regional Development (BRD), Command Area Development (CADP)	Target Area Target Group

5. Fifth Five Year Plan 1971 – 1979	Decentrailised Planning Tribal Area, Hill Area Drought Prone Area Development Programme.	National Programme of Minimum Needs, Integrated Rural Development Programme (IRDP)
6. Sixth Five Year Plan 1980 – 1985	Multi Sectoral Approach DWCRA TRYCEM, RLEGP	Removal of Poverty Small Farmers Development Border Areas, Backward (SFDA) Districts
7. Seventh Five Year Plan 1985 – 1990	Agro – climatic zones, water shed Development	Self employment Scheme (SES), Jawahar Rojgar Yojana (JRY)
8. Eighth Five Year Plan 1992 – 1997	Panchayati Raj Institutions HADP, BADP WGDP NEC	Human Resource Development, Economic Diversification
9. Ninth Five Year Plan 1997 – 2002	Basic Minimum Services (BMS)	Human resource Development, Housing to the people, Health education in remote rural areas.
10. Tenth Five Year Plan 2002 – 2007	Cleaning of major rivers, Rain water harvesting (renewal of traditional methods.) Interlinking of rivers water, Harvesting in drier regions.	Public Delivery system (PDS), Total Literacy compaign, National Literacy Mission (NLM), Provision of urban Amenities in Rural Areas (PURA), Health for All.

INTEXT QUESTIONS 30.3

1. What is the role of local people in area planning.

____

2. What were the special emphasis of development during first and second Five Year Plans?

____

3. What are the aims of Tenth Five Year Plan?

   ____

4. Match the plans shown in column I with the local area planning recommended in column II.

	Column I Plan		Column II Local Area Planning Recommended
A	IInd Five Year Plan	1.	Balanced Regional Development.
B	IVth Five Year Plan	2.	Industrial estates for self reliance in industrial development.
C	Vth Five Year Plan	3.	Removal of Poverty, DWCRA, TRYCEM, RLEGP
D	VIth Five Year Plan	4.	Cleaning of major rivers, TLC, NLM & PURA. Rain water harvesting
E	Xth Five Year Plan	5.	Integrated Rural Development Programme (IRDP)

30.9 UNIQUE NEEDS OF DIFFERENT PLANNING AREAS

Nature has provided some resources to all areas which can help to develop the regions. Different areas have distinct problems and potentials. Hence it present, unique needs for planning. But every area which has problems has also possibilities to solve such problems. As such, there is a need to develop specific plans for the welfare of people and the development of the specific areas. For example mining areas have large mineral deposits. But, by and large, these areas are faced with the problems of health and natural hazards, noise pollution, collapse mine roofs, waterlogging and so on. The problems of mining areas could be specially taken up for planning.

A slum locality in a city is usually faced with the problems of poor sanitation, insufficient living space, acute shortage of basic social facilities and amenities. The quality of life is poor and full of health hazards. As such it demands for an urgent provision for essential infrastructures in its local area planning charge. Industrial areas are faced with the problems of pollutions, while market areas are faced with congestion, crowding and poor saintation. As a result industrial areas will have priority of planning for pollution control, while market areas will have priority to develop other centers of marketing to relieve the pressure and reduce congestion and crowding.

Agricultural areas have problems of floods and droughts, soil erosion, declining natural fertility and shrinking land-man ratio while pastoral areas suffer from the problems of range and management, conversion of grasslands into farmlands etc. The diversification in cropping pattern, cropping efficiency and increasing agricultural productivity are the priorities of agricultural planning while controlled grazing and effective range, land management and commercial pastoralism are the planning priorities in pastoral areas.

Areas with diverse physical and socio-economic set up have their unique needs. It calls for need based planning solutions. For example hill areas have steep slopes, deep valleys, thin layer of soil and relatively low level of carrying capacity of land. Hill areas, therefore, need afforestation, promotion of horticulture, herbal and medicinal plants, eco-tourism and small hydro-power projects for their development. Similarly, desert areas are characterized by the acute shortage of water leading to the vast expanse of wastelands, sand dunes and barren areas. The desert development requires the provision of water as its top planning priority. Indira Gandhi Canal serves the purpose of need based planning for the desert development in the Thar region of India.

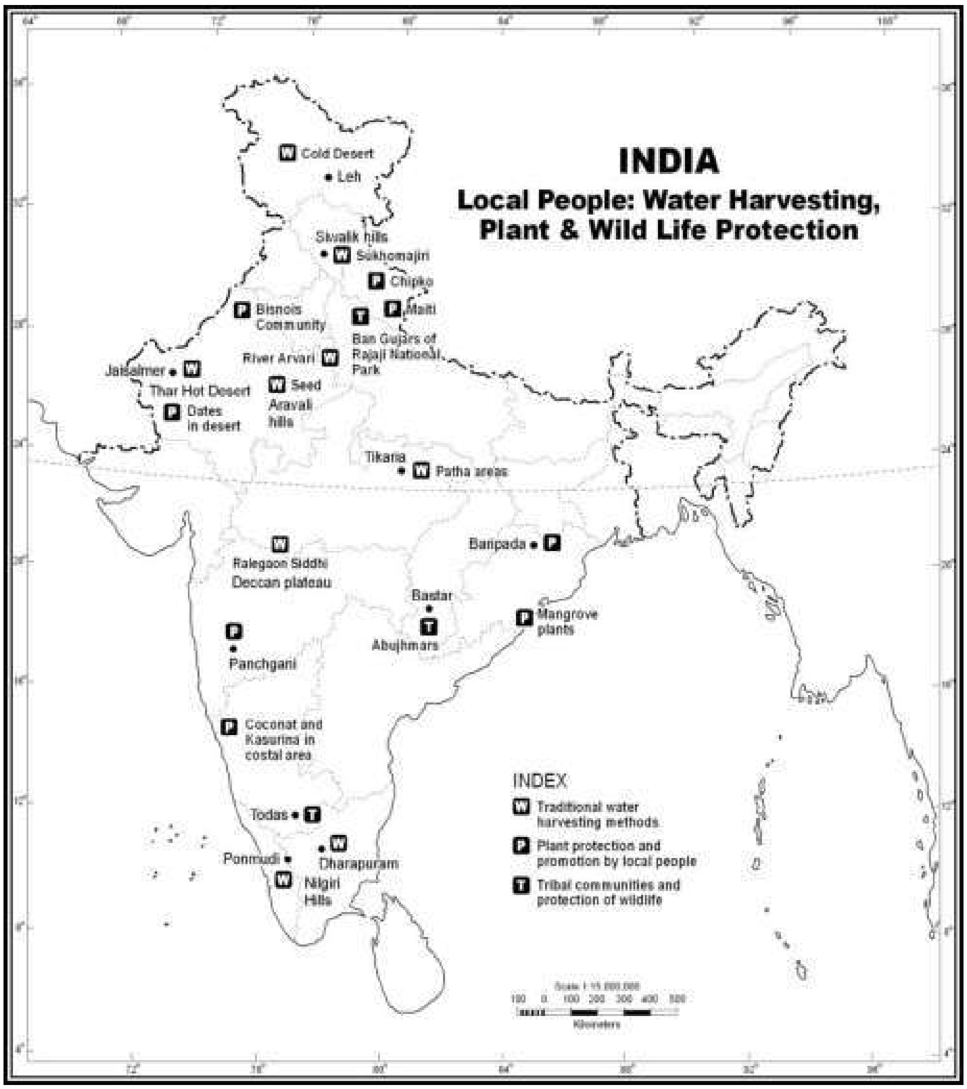


Fig. 30.3 INDIA: Local people: water harvesting and wild life protection

A brief discussion on need based planning is given below:

A. Water Harvesting and Management

These areas reveal scientific and judicious use of water. from remote cold desert of Leh to hot desert of Thar; from Patha area of central India to far south in Kerala and Tamilnadu, water management techniques have completely changed the lives and landscape in these areas. (Recent examples of Arvari in Rajasthan and Tikaria in Patha area of central India are the initiatives of local people for managing water resources of the area). Traditional water harvesting and management methods are also found in every part of India.

B. Protection and Promotion of Forests

Plants and animals need protection and promotion for keeping the ecological and biological balance in a locality. People have been partly protecting plants and animals due to religion and partly due to prevailing customs and traditions. Sacred groves are protected due to age old practice and ritual. They signify the judicious use of natural resources in the long term interest of the community.

> Plants like Pipal, Neem, Tulsi, Beri are sacred in Hindu tradition while Dates, Oak, Bargad are sacred in Islamic, Christian and Buddhist traditions respectively.

Depending upon the ecological canditions in different areas, plants are protected. Such as coconut and casurina in coastal areas, Dates and Beri in desert areas and orchards in hill areas are part of the regional practices towards protection and promotion. There is also a similar tradition of protecting sacred animals like cow, goats and sheep, camels, snake and so on.

C. Tribal Communities and Protection of Wild Life

Tribal communities and wild life both are faced with the problems of survival and development in the face of deforestation. Forest dwellers have protected wildlife, for example Ban Gujars of Rajaji National Park (Uttarnchal), Abujhmars of Bastar and Todas of Nilgiri Hills are known for their skill in wild life protection. However, some of these forest dwellers are now evicted and rehabititated in areas where they have no access to forests. This has happened in Nagarhole National Park in Karnataka and Rajaji National Park in Uttaranchal. Involvement of tribal people and protection of their forest rights has now succeeded in using better methods of wild life protection.

D. Power to People : Local Level Environment Management

Environmental management at the local level is giving power to the people to manage their natural resources. Even after spending large sums on development and welfare activities, India could not perform too well intackling environmental management. It is, therefore, widely felt that local affairs should to be managed by local people for taking care of their needs and aspirations. The 73rd and 74th amendments to the constitution have made decentralized planning possible in a democracy. A few examples of local level environmental management are shown on the map Fig. No. 30.4.

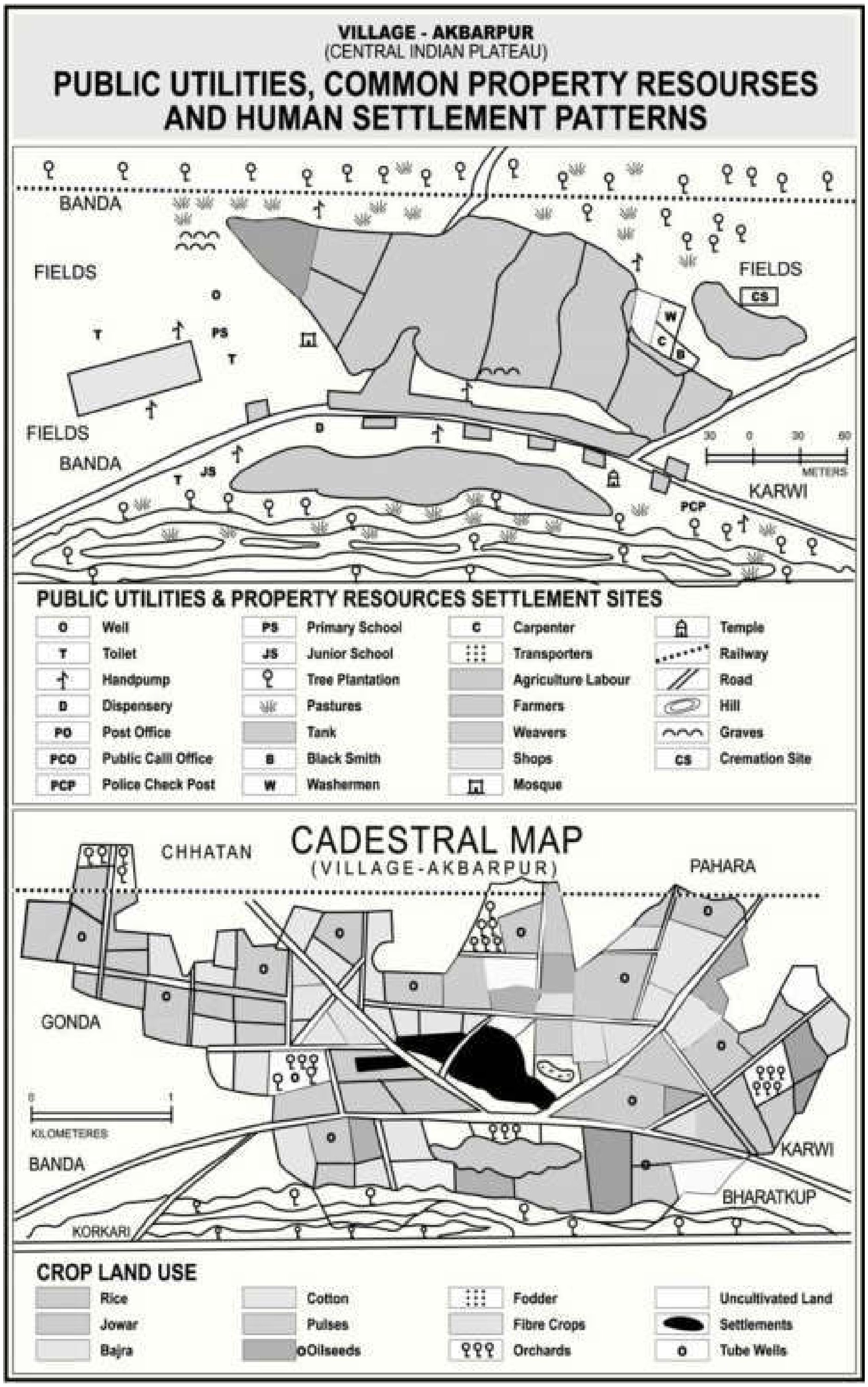


Fig. 30.4 Village Akbarpur

Constructing tanks, bunds, mini reservoirs for water harvesting, plantations along sloppy tracks and controlled pastoral activities are some of the local initiatives that have improved the quality of environment.

30.10 RESOURCE UTILISATION AND INTERRELATIONSHIPS

Resources are all the materials and objects that are ready for use or available as needed by people. Utilisation of resource is a situation in which a commodity in nature is used. These should be balanced utilization of reasources. Resources utilised beyond the critical limit or without replacement leads to imbalances in the ecosystems and ultimately in the environment. Thus the rationale use of resources is of utmost importance. It helps human progress in the long run.

A. Types and Utilisation of Resources:

Primarily, there are two kinds of resources : **non renewable** (mineral wealth) which exhaust after bearing utilized once and there is a certain fixed amount of such resources in the world; and **renewable resources** (fresh water in rivers, oxygen in the atmosphere, the forests and the biological mass), which come from natural processes taking place on the earth and are balanced between annual increase and annual consumption, including the utilisation by human beings. Let us see how the environment influences man and in turn what influence society exerts on the nature. Today there is hardly a place where human beings would not be able to live and work. The effect of human intervention is on the increase in nature. For example while extracting mineral wealth, burning fuel, or irrigating crops in arid lands, we extract certain substances from nature. Similarly, while discharging industrial and agricultural waste and other such by products into the atmosphere and hydrosphere, we introduce new components into the environment. By Farming marshlands or piping water for household and industrial needs, we alter some of the elements of the water balance. The fragile ecosystems like mountains and valley areas are threatened by Felling of trees, road constructions, blasting of rocks and constructing mega dam projects. These activities are responsible for changes in the structure of earth surface and imbalances in the ecological set up.

The use of soil resources for crop production, commercial plantation and pastures are eco-friendly activities carried out by human beings. However, unscientific practices of high intensily or cropping or overgrazing leads to soil erosion and becomes a challenge to the ecosystem. Similarly, deforestation, slash and burn cultivation, polluting industries etc. cause ecological as well as environmental crisis. Hence, it is important to understand the local resources and their utilisation in a eco-friendly and sustainable manner failing which ecological crisis will be inevitable.

B. Depletion of Resources

People have drawn quite a lot through their activities from our natural resources both renewable and non renewable. Some of them are depleted to a large extent or almost in full and others far a lesser degree. Human activities have increased to the extent that it alters the established patterns of cyclic movement of matter affecting the natural course of various processes on the Earth's surface.

The depletion of resources , the growing impact of humans on nature and above all the pollution of environment are matters of growing concern. This concern is further highlighted by the energy crisis and increasing food shortage. As a consequence, very serious ecological crisis is likely to occur. However, it will be possible to avoid the crisis, if measures are taken up to utilise resources on a rational manner, and a policy to conserve resources is adopted beginning from local to global levels.

C. Optimal Resource Utilisation

The transformation of environment in the course of production by society is inevitable. Not only human society but infact any form of life affects Nature with its activity. Ecologists persist in their belief that the development of society will inevitably have negative effects on humans. These consequences in association with the depletion of resources augments ecological as well as economic crisis.

The efforts of local area planning are aimed at maintaining a critical balance between available natural resources and their optimal utilisation in a sustainable manner, while private enterprise is guided solely by the profit motive regardless of social benefits or evils.

It has been seen that the public sector development too suffers from a bias towards developing areas for political or commercial reasons. For example production of luxuries on a commercial scale leads to the exhaustion of resources. As a result the masses suffer even for the bare necessities of life. Since both public as well as private sector enterprises suffer from inherent weaknesses in the system, people's participation in planning and management of resources is of utmost significance.

The utilization of resources must be guided by the availability, existing efficiency and current and future needs of the society. The continuous monitoring of conservation practices keeping in mind the cyclic process of resource renewal and search for viable alternatives are some of the measures to meet the challenges of resources depletion.

INTEXT QUESTIONS 30.4

1. How local needs vary from area to area?

   ____

2. How are local resources important for local area planning?

   ____

3. What is a resource depletion?

____

4. What is optimal resource utilization?

____

30.11 USE OF MAPS IN MANAGING THE LOCAL AREA PLANNING

Knowledge about the local area, where people live and work, is of prime importance. The precise, accurate and comprehensive knowledge helps to manage and plan in an effective manner. Understanding the capacity of land, work efficiency of the people and their belief system is essential to develop a local area plan. The acquired knowledge information needs to be transferred in some presentable form for discussion and interactions on the theme; supervising activities and guidance. The primary data, the issues and problems needs to be organized in a systematic manner reflecting the qualities over the land. For this maps diagrams charts, photographs and sketches are very necessary. Maps act as a shorthand script to planners and geographers and a guide to common people.

Local areas vary significantly in their physical set up and socio-economic conditions. There are different techniques to record and display the informations/knowledge. Among various forms of presenting information maps are the most effective tools of knowledge as they use scales and directions for true representation and theme specific focus. Besides the above, maps are easy to handle, comprehend and communicate through.

A. Use of Maps, Sketches and Photographs

Maps are used for a variety of purposes. They are used for the identification of landforms, resources, human settlements and site specific facilities and amentities. Maps are also used to show designs of buildings, transport routes and planning for the location of various activities such as markets, industries, schools, parks, playgrounds etc.The exercise on the feasibilities and viability of a planning project is also assessed through its maps. A drawing without having a scale, direction and projection is called as a sketch map. Sketches are used as a rough drawing for on the spot representation of facts and a remembrance for the records. These sketch maps and photographs are quite useful for finalizing the blue print of a local area planning.

B. Choosing the size and scale of Maps for Local Area Planning

Among various factors that have to be considered while preparing a map, the size of map, details to be shown, choice of the scale etc. are quite important. The size of a map will, in its turn, determine the scope of elements to be covered. The details to be shown determine the symbolization and shades for each element. The choice of the scale is guided by the space available for representing facts of the area on the map. Scale is a ratio between the map distance and the ground distance. Based on the requirement maps could be small or large scales. Small scale maps are used to show large areas with a few details. For example world maps, wall maps, atlas maps etc. are drawn on small scales. On the other hand, large scales are used to represent the plan of a building, agricultural fields/plots of a village locality topographical sheets etc. For local area planning, disaster management, public distribution systems and so on large scale maps are used as they depict many informations of a small area in detail.

C. Maps in Managing the Local Area Planning

Maps are the basic tools for builders, developers, managers and planners. They act as guides to the visitors and ideals of achievements to the participants, planners and the people. Maps are the blue prints of the future plans.

A base map is essential for planning the local area. It helps to conduct surveys related to land use, market, traffic consumer, household etc. Base maps help in developing other theme specific maps, diagrams and charts. It is a guide to the locality and the people for whom planning is to be conducted.

A draft plan map is prepared based on the results of the field-work. The need based planning proposals, their sites, designs, details of the cost are depicted on the large scale map. The draft map helps in holding discussion and inviting suggestions from the experts and the local people. The discussions and suggestions, finally help in designing the blue print for the planning.

Maps act as a base for knowing local area demands like buildings for public use such as schools, hospitals etc. funds, facilities, measurements of different kinds and expected expenditures or costs. Since maps carry detailed informations and are self explanatory also, they become a direct appeal to the funding agencies for their approval. Theme specific maps help in presentations, logical argumentation and step wise implementation of the local area plan.

Use of modern technology in mapping like computer cartography, GIS, image processing etc. has made it possible to prepare maps of various kinds on different scales. Similarly, communication technology like internet, online, website etc. present scopes for transferring knowledge to other people and places. Thus mapping and communication technologies have a direct relevance to local area planning.

30.12 A CASE STUDY OF LOCALAREA PLANNING : VILLAGE AKABARPUR (BANDA, UTTAR PRADESH)

The village Akbarpur, district, Banda, the state of Uttar Pradesh. Geographically, the village lies at about 25^{o} 12 'North latitude and 80^{o} 47' East longitude. The village is located in the northern margin of Central Indian plateau and forms the part of Bundelkhand region.

Vindhyan hills and Badause forest range forms the southern and south western limits of the village. Towards north the village has common boundary with villages Chhatan and Pahara, while towards the south it has common boundary with Gonda, Kurari and Bharatkup. The general slope of the land is from south-west to north-east. In terms of structural formation, the Vindhyan sandstone forms the upper surface upon which Trans-Yamuna alluvial soil forms the top layer. However, there are mainly three types of soils in the village. The forest and hill soil found along the foothills and is characterized by the pieces of pebbles mixed in the thin soil cover. The black and yellow mixed soils are commonly found in the middle zone, while black alluvial soil dominate in the northern part of the village.

Akbarpur experiences a transitional climate between hot moist climate of north east and hot dry climate of Thar desert. It records high temperatures during summer ranging between 40^0-45^0C and low temperatures during winter ranging between 5^0-10^0C. Most of the rainfall occurs during summer monsoon months. The amount of average annual rainfall ranges between 55-80 centimetres.

The village has a mosque towards the west and temple towards the south-east. While majority of the village population belongs to Hindu Community, about one fifth of the population belongs to Muslim Community as well. It is a multi-occupational village having farmers, pastoralists, artesans, transporters, traders and other service providers. Thus village has a harmonious group of people.

(i) Socio-Economic Setup:-

Having an area of 1582 acres and a population of 3952 persons in the year 2005, Akbarpur is a medium size village. There are 382 households in the village. Nearly half of the households (197) belong to farming communities followed by agricultural labourers (106). Thus about 76.7 per cent households are directly engaged in agricultural activities. Nearly 15 percent households belong to the weavers community and remaining about 8 percent households belong to the category of artisans and other service providers. In terms of land holding less than 1 percent (0.94%) are large farmers, nearly 9 percent (8.91%) medium farmers and remaining large majority are the small and marginal farmers. Landless agricultural labourers account for about 37 percent of the total households in the village.

Nearly 37 percent of the total population is literate. Of the total population, about 39.52 percent are the workers of which nearly 36 percent are the main workers and about 3 percent are the marginal workers. Main workers are those who remain engaged in specific works throughout the year, whereas marginal workers are employed for some part of the year on supplementary basis. In terms of general land use about 113 acres are not available for cultivation. The cultivable waste and fallow land account for 119 acres. The forest area of the village account for about 20.54 areas while total cultivable land is 646 acres. The actual area under cultivation is 379 acres of which nearly three fourth (287 acres) is reported to be irrigated.

In terms of connectivity the village is well served by Jhansi-Allahabad highway and Jhansi - Manikpur section of Central railway. Towards the east city of Allahabad lies at a distance of about 135 kilometres and Kowri Town at about 15 Kilometres, while towards west Banda lies at a distance of 55 Kilometres. There is a bus stand in the village and the nearest railway station is at 1½ kilometre.

(ii) Agricultural Landuse

Agricultural landuse changes from season to season. Nearly 63 percent of the net sown area is devoted to kharif crops, while about 36 percent of the net sown area is devoted to rabi crops and remaining about 1 percent area to zaid crops. An account of kharif crops is presented here. Of the total cultivated land in kharif season rice accounted for about 32 percent, jowar nearby 25 percent and bajra about 24 percent. Thus about 82 percent of the cropped area is devoted to these three crops only. Among other kharif crops cotton accounted for about 8.00 per cent, pulses about 4.68 percent and oil seeds about 2.78 percent. Orchards and fibre crops account for 1 per cent each.

(iii) Amenities and Social Facilities

An account of amenities and social facilities reflect the level of social infrastructure in the locality. These are the basic requirements for all types of development. There are five personal phone sets besides one public call office in the village. Being located at the road side, there is a request bus stop in the village. Similarly, Bharatkup is the nearest railway station and is at a short distance of one and a half kilometer from the village. In terms of educational facilities the village has one primary as well as one junior high-school. There are two medical practioners and a government dispensary. A small rural market has also developed along the road side. There are nine small shops dealing with sweets and refreshment, tea, betel, general merchandise, stone pieces, firewood, repair shade, medical practitioner etc. The village has a security check post. In terms of drinking water facility, there are five wells in the village, 17 private handpumps and three handpumps installed by the Governments.

(iv) Common Property Resources

The identification and utilization of common properly resources for the welfare of the community is an important basis of developing a locality. Village Akbarpur has a large stock of common land, water, grasses and trees which need to be managed and maintained for the long term welfare of the local society. In terms of land resources Vindhyan Hills in the south offer stone pieces and blocks of stones, black, yellow and stony soils offer construction material besides acting as basis for all primary activities. In terms of water, village has one large and one small pond. While large pond lies close to the hills, small pond is towards the northeastern side. These ponds are very common sites in platean areas and are the basis for supply of water to animals and wild life. These ponds also serve as a basis for fisheries for local consumption and raising crops like water nuts, lotus etc. Grasslands are the common property resource in the village. They are found as pieces of land along railway and highway tracts, along river, streams and adjacent to hilly tract in the south. Domestic animals of the village like sheeps, goats, cows, baffaloes, oxen ponies etc. graze in these pastures. Trees are yet another important common property resources. These trees provide valuable fruits, flowers, furniture wood and fire woods besides giving green look to the surroundings. Mangoes and Mahua are the large trees and are known for their commercial value in terms of fruits, flowers and furniture wood. Eucalyptus, Babool, Neem etc. are other trees used for furniture and fuel by the local residents. Kadam, Kaner bushes etc. are dwarf trees used by sheep goats for grazing besides being used as flowering plants in the hill slopes.

(v) Planning Proposals

Based on the above description certain planning proposals can be developed. These proposals could be divided into ecological, social and economic set of planning.

A. Ecological Planning

The ecological planning aims at improving the general environmental conditions of the locality. This could be planned interms of improving land, water and green cover in the village. The conservation practices of checking soil erosion, land scape sculptures along the hill slopes, bio-manures in the fields could be put into practice for improving the land quality. Similarly, for improving the quality and quantity of water resources to meet the domestic, pastoral and agricultural needs during drought years, deepening of tanks, cleaning the silts from the tanks and digging more sites for water recharge and rainwater harvesting may be properly planned. The availability of water will increase the level of irrigation and waterings in the field and in its turn it will increase the productivity of land besides making water available to the new plantations.

The increase in the level of green cover and biomass is essential for sound environmental setup. Ways to increase green cover could include the plantation of medium and large trees along the highways, river banks, railway tracks, around the ponds and on the panchayat lands. Small and dwarf trees along with flowering plants could be planted along the hill slope. It is a planning proposal for which financial and technological help could be availed of from the Departments of Forests, Revenue and district planning office. Once these planning proposals are implemented cooperation and participation of the local people helps in protecting and maintaining these ecological input.

B. Social planning

Social planning is central to safe guard the interests of ecological as well as economic planning. A sound social setup is an asset to balanced development. The social planning of the village Akbarpur demands for more attention in the fields of health, education, training and job generation. The status of health among women, children and aged people is pathetic. It calls for an urgent planning towards opening a mini health centre besides having at least one maternity and child health centre. The trained lady health workers and assured delivery of health care can help in improving the health and controlling the population growth. Similarly, growing population of the village deserves to have an anganwadi and a middle and secondary school. An industrial training institute is also an essential requirement of the village, because weaving, carpentary, gold smithy are still practiced in the village as a family profession. To solve the problem of out migration of rural youths, self employment must be given priority in the village. A rural bank branch can also be established to solve the problem of loans, savings and investments of the people.

C. Economic Planning

A sound economic base is essential for the development of a local area. Village Akbarpur has ponds which could be developed for fisheries and water nuts. The area has a sound base of stone pieces. Hence, mining and quarrying could be initiated as an economic activity. Trees from the forests especially dried ones could be used for timber works. Similarly sand and soils are available in large quantities for construction purposes. Modern handlooms can further upgrade the weaving and spinning works in the village. Introduction of high yielding variety of milk cattles like cows and baffaloes can improve the dairy industry in the village. Similarly, hybrid goats and sheeps can raise the income of pastoralists in the village. These animals can well be used for meat industry. Since the village is located along the highway, it could take up the advantage of selling its products to the markets of nearby towns Chitrakoot (Karwi) and Atarra. Establishing a bank and constructing a panchayat ghar besides constructing village roads can further improve the interaction of rural community with its urban counter parts, where rural products could be sold on regular basis.

INTEXT QUESTIONS 30.5

1. What factors need to be considered while preparing a map?
2. What is the geographical location of village Akbarpur? Draw a sketch map using the description given in the text.
3. What is the agricultural landuse of the village Akbarpur.
4. What are the planning needs of the village Akbarpur.
5. Discuss major social and economic plans of the planning in village Akbarpur.

WHAT YOU HAVE LEARNT

Local area planning is a process of planning that is concerned with resolving local level problems and issues. Local area is both a physical as well as a cultural attribute like landscape of an area, local products of folk dances, handicrafts etc. An effort to devise way and means to solve the problems of places and people is termed as planning. Planning is carried out of various levels from small local area to as large area as the world. However, it is the sincere effort of the local people that ensures local area clean, green and prosperous. For local area planning, formulation of objectives fixing targets and priorities to be achieved, mobilization of local and other resources for the execution of plan, creating social group for the implementation of the plan and monitoring of progress are the basic requirements. The success of local area planning largely depends upon the ecological and socio-economic base of the locality. As such local area plans vary significantly from place to place. The dimensions of local area planning are essentially to fulfill the basic and higher needs of the people besides creating adequate opportunities for employment and income generation to meet the growing needs of local people. Hence, need based utilization of local resources is a precondition for such a planning. Local resources refer to land resources like rocks and soils, water resources, plantations and forest resources. Assessment of local resources helps in data collection and preparation of plan and its implementation. Planning is, thus, a continuous process. India is making planned efforts to develop its economy and areas for the welfare of people. India has designed 10 Five Year Plans based on its priorities so far. Priorities have been changing during different plan periods. However, all of these plans were aimed at achieving higher economic growth rates while keeping general welfare of the people as the main goal. There are distinct problems and potentials of the different regions. Hence, present unique needs for planning. Water harvesting and management, protection and promotion of forest, tribal welfare and protection of wild life, power to the people for managing local environment are some of the planning priorities of different regions based on their unique needs. To improve the quality of local environment, utilization of local resources and initiatives of the local people are important. There is a need for optimal resource utilisation in the light of resource depletion and their renewability. Maps are the basic tools and designs for the development and planning of a local area. As such use of maps, sketches and photographs helps in the identification of local issues, collection of data/information and for finalizing the blue print of local area planning. The case studies need to be conducted to analyse the socio-economic set up, landuse pattern, amenities and social facilities and common property resources in the area. Based on the result of the case studies, planning proposals need to be developed. These proposal must include the issues and specific schemes for environmental, social and economic planning of the area.

TERMINAL QUESTIONS

1. Describe any two dimensions of local area planning in brief.
2. Discuss the basic features of developing a local area plan.
3. How can local people help to improve their local area by local self initiative.
4. What is the utility of maps in managing the local area planning.
5. Explain the unique needs of tribal areas.

ANSWERS TO INTEXT QUESTIONS

30.1

1. **Local area** is a location site specific issue, commodity or community. It presents both physical as well as cultural landscape, local products like handicrafts and specialties of the locality such as folk dances, art artifacts etc. Local area reflects strong bonds of association with the location and people.

   Planning is an effort to devise ways and means to solve the problems faced by the people and places. It also aims at improving the local environment and quality of human life.

2. Various levels of planning in India are:

   Local area planning, Block or micro level planning, District level planning, State level planning and National level planning.

3. Three challenges for the planning of an area are:

   A. Environmental degradation

   B. Poverty and malnutrition

   C. Unemployment

4. Basic expectations of people from planning.

   A. Provision of basic services and amenities.

B. Developmental projects like irrigation, industries for increased agricultural and industrial productions

C. Job generation and markets to sell their products.

5. Basic requirements of planning are:

A. Formation of goals

B. Fixing targets and priorities.

C. Mobilization of resources.

D. Creation of social group.

E. Evaluation and monitoring of the progress.

30.2

1. Two examples of eco-friendly planning are:

A. Taming the rivers for irrigation and flood control.

B. Plantation

2. There is an apparent need for maintaining a balance between the availability of resources and human requirement because resources have limitations of renewability and depletion. Hence, utilization of resources has to be judicious to meet the human requirements.

3. The designing of tree plantations in a local area should be based on the following:

A. Relief

B. Climatic conditions

C. Pedological conditions

D. Natural vegetation

4. Two examples of basic and higher needs

a. basic needs	(i) Safe drinking water
	(ii) Basic education and health
b. Higher needs	(i) Technical Education
	(ii) Advanced transport system

5. Two effects of technological innovation and institutional support.

a. Technological innovations	(i) Agricultural development

		(ii) Information Revolution
b.	Institutional support	(i) Education for all
		(ii) Public transport system

30.3

1. Local people play significant role in area planning through their experiences in designing schemes of development, participation in the implementation and execution of planning schemes and cooperation in maintaining the projects planned.

2. The special emphasis of development during:

   A. First Five Year Plan was on developing irrigation networks.

   B. Second Five Year Plan was on self reliance on industrial development.

3. The aims of Tenth Five Year Plan are cleaning of major rivers, rainwater harvesting, interlinking of rivers, public delivery system, literacy mission, health for all.

4. Match the column I with column II.

   A-2, B-1, C-5, D-3, E-4.

30.4

1. Local needs vary from area to area depending upon area specific issues and problems and potentials available for development.

2. Local resources are important for local area planning because development activities are mostly based on resources. Use of local resources, minimizes the cost of planning and maximises the benefits to local people.

3. Resource depletion is the decrease in the available stock of resources. Some of the resources have been depleted to a large extent, while others to a lesser degree.

4. Optimal utilization of resources refers to the judicious use of resources in meeting the human requirements so that it continues to remain sustainable.

30.5

1. Factors such as size of the map, details to be shown, choice of scale etc. need to be considered while preparing a map.

2. The geographic location of village Akbarpur is at $25^0$12’ North latitude and $80^0$47’ East longitude.

3. The agricultural land use of village Akbarpur is dominated by rice, jowar and bajra in kharif season and wheat, gram, pulses and oil seeds in rabi season. The kharif crops occupy nearly 63 percent, whereas rabi crops cover about 36 percent and the remaining about 1 percent is devoted to zaid crops.

4. The planning needs of village Akbarpur are related to the provisions of basic facilities, irrigation facilities and agri-industries for development.

5. See planning proposal of Akbarpur under the heads of environmental, social and economic planning.

HINTS TO TERMINAL QUESTIONS

1. Refer to section 30.3
2. Refer to section 30.5
3. Refer to section 30.7
4. Refer to section 30.9
5. Refer to section 30.7

Notes

31

DATA COLLECTION, PROCESSING AND ANALYSIS

In the previous lesson we have learnt about the concept and approaches of local area planning for which data is a necessary condition. In this chapter we will discuss about the procedures followed in data collection processing and analysis. In our routine life we come across several information through print, audio and visual media, social gatherings and discussions. But have you ever thought how data for these information is collected, processed and anlaysed? The collection of data refers to a plan for gathering data, information from field situations. A set of procedure is followed to get the desired data/ information from the field work in geography, to process and analyse the facts in a logical and scientific manner.

OBJECTIVES

After studying this lesson, you will be able to :

- identify the steps and issues involved in data collection;
- describe various tools and techniques of data collection;
- formulate questionnaire, schedule, rating scales etc.;
- draw sketch maps of the area to be surveyed;
- select the samples and collect primary data/information;
- collect secondary data;
- make simple tables and diagrams from the collected data;
- analyse tables, maps, diagrams, photographs and charts, and generalize the results and make suggestions.

31.1 STEPS IN DATA COLLECTION

Broadly speaking there are three major steps in data collection viz.

1. One can ask people questions related to the problem being investigated.
2. One can make observations related to places, people and organizations their products or outcomes.
3. One can utilize existing records or data already gathered by others for the purpose.

The first two steps relate to the collection of primary data while the third step relates to the collection of secondary data. The information/data collected by a person directly is known as primary data while records or data collected from offices/institutions is known as secondary data.

A. Steps in Primary Data Collection:

Collection of primary data involves the following steps :

1. Making oneself ready both mentally as well as physically for collecting primary data from field situations.
2. Keeping a field book/record book or diary for writing relevant information, doing field sketching or writing records of the occurrence of phenomenon at specific time intervals.
3. Administering questionnaire schedule to the target groups of area people across sampled sites.
4. Verifying the facts through cross checks in the answers and ground realties.
5. Integrating the observations, responses and recorded facts in a systematic and logical framework.

B. Steps in Secondary Data Collection:

The collection of secondary data involves the following steps:

1. Knowledge about the offices/institutes etc. keeping the record of relevant data is of prime importance to obtain the secondary data/information.
2. Get an official letter containing your requirements of data and purpose of data collection from your Principal/Head of the Institute? Your identity card is also an essential requirement to get an entry in the offices.
3. Keep a note book/record file to transfer data for the purpose. It could also be done with the help of photo copying systems.
4. The secondary data, thus, collected forms the basis for tabulation and processing as per need.

C. Identification of Issues:

It is very important to identify clearly the issues that are going to be assessed.

Depending upon the availability of time, cost, manpower and tools, a frame work of issues to be covered need to be developed. In case of local area planning the following issues need to be considered.

1. Issues related to environmental conditions like environmental degradation, quality of human life etc.
2. Social issues like people's perception, literacy status, health hazards, incidence of crime etc.
3. Economic issues like employment, expenditure pattern, flow of goods and commodities etc.
4. Population study for agriculture, industry etc.
5. Landuse study for agriculture, industry etc.
6. Facilities and amenities available for social and economic development.
7. Problems related to growth of economy such as irrigation, means of transportation, availability of power etc.
8. Focal theme of planning like provision of basic amenities in slum areas, pollution control, clean environment in an industrial area.

31.2 TOOLS AND TECHNIQUES OF DATA COLLECTION

For data collection we make use of certain tools and follow specific techniques. The tools that help in data collection are as under:

- Observing the phenomenon and recording the details,
- Inquiring about the facts through questionnaires/schedules
- Making measurements.
- Conducting tests.
- Recording the events.

Now let us study some of these tools and techniques of data collection.

A. Questionnaires:

The questionnaires or interview schedules are the set of questions framed for the specific purpose of data collection through field work. The questionnaire serves two purposes. First, it translates the objectives of the field work into specific questions which help in the collection of necessary data. The data collected through the responses of the questions forms the basis of understanding the problem or explore the idea set by the objective. In order to achieve these objectives, each question must communicate to the respondent the idea or group of ideas required by the objective and obtain a response which can be analysed to fulfill the objectives. The question must perform these functions with minimum distortion of the response it deals. In asking a question to the respondents, we assume that he possesses adequate knowledge, opinion or attitude. Each question should, therefore, be constructed so as to elicit a response which accurately and completely reflects each respondent's position.

The second purpose of questionnaire is to assist interviewer in motivating the respondent to communicate the required information. There are many factors which determine the respondent's willingness to engage in an interview. The questionnaire itself does much to determine the nature of interviewer-respondent relationship. Thus, the quantity and quality of data collected depends largely on the nature of questionnaire.

(a) Contents of Questionnaire:

The following two types of information should from the contents of questionnaire:

(i) Identity or location specific contents

(ii) Respondent centred contents

(b) Form of Questionnaire:

The form of questionnaire depends upon some of the factors such as willingness of the respondents, usefulness of the information and its level, language, sequence of questions, single idea etc.

(c) The Interview

The process of conducting interviews starts soon after the formulation of questionnaire is complete. The investigator should have a letter of introduction to explain about himself in the field. The letter of introduction must have a note that the information so collected is going to be used for the purposes of presentations and educational use only. The information will remain anonymous completely. While conducting interviews, we should help in removing the difficulties of the respondents without giving any clue as to the answer required. As far as possible we are not supposed to make any responses or show any expressions to the answers. Finally we should pay regards and express thanks to the respondents for their co-operation.

B. The Schedules

The schedules are the timed plan for a survey. It reflects time specific recording of the phenomena like traffic survey, consumer behaviour survey, precipitation pattern etc. The investigator must record the occurrence of a phenomenon over a specific time interval. The time is an important reference of analysis. It could be in convenient units of hours, minutes or seconds depending upon the frequency of occurrences. Similarly, a phenomenon is more often associated with several elements. Hence, the record book need to have further sub divisions both on X as well as on Y axis.

1. What phenomenon to be selected and recorded in order to obtain the required information?
2. Under what conditions are observations to be made? How is the observational situation structured?
3. Can a score be assigned to the observation and what are the characteristics of that score?
4. How stable are the observations? Can the same results be obtained under the same conditions?
5. Whether the phenomenon observed has functional unity with same process?

C. Rating Scales

By the term rating scale, we mean a scale with a set of points, which describe varying degrees of dimension being observed. Rating scales are most often used in either of two ways, 1) to record the pattern at frequent intervals, or 2) to rate the entire event after it has ended. Thus, rating scales, which contain a variety of items at each point on the scale, are more efficient since they can provide more data per observer, more dimensions per unit of area and time. Investigator observes a number of acts throughout the situation, integrates them in his mind, and makes a judgment as to which point on a number of scales best described his interpretation of the varied behavior. The following examples offer an idea of rating scales.

Temperature Conditions:

Very Cold	Cold	Cool	Moderately Warm	Hot	Very Hot
0	1	2	3	4	5

Development Level:

Under Developed	VeryLow Level	Low Level	Medium Level	High Level	Very High Level
0	1	2	3	4	5

D. Field Sketches

Making of field sketches on the spot is an essential component of field survey in geography. These are simple, rough drawings or design done rapidly to depict the ground truth on a piece of paper. Geographical facts like structure or form of physical landscape, location and site, mobility, intensity of interactions, patterns of level use, distance and directions and interdependence of certain natural or cultural objects can be depicted symbolically in the form of field sketches.

E. Photographs

Camera is one of the important equipments that is needed during the course of a field work and data collection. It is needed for taking photographs of typical features. Photographs present the view of a landscape in its totality, activity in operation and events in their occurrences. Photographs provide comprehensive data bases for analysis and interpretation. Certain aspects that need more time to record such as conditions in a slum locality, variety of landscapes, plant species, office and factory systems can be photographed and the output can be used for the explanations and analysis. Photographs are used to supplement the results.

- The formulations of questionnaires serve two purposes: (i) first translate the objectives of the field-work into specific questions which help in collection of data and (ii) the second purpose is to assist the interviewer in motivating the respondents to communicate the required information.
- Various factors which affect the form of questionnaires are (i) willingness of the respondent, (ii) the frame of reference, (iii) usefulness of the information, (iv) possibility of misunderstanding, (v) type of questions, (vi) the information level (viii) social acceptance (viii) single idea and (ix) sequence of question.
- Various precautions need to be observed while administering the questionnaire. These precautions are (i) The collection of information need to be done in an atmosphere of permissiveness, (ii) the respondent should not be kept in dark about the purpose, (iii) explain the anonymous or confidential nature of interview, (iv) socially unacceptable questions need to be avoided, and (v) the intention of the interview need to be given convincing explanations.

F. Methods of Administering the Questionnaires and Survey Schedules

The questionnaires are the set of questions framed for specific purpose of field work. Before designing the questions the purpose of specific problem is divided into various steps and phases. After this logical sequence of questions is to be developed so that desired response can be obtained. The coding of questions (each question to be given a numerical code) is another important dimension required for the transfer of data/information to computers. The whole questionnaires is divided into schedules sets like household schedule, amenities and facilities schedule, function or activity schedule. Thus the questionnaires is a set of schedules having purpose specific questions. Schedule of time is another dimension worked out to complete the field work in given period.

Normally, the administration of questionnaire will follow a sequence of procedures in the manner given below:

1. **Building Rapport:** It refers to the atmosphere of entire relationship between respondent and interviewer. It would be necessary for him to establish a deeper kind of personal relationship with the respondent.
2. **Asking the Questions :** The interviewer's job of asking questions from the questionnaire is through the use of carefully worded questions transmitted to the respondent in verbatim which will help in achieving most of the standardization in the interview. The major aims of putting questions to a variety of respondents is to have complete and clear response about the point of investigation.'
3. **Use of the field sketches and sketch maps:** The field sketches are additional supports to the questionnaires in the collection of primary data. Field sketches supplement the set of information by producing a rough image of physical as well as cultural landscapes. These are the free hand pencil or pen drawn images on the field diary. These sketches help remembering and recollection of field relations. They also substantiate the facts as a visual presentations.

G. Collection of Information

Both the tools of registration and recording help us in the collection of primary data. With the help of these tools, we try to transfer the facts from field into data and tables. In this process of collection, there is obviously the loss of some information. Nevertheless, a good deal of satisfactory information is collected and utilized for the purpose of analysis and interpretation. Based on the set of questionnaires, schedule administered to the respondent, the desired information/data is collected. The collection of information could be a routine as well as specific purpose exercise. The routine data collection could relate to daily sales, commuting population, movements of goods etc. Similarly, recording of weather elements like temperature, air pressure, precipitation, direction of winds, cloud cover, sea conditions etc. is a routine data collection. There are many other examples of daily data collection. Based on the daily information or facts, seasonal trends and annual averages are worked out. The purpose specific data is collected at one point of time only.

H. Precauations in Collecting the Information

The task of collecting the needed genuine information is difficult one. The collection of data from field situations is a complicated affair compared to the office or organizational situation. To get an unambiguous, unbiased and correct information from field, specific precautions need to be observed. These are related to the non-cooperation, incorrect information and tensions. The following precautions need to be observed to overcome these difficulties:

(i) The collection of information need to be done in a friendly way. The interviewer is supposed to remain humble, polite and establish good rapport with the respondent.

(ii) The use of words and sentences should not sound unfamiliar and causing hurt to the sentiments of the respondents. Such words and sentences need to be replaced by more appropriate words.

(iii) Socially unacceptable questions need to be avoided. If so required, indirect information be used for the purpose.

(iv) The respondents should not be kept in dark about the purpose of the field work. The respondent may not like to answer the questions if he is not clearly explained about the objective of the fieldwork and more specifically about his selection as sample for the data collection.

(v) The respondent need to be assured of his/her identity and response to remain undisclosed (anonymous) and his/her cooperation to be duly acknowledged in the work.

(vi) The intentions of the interview need to be given convincing explanations. The information collected is in no way going to affect the respondent adversely i.e., to impose a check upon his activities.

I. Selection of Samples and Sample Size

A sample is a part of a larger group or area selected for obtaining information about the whole group or area known as the universe of the study. The part of the whole is called sample and is used to ascertain the characteristics of the universe of the study. While choosing a sample, the population is assumed to be composed of individual area units or members of the group. Some of these units or members of the population selected for detailed study are called the samples. When the entire universe is taken into consideration for the study, it is known as census survey. Examples are population census, agricultural census and so on.

1. **Identification of Samples:** The identification of samples is the first task while conducting the field survey. The selection of sample should be such that it reflects the characteristics of the whole. The sample should not be identical as it leads to error.

2. **Sampling Techniques :** Samples are selected to avoid unnecessary large expenditures likely to be incurred on the total survey of all the units of universe of study. Moreover, a sample study can be completed in a lesser

time period compared to the study of universe or population. The level of accuracy also increases when we study a smaller area units and vice versa in case of the universe. The measures of assessments, estimates and projections can be better used for the purpose of planning, execution and diffusion studies. Some of the popular sampling techniques are discussed here.

(a) **Systematic Sampling :** The items selected from the population are chosen in a regular way. Such a procedure of sampling is called a systematic sampling. For example selection of samples in a multiple of 8(8th 16th, 24th etc.), 10 (10th, 20th, 30th etc.) or any other number so decided.

(b) **Random Sampling:** The selection of samples, in random sampling, depends upon the chance as universe presents homogenous conditions throughout. There are two types of random sampling.

(i) **Simple Random Sampling:** The procedure of sampling in which each unit of universe has equal chance of being included as the sample is known as simple random sampling. For example in a survey on consumer behavior each consumer has an equal chance for being selected as a sample.

(ii) **Stratified Random Sampling :** This type of sampling procedure is used when considerable heterogeneity is present in the distribution. The selection of samples in such a situation is based on the division of the universe of study into homogeneous subgroups or strata. Certain aspects of study present stratified character like social structure (having groups like general population. SC population and ST population); economic structure (primary, secondary, tertiary sector etc.) Random samples are selected from each sub group based on their relative significance in the universe.

3. **Sample Size:** There are two basic requirements for the sample to fulfill. A sample must be representative and adequate. The sample is said to be representative when it reflects the various patterns and sub classes of the universe of the study. Similarly, a sample is adequate if it provides very precise result to the investigator. It is important to note that larger is the sample size, greater is the accuracy.

   Usually a small sample is sufficient if the phenomenon studied is fairly homogeneous which very rarely occurs. Normally, for a field survey sample size chosen is about 5 to 10 percent of the total units of the universe.

- The sum total or aggregate from which the sample is taken and the result is derived is known as the universe or population.

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- A sample is a part of a group or aggregate selected for the purpose of obtaining information about the universe.
- The procedure dealing with the selection of a part of a group from the universe to obtain information about the whole or the universe is known as sampling.
- A scheme for obtaining a suitable sample from a given universe is known as sampling design. It also indicates the size of the sample to be used keeping in view the cost involved and the precision of the result required.
- A procedure of sample selection in which units are selected at equal interval is known as simple random sampling.
- Stratified random sampling is a method of sample selection in which the universe of the study is divided in to homogeneous subgroups and simple random sample is selected from each subgroup.

INTEXT QUESTIONS 31.1

1. Give a single term to the following statements:
   a. The date collected by asking questions from people or making observations related to the problem of investigation is known as.
   b. The data available in records or already gathered by others for the purpose is called.
   c. The material medium that help in data collection are called as.
   d. Methods or ways through which data is collected are known as.
   e. A set of questions framed for the purpose of data collection through field work is called.
2. State three important steps each for primary and secondary data collection.

A.	Primary data collection	1.
		2.
		3.
B.	Secondary data collection	1.
		2.
		3.

3. Match the two columns

Coumn A	Column B
(a) Interview	(1) A type of scale with a set of points, which describe varying degrees of dimensions.

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(b) Schedules	(2) A rough drawing or design to present the item.
(c) Rating Scale	(3) A timed plan for finalizing a project or field work.
(d) Sketches	(4) The process of interacting with the target group in the form of questions.

4. State the two types of information that form the contents of the questionnaire.

   (a) (b)

5. Name two criteria which are necessary for the identification of a sample.

   (i) (ii)

31.3 PROCESSING OF DATA

The processing of data/information is an essential dimension of stream lining the facts and writing of a field report. A separate account of processing is given here.

(A) Processing of primary data: The primary data collected from the field remains in the raw form of statements, digits and qualitative terms. The raw data contains error, omissions and inconsistencies. It requires corrections after careful scrutinizing the completed questionnaires. The following steps are involved in the processing of primary data.

(i) Editing of data: The editing of data can be done at two stages: field and post-field editing. The field editing is a review of reporting by the investigator for completing what has been written in an abbreviated form during interviewing the respondent.

The post-field editing is carried out when field survey is completed and all the forms of schedule have been collected together. This type of editing requires review of all forms thoroughly.

(ii) The coding of data: To keep the response with in limited alternatives, we need to assign some alphabetical or numerical symbols or both to the answers. The alternatives must be mutually exclusive i.e. defined in one concept or term only. This form of processing is known as coding. For example in a question of educational qualifications alternative choices given are: Uneducated; Below Matriculation; Matriculation & above but below Graduate; Graduate & above; Technical Diploma; Technical Degree

The alphabetical codes assigned to these alternatives could be A,B,C,D,E and F. Similarly, numerical codes to these alternatives could be 1,2,3,4.,and 5 respectively. It is necessary for the efficient analysis. Though coding exercise is a part of the formulation of questionnaire yet responses to questions need to be coded and made final at the processing stage. This simplifies the transfer of data from questionnaires to the master chart. It is a two dimensional chart in which observations are entered on one axis (X) and details of the responses on the other axis (Y). The calculations becomes easier and quicker if the details are coded and entered in the master chart or fed in the computers.

(iii) Organization of Data: The data information collected through different sources should be organized. The first task in this regard is to develop a master chart. For example in a local area survey, we record individual households in rows and the details of population, function, facilities and amenities etc. in columns. Thus a large chart is prepared that contains, practically, all relevant information/data. Finally the total of rows and columns are cross-checked. The information arranged in an ascending order is known as the array of data. The set of information related to specific entity is called the field. The following illustration demonstrates the way data is organized.

Details / Households	Population			Functions				Facilities		
	P	M	F	Agri	Ind	Trade	Service	T.V.	Phone	Vehicle
01	20	12	08	5	-	1	12	1	1	1 Scooter
02	17	09	08	6	-	1	1	1	1	1 Scooter
03	9	04	05	-	-	2	1	1	2	1 Car and 1 Scooter
04	12	06	06		1		2	1	1	1 Scooter
05	13	07	06	2	-	-	2	1	-	1 Scooter

(iv) Classification of data: A huge volume of raw data collected through field survey needs to be grouped for similar details of individual responses. The process of organizing data into groups and classes on the basis of certain characteristics is known as the classification of data. Classification helps in making comparisons among the categories of observations. It can be either according to numerical characteristics or according to attributes. The numerical characteristics are classified on the basis of class intervals. For example monthly income up to Rs.2000 may form its group and the respondents reporting income in the range may form its frequency. Similarly, further group can also be made like income group Rs.2000 to Rs.3000 and so on. The number of items entered against each class is known as the frequency of the class. Every class has a lower and an upper limit. The difference between the upper and lower limits is known as the range of the class. The class intervals are mostly kept equal. Sometimes when the range of the data is too large class intervals are not kept equal, instead they are based on the perceptible gaps in the array of the data. For example settlements having less than 2000 population can be grouped as below 200 population 200-500 population, 500-1000 population and so on. In this group as class intervals are unequal.

The data is also classified on the following bases.

1. Descriptive characteristics-example land holding, sex, caste and so on.
2. Time, situation and area specific characteristics.
3. Nature of data as continuous or discrete.

(B) Presentation of data: The presentation of data could be tabular, statistical and cartographic. In case of tabular form of presentation, data related to different variables should be classified and compared. Various statistical techniques are available to derive accurate and precise results. Since techniques have a large range coupled with the limitations of their own, selection of appropriate technique needs to be made for the purpose. The construction of graphs, charts, diagrams and maps are the various forms of cartographic presentations. The data is transformed into cartographic system which is used for visual presentation. A brief account of tabular, statistical as well as cartographic presentation of data is discussed below.

(i) Tabular Presentation: It is used for summarization of data in its micro form. It helps in the analysis of trends, relationship and other characteristics of a given data. Simple tabulation is used to answer question related to one characteristic of the data whereas complex tabulation is used to present several interrelated characteristics. Complex tabulation results in two way, three way tables which give information about two or three inter-related characteristic of data. The following points may be kept in mind while constructing a table.

1. To make a table easily understandable without a text, a clear and concise title be given just above the frame of the table.
2. Each table should be numbered to facilitate easy reference.
3. Both columns and rows of the table should have a short and clear caption. They may also be numbered to facilitate the reference.
4. The units of measurement (production units)- kgs, quintals, tones, or areal units-hectare, kilometre) be indicated. If table relates to some specific time, it must be mentioned. The tables should be logical, clear and as simple as possible.

5. The source of data must be indicated just below the body of the table.

6. The abbreviated words and explanatory foot notes if any should be placed beneath the table. However, it should be used to the minimum possible extent.

7. The sequence of data categories in a table may follow alphabetical, chronological, geographical order according to magnitude of the item presented.

(ii) Statistical Presentation of data: The data collected through various sources needs to be processed statistically for precise explanations. Very often it becomes necessary to obtain a single representative value for the whole data set. The statistical measures that enable us to work out a single representative figure for the entire data distribution, is known as central tendency. Measures of central tendency help us to compare different distributions besides being representative for each distribution. These measures normally denote the central points of values, distance and occurrence in a distribution. The commonly used measures of central tendency are:

(a) Arithmetic mean or average

(b) Median

(c) Mode

Σ
X

(a) Arithmetic Mean

It is most frequently used and is calculated by adding the sum of all individual values in a distribution and dividing the sum by the total number of individuals. For example, the production of rice per acre in five districts is 10, 8, 12,9 and 6 quintals. The average production of rice for these districts is :

$$\frac{10+8+12+9+6}{5} = \frac{45}{5} = 9 \text{ quintals per acre}$$

The arithmetic mean is expressed in the form of equation noted below:

Where $\overline{X}$ is the mean value,

is the total of X values,

N= Number of individuals/observations.

The arithmetic mean can be easily worked for small ungrouped data. However, when the number of observations are large and data is in the form of frequency

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distribution of groups, arithmetic mean will be worked out with the help of following equation.

Where is the arithmetic mean,
f is the frequency,
m is the mid value of the classes

Example

Calculate the arithmetic mean from the temperature data given in the following table.

Classes (Temperatures in degree Celsius)	No. of days f	Mid values	
x	*f*	*m*	*fm*
1-05	20	3	60
06-10	24	8	192
11-15	44	13	572
16-20	72	18	1296
21-25	76	23	1748
26-30	60	28	1680
31-35	62	33	1716
36-40	4	38	152
41-45	8	43	344
	f = 360 days	*f*x=7760	

$\bar{X} = \frac{\Sigma fm = 7760}{360} = 21.50°C$

From the above

temperature

Merits of the Arithmetic Mean

1. It is easy to understand the complete idea of the distribution and simple to workout.

2. It is the average of the values in a distribution. Hence, it has a balancing property in case of sample surveys.
3. It is widely used in case of normal distributions.

The arithmetic mean has certain limitations. It is affected by the extreme values especially when they are large. For example, income variations are very wide in case of Indian population.

(b) Median

Median is the middle most positional average. It is worked out by arranging data in an ascending or descending order. For example, the value of the median is worked out by adding 1 to the number of observation and the sum divided by two. It is expressed as:

For example if we are interested in working out the median latitude and longitude for the country, we must arrange these distributions in a tabular form.

Latitudinal Extent of the Mainland of India (8’4’ N to 37’ 6’ N)

9	10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	

The median or middle most latitude of India is 23°N which is close to the Tropic of cancer (23° 30' N,). Since mainland of India starts from 8' 4’ N which is a part of 9th latitude and extends up to 37° 6’ N which covers the 37° latitude completely, hence the latitudinal coverage of India is approximately 29° latitudes. The median latitude is therefore, 23°N i.e.

$$\text{Med} = \frac{N+1}{2} = \frac{29+1}{2} = \frac{30}{2} = 15$$

8° + 15° = 23°N Southern tip of India)+ 15° (median value)=23° (middle east latitude of India) Similarly, we can also workout the median value for the longitudinal extent of India. The Longitudinal Extent of India ranges between = 68°7’ E to 97°25’E.

The median or middle most longitude for the country is 83°E.

69	70	71	72	73	74	75	76	77	78
79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	

Longitudes are used to calculate local time, standard time of a nation and international time which is linked to Greenwich Mean Time (GMT). Indian standard time is calculated keeping $82^0 30'$E longitude as the base. The median longitude for the country is 83^0E which is close to the standard meridian used for Indian Standard Time calculation.

Merits of Median:

1. Being the middle most value, median remains unaffected by the extreme values in the distribution as in the case of arithmetic mean.
2. It is a partition value which divides the series into two nearly equal parts and remains the centre of gravity.
3. However, it cannot be worked out without putting data in an ascending or descending order. If data are large, it might be a time consuming and tedious job. The values of median will be erratic if one or two items are added or subtracted from the series.

(c) Mode:

It is one of the important measures of central tendency. The maximum concentration of items occurring in a distribution is considered to ascertain the mode. The value which occurs most frequently is identified as mode in case of ungrouped data. Similarly, for grouped data the mode can be calculated by identifying the class with the highest frequency. The mode denotes the centrality of the occurrence of an item in the distribution. The distribution of rural settlements in Uttar Pradesh is given below. Workout the mode for the data.

Distribution of Rural settlements in Uttar Pradesh 2001

Size of Rural Settlements	**Very small (Below 500 Population)**	**Small (500-999)**	**Medium (1500-1999)**	**Large (2000-4999)**	**Very Large (5000 and above)**
Proportion of distribution	16.69	23.46	47.97	10.59	1.29

Solution: Arrange the data in a sequence (either from small to large or from large to small). Put up the frequency values against each. Now compare the frequencies. The distribution registering maximum frequency is identified as 'mode'.

Merits of the Mode:

1. It is the most typical value of a series. Mode can be located easily by the inspection and can be used by common people also.
2. The occurrence of a few extreme values does not affect the mode, since it is the most typical value of series.

It is, however, not a significant measure of central tendency unless the number of observations is large. Both in case of uniform as well as skewed distributions, mode ceases to be a measure of central tendency.

Percentiles:

Percentile is a measure which divides a series into 100 equal parts. It helps to understand various classes or categories that constitute a distribution. It is expressed as:

for ungrouped series and $P_j = L_1 + \left(\frac{P_j N/100 - C}{f} \right)$ for grouped series

Where P is the percentile and N is the number of observations.

There are 99 percentiles, P_1 P_2 ……………P_{99}

L_1 = The lower limit of the j^{th} percentile class, this is frequency of this class,

C = is the cumulative frequency of the class preceding the percentile class, and

h = the magnitude of the j^{th} percentile class.

f = the frequency of the percentile class.

P

Distribution of Monthly Income Among Households of a locality

	Actual Number	Percentage Distribution
Economically weaker sections (Below Rs.500)	112	56.0
Lower Income Group (500-999)	41	20.5
Middle Income Group (1000-4999)	29	14.5
High Income Group (5000 and above)	18	9.0
Total	**200**	**100=00**

Distribution of Per Capita Monthly Income of the Households of a locality

Income group in Rs.	No. of Households Frequency	Cumulative Frequency
Below 500	112	112
500-999	41	153
1000-4999	29	182
5000 and above	18	200
Total	**200**	

Let us calculate 60^{th} percentile as P_{60}.

Now $P_{60} =$

The 120 the income lies in the group 500–999 so that,

$l_1 = 500$, $f = 41$, $c = 112$ and $h = 500$

$$P_{60} = 500$$

$$60 \times 200 \div 100 = 120$$

$$+\left[\frac{120-112}{41}\right]\times 500$$

$$= 500 + \left[\frac{8}{41}\right]\times 500$$

$$= 500 + 97.56$$

Ans. = Rs. 597.56

It means that 60 percent of the monthly incomes are below Rs. 597.56 and remaining 40 percent above it.

(iii) Cartographic Presentation of Data: The primary data collected through the field survey may be presented cartographically. The representation of data in visual form refers either to time, space or to both. The cartographic presentation refers to the display of data by constructing graphs, diagrams and maps. The set of data is transformed into some form of figure which is used for illustrations. These figures could be graphic, geometric or theme specific maps. A brief discussion on different form of cartographic presentation is given here.

(a) Graphical Presentation of Data: The graph refers to the arrangement of horizontal as well as vertical lines in inch or centimeter's divisions. These divisions are in an arithmetic sequence. A graph is used to locate the position of a given characteristic with respect to two variables represented by two axes of the graph. 'While ordinate or X axis represents independent variable, abscissa or Y axis represents the dependent variable. Due care is needed in the construction and interpretation of graphs. Theoretically, a phenomenon could be either increasing or decreasing or keeping constant trend of change across time. However, the observed facts may represent the change in a mixed fashion. For example, we can make use of simple line graph to represent the profile of Indian population during the past ten decades i.e. 1901 to 2001. Although we can see changes in the data, the presentation of the same on a line graph provides better comprehension.

Table 31.1 : Growth of Population in India 1901-2001

(Population in million persons)

Year	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
Pop.	1238.3	1252.0	251.3	278.9	318.6	361.0	439.2	548.1	685.1	846.3	1028.73

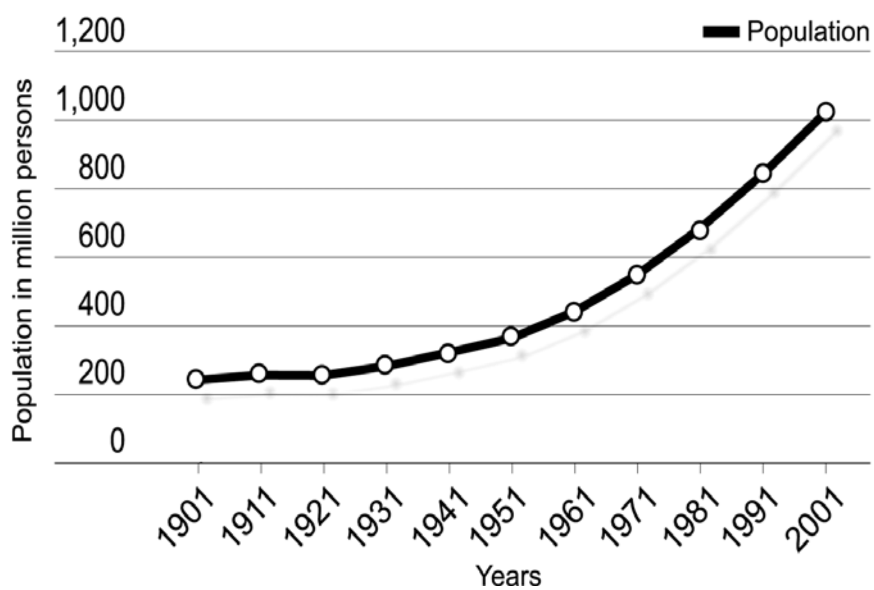

Fig. 31.1 Growth of Population in India (1901-2001)

(b) Compound Graphs: These graphs are being used to represent two or more dependent quantities at the same time. Different quantities represented by curves are either superimposed on the top of each other or placed on the each other in a cumulative way. For example, compound graphs of male and female population or rural and urban population can be used to represent the two segments of population. Similarly, variables having three or four segments can also be represented through compound graph. For example energy production (thermal, hydel and nuclear), migration streams (rural-rural, rural-urban, urban-rural and urban) and religious composition of population (Hindus, Muslims, Sikhs, Christians, Jains, Buddhists, etc. represent various segments of the variable.)

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Table 31.2 : Sex Ratio of Population of India

(Population in million)

Years	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
Male	120.9	128.3	128.5	142.9	163.7	185.5	226.2	284.2	354.3	439.2	532.1
Female	117.4	123.7	122.7	135.9	154.9	175.5	212.9	264.1	307	407.1	496.4

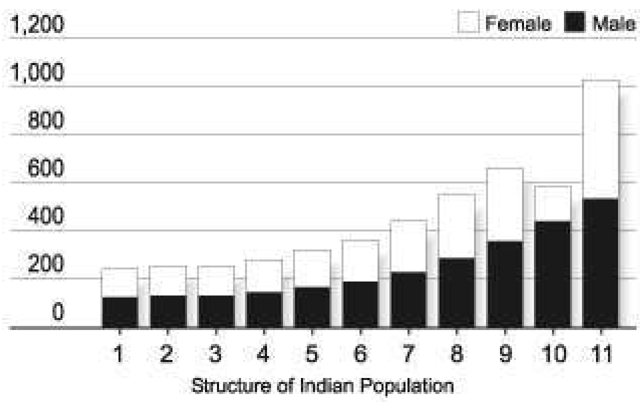


Fig. 31.2 Sex Composition of population of India (1901-2001)

(C) Diagrammatic Presentations: Diagrams are both graphical as well as geometric in nature. The processed data is portrayed through different diagrams for visual presentations. It is important to make use of diagrams based on their relative merit of visual presentation. The diagrams mostly refer to time or space or both the characteristics related to one location. Some of the diagrams used for the presentation of primary data are discussed below:

(i) Bar Diagram : The use of column or bar has become common in representing a comparative performance of various units and growth of an individual unit. The length of bar is kept proportional to the size of production or the volume of change. Thus bar diagram is used to represent many elements at one point of time and one element across the time. The compound bar diagrams are used to represent the subclasses of an element. The block of a bar is proportionately subdivided to represent the sub classes in a compound bar diagram.

(ii) Pie Diagram: The pie diagram is also known as divided circle. It is used to represent the proportion of the sub-unit of whole. The different segments of a circle represent percentage contribution of various components of data. For drawing a pie diagram, we construct a circle of any diameter. The circle is then divided into desired number of segments. i.e. angle 360 represents 100 percent. Pie diagram is generally used to represent the general land use of village, composition of shops in a functional profile of urban areas, social composition of surveyed village, composition of total population.

(d) **Presentation of Data through Maps:** Various types of maps can be constructed with the help of primary data. Maps related to various themes such as environment, trade, land use, production of community population, etc. can be prepared for presentation. A map is a proportional representation of some or whole part of the earth on a fiat surface or piece of paper. Thus, the outline map represents the direction, distance and shape of the area, while the technique of the representation of data on the maps explains distributional characteristics. The method of preparing dot map is given below here as an example.

Dot Maps: These maps are used to show the dispersal as well as concentration tendencies (characteristics of a distribution) of the phenomena. Dot maps are related to point specific pattern of distribution unlike isopleth maps which are concerned with joining places having the same or equal values of distribution or choropleth maps which are concerned with area specific distributions instead of location specific distributions.

These maps use data to represent location specific distribution. The size of the dot is worked out considering the capacity of space on the map and the value of distribution at one point of location. The dot is assigned specific value in quantitative terms. Once the value of a dot is determined the number of dots at each location can be worked out. Dots are plotted on the map based on location specific distribution of variable. Due care needs to be taken while putting dots on the map.

Transport lines, rivers and canals, mountain tops and such other negative areas should be separated from placing dots. The final map clearly represents the concentration and dispersal of a distribution. The field data related to house-hold population, agricultural production, shop-wise daily sales or consumer pattern, unit-wise industrial production or field-wise crop can be better represented through dot maps.

For more details you are suggested to read the Practical Manual in Geography.

- Arrangement of information data either in ascending (from bottom to top) or in descending order (from top to bottom) is know as Array of data.
- Putting data on columns and rows to find the sum of the two sets for verification is called cross matching of data.
- A group of records showing similar data is called data flow.
- A set of data related to particular entity or a group is called the field.
- A complete set of information showing all basic data is known as master chart.

INTEXT QUESTIONS 31.2

1. Give single term to the following statements:

   (a) The process of organizing data into groups or classes on the basis of certain characteristics.

   (b) A graph used to represent two or more variables which are either superimposed or placed in a cumulative way.

   (c) Grouping the data on certain basis.

   (d) A measure which divides a series into 100 equal parts.

   (e) The maps which are concerned with point specific pattern of distribution.

2. Match the following terms with the statements:

Terms	**Statements**
a) Array of data	(1) A person on whom questionnaire is administered.
b) Cross matching of data	(2) A complete set having all basic data.
c) Charts	(3) Arrangements of information either in ascending (from bottom to top) or in descending order (from top to bottom)
d) Respondent	(4) To put information on columns and rows to find the sum of the two sets.

3. State the three forms of data presentation.

   (a) ________________ (b) ________________ (c) ________________

4. Write the three forms of cartographic presentation.

   (a) ________________ (b) ________________ (c) ________________

5. Define the following terms.

   (a) Pie diagram

   (b) Median

   (c) Coding of data

   (d) Master chart.

31.4 INTERPRETING THE INFORMATION

Interpretation of information/data is crucial for written communication. It is an art of expressing a given data/information in a written or oral form to provide a logical explanation for the given facts. The following points should be kept in mind while interpreting the information:

i) Clarity and explicitness of the interpretation.

ii) Segregation of common and special features.

iii) Focus should be clarified right in the beginning.

iv) Organisation of the facts must be step by step.

v) Accuracy of facts need to be checked.

I. **Interpretation of a table:** A table is a compact orderly arrangement of facts. It is summarized or grouped from a processed data. Interpretation of a table needs to start with the identification of minimum and maximum value i.e. ranges in the data. The difference between these two values explains the range to be comparatively smaller or larger. The smaller the range, lower the deviation and in the concentrated form is the distribution. Contrary to this, if range is larger, the interpretation will change as the distribution will be dispersed. The second step in the interpretation of a table relates to the analysis of various classes and their frequencies. The third step in the analysis of a table relates to the inferences derived. It should be brought out very clearly as what generalizations emerge from the table.

II. **Interpretation of a graph:** Graphs are different types and their interpretation varies significantly one another. The interpretation should be done with great care. There could be broadly two types of graphical interpretations. The first type of interpretation may deal with the amount of change with reference to time or areal units or both. The second dimensions of graphical interpretation is the trend. It is further divided into total trend and point specific trend.

III. **Interpretation of a diagram:** Each diagram has its own merit of presentation. It should be interpreted with regard to variables shown. A diagram highlights different levels of variables viz high, medium, low, very low etc. Interpretation of each component should be made clearly to give an idea about the performance of a variable across time and places.

IV. **Interpretation of Maps:** Interpretation of maps refer to area specific characteristics of a phenomenon. It could be with regard to time, intensity and community. The distributional, characteristics of a variable should be interpreted. It will bring out the distributions both in terms of volume and area covered. Logical explanation should be given to the factor responsible for such a distribution.

- While interpreting the information certain points should be kept in mind. The points are clarity and explicitness, segregation of common and special features, focus, organization and accuracy of facts.
- The interpretation of processed data differs from one medium to another. For example, the interpretation of a table is different from diagrams, graphs and maps.

31.4 PREPRATION OF FIELD REPORT AND ITS FORMAT

Fields report are the written account of the facts and data collected from the field, its generalizations and basic conclusions. These reports are being used for comprehensive and application oriented learning. Implementation of various development schemes and plans are made depending on the conclusions derived, suggestions and recommendations made in the report. Since report forms the basis of decisions making, it needs to be comprehensive and capable of reflecting the ground truth. The field report should be prepared based on the following components:

(a) **Introduction:** The first step in writing a field report is its introduction. The introduction includes the statement of the problem of field survey and its objectives. Methodology of the field work and the general background of the area of field survey has to be planned. The selection of samples and variables, hypothesis, processing and presenting the primary data from the part of mythology. The last part of the introduction is expected to discuss the scope and plan of the report.

(b) **Analysis:** The value of the report is adjusted on the basis of insight and labour put in its making of a scientific and logical project. Analysis of the report is sub-divided into chapter of convenient number. Sequence of these chapters however, follows the system like 1) structure on nature of the theme of investigation. 2) Trends and patterns (both temporal a well as spatial) related to the theme of investigation. 3) correlation of associated factor influencing the problem under study 4) constraints and associated problems and 5) conclusions and suggestions. Each chapter contains logical and scientific analysis of the facts derived through the processing of data in the form of tabular and cartographic presentations besides investigators personal impressions gathered during the field work.

(c) **The Results and recommendations:** The third and the important part of the field reports is related to deriving results and the recommendations. The generalisations made in each chapter are put together to form specific conclusions. To make suggestions more meaningful, constraints and likely problems should be worked out. Having analysed the entire theme of survey both individually (at the level of variables) as well as collectively (at the level of groups), one is able to make final observation or to derive both broad as well as specific conclusions. The recommendation should be based on these results. Both basic as well as functional aspects of the problems should be covered by these recommendations. Before making recommendations one is expected to assess the viability and feasibility of the same. The smaller and specific is the dimension of the problem, more workable and viable is the recommendation. Similarly, the feasibility aspect of recommendation deserves to be assessed in the light of available technological, financial and social implications. The report must avoid vague and unclear recommendations. Thus, result and recommendations should touch upon finding solutions to problems faced and accelerating the pace of development.

Format of the field report: It is important to note that all field reports are special and unique in so many respects. However, there are certain formats which are common to all reports. On the basis of common characteristics, it may be summarized that a field report mainly consists of three parts. viz. (a) Parling (b) Body of the text and (c) Documentation.

(a) The Prelims: It consists of Title page, Preface, Table of contents, List of tables, list of maps and diagrams and list of Appendices.

Example:

Title of the Field report

Context of Field Report and Period of Survey

Name of the Investigator/Address

Name of the Project Supervisor

Name of the Institution or Organization

Year of submission

(b) Body of the Text: It includes from introduction to the conclusion and recommendations

Chapter Scheme:

(1) Introduction

- (a) Statements of the problem
- (b) Objectives of the field work
- (c) Methodology used
  - (i) Universe of the study
  - (ii) Selection of samples
  - (iii) Hypotheses proposed
  - (iv) Methods of data processing
- (d) Scope and plan of the study

2. Nature or structure of the theme of Investigation.

3. Spatial and temporal trends of the problem of study. This chapter relates to understanding the area specific patterns and temporal trends.

4. Correlates the problem or investigations - It deals with the analysis of factors responsible for trends and patterns.

5. Constraints of theme of investigation -There are some basic and functional problems linked to each area. This chapter is devoted to study these problems.

6. Conclusions, suggestions and recommendation - This chapter summarises the findings, makes suggestions and recommendations for the development.

(c) Documentation: It includes references, selected bibliography appendices, glossary of terms etc.

INTEXT QUESTIONS 31.3

1. State the three main parts that a field report consists.

   (i)________________(ii)________________(iii)________________

2. Write seven points of Chapter Scheme of the field report.

   ____

____

WHAT YOU HAVE LEARNT

The data collected from the field are very extensive and unprocessed. While surveying in the field some objects remain unsurveyed and data, therefore, becomes dissimilar. Hence, there is need for processing the data properly. The different steps involved in processing data are editing, coding, organisation and classification. Only then the data becomes in the presentable form. The presentation of data could be tabular, statistical and cartographic forms. The tabular presentation could be simple or complex depending upon the variables used. Statistical presentation makes use of mean, median and mode for getting central values. Percentiles are also used to explain the coverage of a phenomenon studied. Cartographic presentation of data is made in different ways. Such as graphs, charts, diagrams, maps etc. Two variables can easily be represented by a line graph. Bar diagram is used for comparing different units. Compound bar diagram issued for representation the sub units of an element proportionately. Different types of maps are prepared with the help of primary data. The dot map is the most popular map. The dot map shows the distribution of an element. It also depicts the concentration and dispersion of the element. Isopleth map also depicts distribution of phenomenon. In this map, points of the same values are joined by curve lines. Distribution maps are also shown by shading methods.

The following points are kept in mind while interpreting the information. Clarity and explicitness, segregation of common and special features, highlight the focus, organise the matter in small paragraphs and facts should be complete and accurate.

Report is the most important component of the field work. It is a written document highlighting the conclusions drawn from the field work and data collected. The report should be extensive and related to ground realities. It should be written under the heads in a sequential orders of introduction, analysis, results and recommendations. .

TERMINAL QUESTIONS

1. What is data collection ? Describe any three issues that need to be covered in case of local area planning.
2. What are the tools and techniques of data collection?
3. Why is cross matching and array of data necessary in the organization of field data. Give any three reasons in support of your answer.
4. Explain any three steps in the processing of primary data.
5. What points should be kept in mind while interpreting the information.

6. Write a brief account of the Components related to the preparation of a field report.

ANSWER TO INTEXT QUESTIONS

31.1

1. a) Primary data.
   b) Secondary data
   c) Tools of data collection.
   d) Techniques of data collection.
   e) Questionnaire
2. A. 1. Making oneself ready for collecting data from field situations.
      2. Keeping a field book /record book/diary.
      3. Administering questionnaire/schedule to the target group.
   B. 1. Acquiring knowledge about offices/ institutions etc. keeping the records of data.
      2. Getting an official letter for introduction and keeping identity card to get on entry in the office.
      3. Keeping a note book /record's file for transfer of data.
3. (a) ___ (4), (b) ___ (3), (c) ___(1) and (d)___(2)
4. (a) Identity specific contents (b) Respondent Centred Contents.
5. i) The sample should be such that it reflects the characteristics of the whole.
   ii) The sample should not be identical as it leads to error.

31.2

1. (a) Classification of data.
   (b) Compound graph
   (c) Classification of data
   (d) Percentile
   (e) Dot maps.
2. (a) ___ (4), (b) ___ (4), (c) ___ (2), (d) ___ (1)
3. (a) Tabular (b) Statistical and (c) Cartographic
4. Graphical (b) Diagrammatic and (c) Maps

5. (a) A diagram which represnts the share of sub-groups of an element within a circle.
   (b) The middle most position in a distribution.
   (c) To assign some alphabetical or numeral or both as the symbols.
   (d) A complete set of information showning all basic data.

31.3

1. (a) Prelims
   (b) Body of the text
   (c) Documentation
2. (i) Introduction
   (ii) Nature or structure of theme of investigation.
   (iii) Spatial and temporal trends of the problem of study.
   (iv) Data source and methodology
   (v) Correlates of the problem of investigation
   (vi) Constraints of theme of investigation
   (vii) Conclusions, suggestions & recommendations.

HINTS TO TERMINAL QUESTIONS

1. See Section 31.1
2. See section 31.2
3. See section 31.3
4. See section 31.3
5. See section 31.4
6. See section 31.4

Notes

32

RECOMMENDATIONS THROUGH CASE STUDIES

Till now we have studied various dimensions of local area planning and processing techniques of data/information. These dimensions will help in conducting the case studies under different geographical setup. To make your work more convenient, we have discussed four case studies. These case studies are related to market, slum, tribal and hill areas. In this unit we have given a detailed account of these case studies.

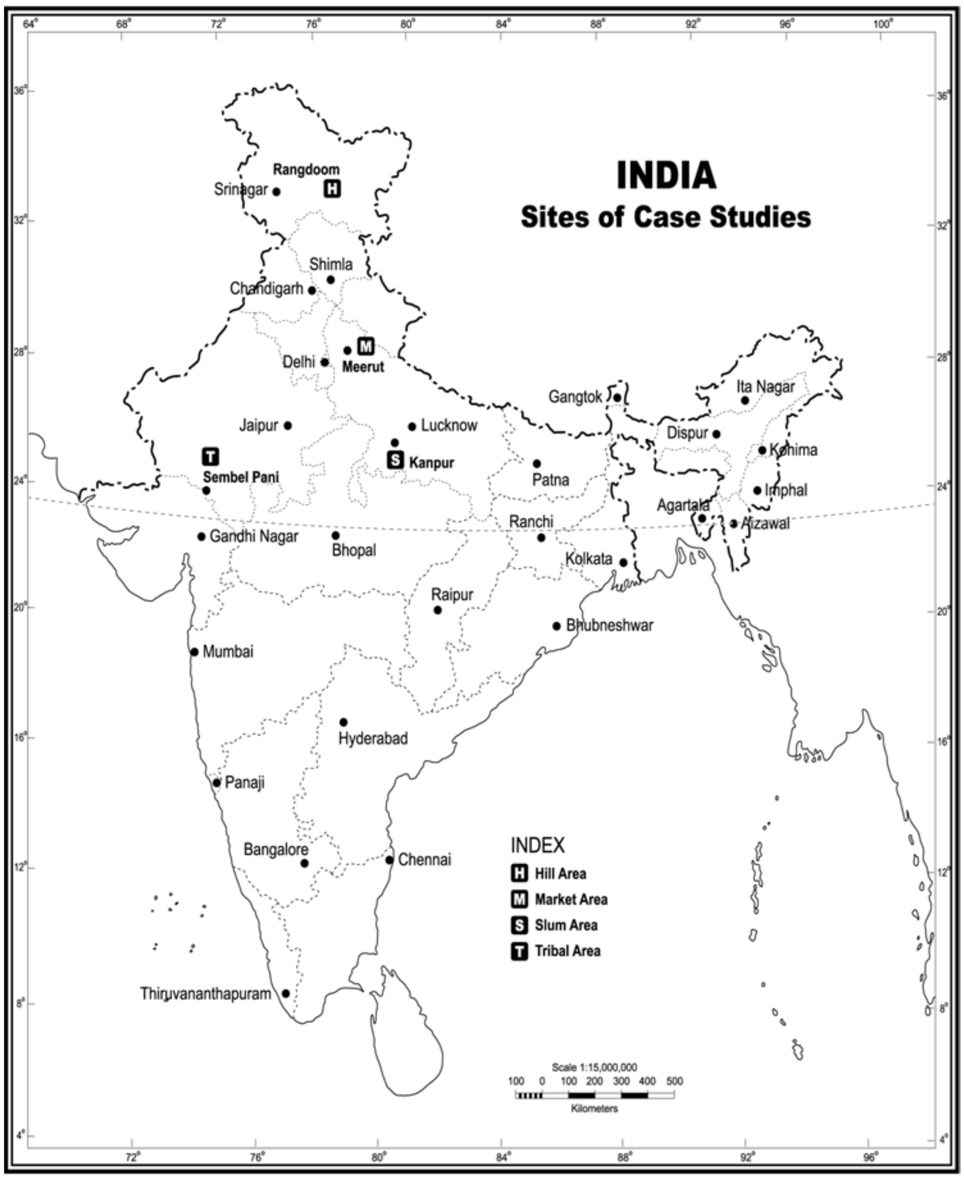
OBJECTIVES

After studying this lesson, you will be able to:

- justify the rationale behind studying the case studies.
- know different case studies and their local area significance.
- compare situations and conditions under different geographical setups.
- analyse and establish relationships with geographical conditions and socio-economic development of local areas.
- explain the case studies with reference to their planning priorities and socio-economic concerns of the local people.
- suggest the plan to be taken up for further development.

32.1 SIGNIFICANCE OF CASE STUDIES

There are marked variations in terms of geographical setup, socio-economic conditions and levels of development of the people in different parts of the country. We can understand the ground realities better by conducting field surveys. The approach to field survey is generally systematic and follows the set norms of inquiry for all kinds of surveys. However, this approach is not sufficient to take care of specific case studies which are distinct in their nature and solution to planning problems. This creates confusion and provides undue coverage to certain issues which are relatively less meaningful in another setup. As such there is a need for case studies that deal with area and people specific conditions and present the ways to analyse the situations. The case studies reflect different problems faced by specific group of people and areas. It also reflects the priorities of planning for different local areas and people. For example market areas are faced with issues like parking space, overcrowding and congestions, quality and variety of goods for different levels of producers and consumers. On the contrary tribal areas suffer with the poor technological base, inhygenic condition, poverty, and environmental



Based upon Survey of India Outline Map printed in 1990
The territorial waters of India extened into the sea to a distance of twelve nautical miles measured from the aporopriate base line.
The boundary of Meghalaya shown of this map is as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but has yet to be verified
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig. 32.1 Site of Case Studies

degradation. The priorities of slum areas are sanitation, health and hygene, while that of hill areas is inaccessibility, remoteness, harsh environmental conditions. This is also true is case of functional or occupational surveys. Agriculture in hills, plateus and plains varies significantly. It also presents marked variations even within one setup also. For example agriculture of Punjab is different from that of Assam plains or plantation areas of Kerala and Tamilnadu. As such case studies provide genuine basis for analyzing area specific planning issues.

Background to case studies

The case studies presented here have been briefly discussed in terms of their significance in geographic analysis.

The case study of market area deals with a location where some people sell their products and services, while other purchase goods and commodities for consumption or for further processing. Markets may vary from a village market, a weekly market to specialized markets and malls. In the study of a market interaction is most important for the exchange of goods and services.

The case study of slum relates to a geographic situation in which a group of people are forced to live in poor sanitary and unhygienic conditions of living space largely due to poor economic conditions. The study of slum gives an insight into the problem of space and seeks to address some of these issues through developmental activities.

The case study of tribal area relates to the habitat, economy and society of a group of people who practice traditional modes of production and distribution. A tribal group is usually placed in remote geographical pocket like forests, hills, grasslands and less fertile zones in uplands and lowlands. The study of tribal area explains how a community lives in harmony with nature despite low productions and low level of infrastructures. Remoteness of the tribal areas keeps their culture intact and improving while slow changes continue to put them in the less modernized category.

The case study of a hill area explains ruggedness of the terrain, its higher altitude, steeper slopes and limited land resources. Consequently, pressure on limited fertile land is quite high. It is to be noted that hill areas vary with each other in dimension and significance. For example hill stations, valley areas and areas of moderate slopes have varying population pressure due to differing carrying capacity of land. Snowfall is place specific constraints in hill areas. The communities in hill areas remain organized well knit and compact to face the constraints imposed by nature.

INTEXT QUESTIONS 32.1

1. List three factors that cause variations in different parts of the country.

   a.__________________ b.__________________ c.__________________

2. Explain two distinctions between a general field survey and specific case study.

   a.____________________ b.____________________

3. Write two priorities of planning related to each of the following.

   (i) Market area : Planning Priorities

   a.____________________

   b.____________________

   (ii) Hill area : Planning Priorities

   a.____________________

   b.____________________

32.2 CASE STUDY-I

SURVEY OF MARKET/WEEKLY MARKET

Market places are the localities where sellers and buyers meet and exchange goods and commodities on payment. Buyers are those who purchase items of their requirements where as sellers are those who sell the items (goods and commodities) on payment. The market places are broadly of two types-general or retail markets and specialised or wholesale markets. The general market places offer marketing facility for almost all types of goods / commodities. There are shop to shop variations in terms of goods sold. The number and variety of goods remains limited in case of a retail market centre. It serves the locality and nearby places with all sorts of required goods and commodities. There are large variations in the size of the retail marketing centres. Ranging from a few shops in residential localities or village shopping centres, a retail market centre could be as large as a large cluster of shops. On the basis of the structure and permanence of a shopping centre, the markets could be divided into regular and weekly markets. The regular markets are those which have a permanent physical structure of shops and offer marketing facility on a regular or daily basis. The weekly markets are those which do not have a permanent physical structure of their own rather these shops are mobile and offer marketing facility on the fixed day in a week. These markets have open or partly covered temporary tent or shop like structures which is packed, rolled and transported to other place where weekly market is scheduled to be held the next day. Weekly markets play significant role by serving large variety of consumer both from rural as well as urban areas. Almost all essential requirements of a household are sold in these markets. Weekly markets have different local names, “Painth”, “haat”, “bazar” etc. These markets are also named after the week day.

Conducting the field work

The first task towards conducting field survey is the selection of a market area which should not be too far from your reach and should be an important one. It should be a general mixed type of a market. Conduct a preliminary survey to find out the goods and commodities being sold, select two to five shops under each category subject to twenty five shops for the total survey. The next step is to collect basic information and prepare the base map of the market. The basic information such as population, area and civic amenities and the map of the market can be obtained from the office of the local government. (municipality, corporation etc.). In case maps are not available, sketch maps can be prepared. These maps are meant to provide sequence and direction of a place and are usually made not to the scale. All shops are shown having the same space. Such maps serve the limited purpose of the study.

The procedure of market survey should be based on the time available and the objectives of the field work. For example if the shopping centre is small, all shops can be surveyed. However, in case of medium and large sized shopping centres, we need to select varied shops from each lane. Only market locally known as "Sunday bazar", "Budh bazar", "Mangal Bazar" etc. can also be surveyed. These markets are regulated under "tak bazari system". Under this system local govt. (municipal committee or a village panchayat) offers contract of tak bazari to the contractors (they may be a group of persons or individuals) for smooth functioning of the market. The charges of *tak bazari* are proportionate to the area occupied by the shops. For example, a shoe repair shop covering one sq. metre area may pay Rs. 5.00, while a cloth merchant with 8 to 10 sq. metre area shop may have to pay Rs. 50-99 for the market day.

The specialised markets deal with the marketing of a few goods / commodities. These markets are characterised by the cluster of shops dealing with the same specialised item on sale. Most of these markets deal with the whole sale trade and offer great range of variety in the quality of the specialized item. For example Grain market (Galla Bazar), market of pulses (Dal Mandi), fruit market (phal mandi), vegetable market (sabzi mandi), cloth market (bazar Bajaja), market of ornaments (bazar sarrafa), market of stationery (Kagzi bazar) etc.

The customers to the market places are both from neighbourhood and country side (near by villages). Since agricultural operations are mostly seasonal in nature, there are fluctuations both in retail as well as whole sale trade. Similarly, during occasions of festivals and ceremonies, there is rise in the trading activity. Contrary to this, during unfavorable weather conditions, there is a considerable fall in the marketing activity. Even during the hours of business, there are peaks and lows of movement of customers. Usually the period between 10.30 to 12.30 PM and 4.30 PM to 6.30 PM are the peak hours of business activity. The shops to be surveyed should be selected on the basis of a suitable sampling technique. However, repetition of the sample should be avoided to reduce the possibility of errors in the results. Having selected the sample shops and sample business activity (general merchants, grocers, clothiers, stationeries etc), we should conduct market survey shop-wise.

INTEXT QUESTION 32.2

1. Provide one word answer to the following statements:
   a) A localities where sellers and buyers meet and exchange goods and commodities on payment.
   b) A site with permanent physical structure of shops which offer marketing facility on daily basis.
   c) A site with temporary structure of shops on a fixed day in a week.
   d) A Shopping centre dealing with very specific items having large variety and quality.
2. List two characteristics of each of the following:
   (i) Retail market

   (a)________________________(b)________________________

   (ii) Wholesale market :

   (a)________________________(b)________________________

32.3 CASE STUDY - II

SLUM AREA DEVELOPMENT: A CASE STUDY OF KANPUR CITY

Slums are the shelters of urban poor. They reflect insanitary conditions in the absence of bare minimum social facilities and amenities. Characterized by extremely low level of per capita income and living space, slums are the shelters of urban poor in India's most of the metropolises. According to an estimate about 20 to 40 percent of the population in large cities lives in slums. The increasing industrialisation, growing capital investments and job opportunities in urban areas continue to attract rural migrants by assuring provision of at least a subsistence means of livelihood. However, increasing housing cost and rental value forces the majority to live in slums. It is, thus, a transfer of rural poverty into urban areas. Majority of the people living in slums are illiterates. Hence, they are employed in low paid jobs or work in low earning professions. Slums are generally known as Basti in Kolkata, Chals in Mumbai and Ahatas in Kanpur. As such slums have location specific names in different cities. Nearly 1.65 crore population lived in slums of million plus cities of India in 2001.

Kanpur metropolis is situated over the southern bank of river Ganga in the state of Uttar Pradesh. According to Indian census 2001, Kanpur metropolis recorded a population of 25,51,337 persons and was ranked 8th among Indian cities. From a population of 2,02,797 persons in 1901, the city grew more than 12.5 times during the past one century. Accordingly about 24 thousand persons are added to the city every year. The rapid growth of industries, trade and commerce worked as gravitational pull for the labour from neighbouring districts of Uttar Pradesh. According to an estimate about 76.27 percent population of the Kanpur City lived in the congested part of the city centre.

Field survey of a slum locality (Kanpur metropolis) was undertaken at two successive steps. The first step was based on total survey of slum dwellings (in Bansmandi, Darshanpurwa and Chamanganj area) with regard to sanitation, health conditions and provisions of public utilities. The second step related to sample survey of households (25) randomly selected from slum localities in inner, middle and outer zones of the city. This survey deals with population size, living space, employment and income of the households.

Population Structure And Household Size

On an average, a household in a slum area occupied a living space of about 10 to 15 square metres only. The density of population ranges between 3000 to 4000 persons per hectare in most of the slum localities in Kanpur. There is a contiguous belt of residential areas surrounded by central commercial core and industrial pockets of the city. Housing blocks are usually double or triple storeyed and are separated by narrow lanes or by lanes. The over all outlook of slum localities presents most unhygienic conditions for human habitat. According to 2001 census of India, Kanpur city recorded a total slum population of 3,68,808 persons.

Slum localities are mostly segregated areas in terms of social composition. It is observed that a slum locality is predominantely occupied by one type of social group (Hindu or Muslim in this case). Further, within each social group a slum locality could be dominated by a caste group or people migrated from specific area. Functionally, a slum locality represents, by and large, the same economic profession and economic levels. Most of the slum dwellers are economically poor.

The average household size is 6.1 However, one could notice small and medium, ranging between 1-5 persons; large ranging 6-11 persons and very large with 12 or more persons. The survey of households conducted in a slum locality revealed 38.4 percent as small and medium sized, 54.7 percent large sized and 6.9 percent very large families.

Occupational Structure

The study reveals that 46.4 percent households were employed in professional services plumbing, masonary works etc., 32.8 percent assistants in business and commerce, 18.12 percent were daily wage unskilled labour and 1.8 percent were unemployed job seekers. In terms of sectoral employment, about 46.9 percent workers are engaged in informal sector.

Table No. 32.1 Size of households and their occupational structure in a Slum Area of Kanpur

Size of the Households	Services		Business		Labour		Unemployed		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Small and Medium (1-5 persons)	44	45.36	27	27.84	22	22.68	4	4.12	97	100
Large (6-11 persons)	63	46.67	47.	34.81	25	18.52	0	0.00	135	100
Very large (12 & more persons)	9	50.00	8	44.44	1	5.56	-	-	18	100
Total	**116**	**46.40**	**82**	**32.80**	**48**	**19.20**	**4**	**1.60**	**250**	**100**

Results reveal that most of the slum dwellers are engaged in service sector. It includes both formal as well as informal sector services. The employment in business is proportionately higher among large and very large household groups. Contrary to this, proportion of daily wage earners is higher among small and medium sized household groups. This group also reflects unemployed job seekers.

It is, thus, obvious from the above discussion that large and very large households increase family income by diversifying their economic activities. In its turn, it leads to different kinds of business activities due to increased income of the household. The joint family set up in a slum locality has a higher cumulative causation effect for the survival and growth compared to a nuclear and smaller family set up.

Level of Income Generation:

The overall impression of a slum locality reflects the pocket of urban poor. However, one could notice income variations among the slum dwellers. The field survey reveals the three levels: lower, middle and higher on the basis of monthly income.

Table No. 32.2 Monthly Income Levels in a slum Area of Kanpur

Income Group	No. of Households	Percentage Share
Lower (Below Rs.1000)	185	74.0
Middle (Rs. 1001 - Rs.2000)	53	21.2
Higher (Rs. 2000 and above)	12	4.8
Total	**250**	**100.00**

Out of 185 lower income groups, 74 came from small and medium, 106 from large, and only 5 from very large household size. From 53 middle income groups, 14 were recorded from small and medium, 28 from large and 11 from very large household size. In the higher income groups, these figures were recorded as 3, 6 and 3, respectively. The following table explains the relationship between per capita income and the household size.

Table No.32.3 Daily Per capita Income

Size of Households	Rs.50 or less	Rs.51-100	Rs.101-150	Rs.151-200	Above Rs.200	Total
Small/Medium	22	38	27	6	4	97 (38.8)
Large	46	42	33	13	1	135 (54.0)
Very Large	4	8	4	2	-	18 (7.2)
Total Households	**72 (28.8)**	**88 (35.2)**	**64 (25.6)**	**21 (8.4)**	**5 (2.0)**	**250 (100.00) (100)**

Figures in the brackets indicate percentage to total

Results reveal that 28.8 percent of the slum dwellers earn Rs. 50 or less on daily basis. About 35.2 percent earn between Rs. 51-100, 25.6 percent between Rs. 101-150,8.4 percent between Rs. 151-200 and remaining about 2 percent earn above Rs. 200. Thus most of the slum dwellers have low per capita income. The average income of small/medium sized household was Rs. 90/- of large households Rs. 81/- and of very large Rs. 86/-.

Literacy

Out of 250 households, 158 (63.2%) were literates and 92 were (36.8%) illterates. Out of 158 literates, 98 were from service, 54 from business and 2 from unskilled labour and 4 of them retired from service. Among 92 illiterates, 18 were from service, 29 from business and 45 from labour force.

Residential Structure

The residential space available to the households ranged between 10 square metres to 15 square metres. The housing space was classified as : 1) small with less than 10 sq.metres., ii) medium from 10 to 12 sq.metres and large above 12 sq. metres.

Table No. 32.4 Residential Structure in a slum Area of Kanpur.

Type of Available Space	No. of Structure	Percentage
Small	149	59.6
Medium	53	21.2
Large	48	19.2
Total	**250**	**100.00**

Table 32.4 reveals that most of the people living in the slums occupy small residential space. As many as, 149 out of 250 surveyed households lived in small, 53 in medium and 48 in comparatively large housing space.

Slum dwellers are mostly tenants (83 per cent) living in one rooms paying an average monthly rent of Rs. 62/-. Nearly 85 percent of the residences were electrified, 21.3 percent had bath room and 43.5 percent toilet and 28.2 percent with water tap facilities.

Notes

+Thatched mud and tent houses are common sites of slum dwellers along major drains, railway tracks and garbage sites. Some times these people are also provided with low cost housing by urban development authorities. Thus they are often displaced and the problem of resettlement and rehabilitation remains common to them.

> Slums are the shelters of urban poor. They reflect insanitary conditions in the absence of bare minimum social amemties and facilities. Slums are the result of rural poverty, large scale displacement and increasing job opportunities in cities.

Slum Area Development

Slum areas are the most deprived localities of human settlements.

Based on the field survey and experiences of slum improvements in different cities the following planning is suggested.

1. **Provision for Basic Social Amenities:**

   The provision of safe drinking water, sanitation, toilet, ventilation, school, dispensary, post office, road, means transport and communication, shopping outlets, community centre etc. need to be provided to each locality irrespective of its status (rich or poor). It could be done for assuring human welfare. Services of 'Sulabh' International can NGO's have proved most economic and hygenic. This needs to be created for the community as a whole because people are poor and can not afford many of these facilities at household level.

2. **Provision For Economic Persuits:**

   Micro scale business and cottage industries could easily be planned to create self employment and enhance income. Small business such as evening chaat bazar, weekly market, fruit and vegetable outlets could be planned for the local people. Besides business, cottage industries such as sculpturing, embroidery works, statue making, stone works, wood works, iron and repair works etc., if planned, can be meaningful in job and income generation to the slum areas.

3. **Other Welfare Works :**

   Since most of people living in slums are deprived of assets, means of recreation and entertainment; community centres should be planned to provide means of entertainment and a place for social gatherings.

4. **Environmental Quality Control:**

   Slum areas reflect poor sanitation conditions. Slums develop near garbage disposal sites, refuge areas and along drains. Plantations can promote shade; reduction in pollution level and the creation of green environment along sites of waste disposal, roads and drains. Most of the slum localities have problem of space, as such plantations of dwarf and flowering trees is most appropriate.

Planned efforts are also needed to cover the drains and sites of waste disposal. Planned efforts to slum improvement have made significant changes in the quality of life in Dharavi- A slum locality in Mumbai.

INTEXT QUESTIONS 32.3

1. Write three characteristics of a slum locality.

   a. ______________________________

   b. ______________________________

   c. ______________________________

2. List three factors that have contributed to rapid increase in the slum population of Indian cities.

   a. ______________________________

   b. ______________________________

   c. ______________________________

3. Suggest three priorities of planning for the improvement of a slum area.

   a. ______________________________

   b. ______________________________

   c. ______________________________

32.4 CASE STUDY - III

STUDY OF TRIBAL VILLAGE : SEMBELPANI (DISTRICT BANASKANTHA-GUJARAT)

Tribal Area Development: A Case study of Sembelpani tribal Village (District Banaskantha, Gujarat)

Introduction

The study area Sembelpani, a predominantly tribal village, is located approximately at 24°20' north latitude and 72° 44 east longitude in Danta tahsil of district Banaskantha of the state of Gujarat. The Palanpur - Ambaji road (Gujarat) passes nearby the village and connects Mt. Abu in Rajasthan. The village lies to the west of Ambaji town at a distance of about 7 Kilometres.

The area is a part of the south eastern extension of Aravali Hills adjoining district Sirohi in the State of Rajasthan. The village Sembelpani forms a part of Ambaji Mata Hill complex that represents sharp hill features, ranges and hillocks. The general elevation of the study area is approximately 650 metres above mean sea level. River Saraswati, a tributary of river Sabarmati flows through the area. This hilly tract records an average annual rainfall of 830 mm received largely from the south west monsoon. The vegetation is typically dry deciduous type with trees like Teak, Mahua, Bamboo, Golar, Halad, Bija, Kandhi and Sandi (local names). At places, vegetal cover is represented by scrub and open grasslands.

The Sembelpani has an area of 1542.48 hectares and a population of 642 persons. There are 106 households in the village (table-32.5). The proportion of tribal population to total population is 74.06 percent. While Bharwad represents the tribal community, Rabari represent the non-tribal community in the village (Table-32.6). The sex ratio (proportion of females per 1000 of male population) is 871. The proportion of literacy among females is 14.5 percent while among males it is 26.4 percent.

Table No.32.5 Profile of Households in Sembelpani Tribal Village - 2006.

Sample Households

Total No. of Households	Total Population	No. of Sample Households	Member of Households
106	642	30	210

Table No.32.6 Population Characteristics.

Area in Hectares	Population	Percentage of Tribal Pop.	Density of Pop. Per Sq. Km.	Sex Ratio	Percentage of Literacy	
					M	F
1542.48	642	74.6	46	871	26.4	14.5

Rabaris are a semi-nomadic cattle rearing people. It is curious that they live in small conical huts called Khuba. Rabaris have become a group of pastoral or semi- pastoral people in permanent economic relationship with other constituents of the local caste system.

Land Utilisation:

Of the total geographical area (1542.48 hectares) nearly 7.5 percent is arable and 92.1 percent is non- arable. The other uses of the land account for 0.4 percent (Table-32.7). The village represents limited agriculture, widely spaced woodlands and a large grazing ground. The land based activities include animal herding and subsistence agriculture. Most of the houses are thatched, kuchcha, widely spaced, elongated with partly fenced enclosures used for keeping animals, animal feeds like straw, grasses and farming implements. The grazing grounds of the village are commonly shared by the tribal community. Transhumance is generally practised during drought periods. Pastoralists move with their animals along Aravali highlands during summer and towards Kutch, Kathiawad area during winter season.

Table No.32.7 Patterns of Landuse (in hectares)

Total Geographical area (in hect.)	Arable Land	Non arable Land	Forest Cover	Other Uses
1542.48. (100.0%)	116.20 (7.5%)	1420.26 (92.1 %)	0.0 0.0	6.02 (0.4)

Economic Activities and Sources of Income

Of the total working population nearly 53 percent are directly engaged in animal herding and associated activities, about 41 percent in agro-pastoral activities and remaining about 6 percent in cattage industries, trade, transport and services (table-32.8).

Table No.32.8 Participation in Economic Activities

Agriculture			Labour			Other			Total		
Total	M	F	Total	M	F	Total	M	F	Total	M	F
14	3	11	20	12	8	8	5	3	42	20	22

On an average a household owns about 60 livestocks. Cows, buffaloes, goats, sheep, mules, camels etc. are the common animals reared in the area. Besides livestock, households are also engaged in the collection of forest products like honey, grass, guggal, dhaulimusli and bor. Agriculture is practiced in a few pockets with relatively flat land and deep soil cover. Agriculture is largely rainfed. The crops grown in the area are grains like millets, oil seeds and pulses.

Table No. 32.9 Income Through Different Sources

Average Income Per Household from Different sources (In Rs.)

Agriculture	Labour Products	Forest Products	Animal Industries	Cotton	Total
2330 (24.89%)	519 (5.54%)	3149 (33.64%)	3356 (35.85%)	7 (0.08%)	9361 (1 00.00%)

(Figures in brackets indicate percentage).

The sources of income are through the sale of animals and animal products like milk, ghee etc., forest products, agriculture and allied activities, cottage industries and a variety of local services. The average annual income of the household from all sources is Rs. 9361/-. The income generation through animal products and forest products is about 69 percent, through agriculture about 25 percent, through mannual works as labour about 6 (5.54) percent and remaining through handicrafts and other works (table-32.9).

Household Assets

There are very limited household assets with the tribal community. The house, utensils, furnitures, grain storage drums, baskets, musical instruments and farm implements are the assets of a household. The value of the household assets, in money terms, ranges between Rs.6001- to 9001-. On an average the value of a house is Rs. 6800-, farm implements Rs.384/-, utensils Rs. 279/-, furniture Rs. 210/-, musical instruments Rs. 69/-, grain drums Rs. 68/-, baskets Rs. 38/- and others Rs. 81/- (table-32.10).

Table No. 32.10: Average Value of Household Assets (in Rs.)

House	Furniture	Utensils	Baskets	Grain Drums	Farm Implements	Musical Instruments	Others	Total
6800	210	279	38	68	384	69	81	7929

Animals are the major source of income, milk, meat and exchange of goods. The value of a household in the tribal community is judged by the number of animal stock it has. Agriculture is limited to certain pockets in the village. Agriculture is practiced along with pastoral activities to supplement the household income. One or two members of the household also move towards coastal Gujarat to work in groundnut and cotton cultivation. Living in harsh conditions and leading a hard life is common to the tribal people in the area. Forced with poverty and recurring drought, tribals usually go for distress sale of animals and crop produce for their survival.

Interactions

The tribal population in the study area maintains short to medium distance interactions. Ambaji is the nearest market centre where, most of the animal, agricultural and forest products are sold (table 32.10-32.12). The household requirements of cloth, utensils, spices, foodgrains etc. are also purchased seasonally from Ambaji market. In terms of ineractions related to place of work, nearly 87 percent of the workers remain engaged in the village (sembelpani) itself. About 7 percent of the workers move to other places in search of jobs. This is a short distance movement upto 10 kilometres in nearby villages and markets for about 7 to 8 months. Remaining about 6 percent workers move to longer distances (more than 50 kilometres) for about 4 to 6 months to work in groundnut and cotton fields of neighbouring districts. Shortage of fodder grasses, tree leaves etc. also forces pastoralists with the herds of animals to make short duration movements towards north east along Aravali hills and along river valleys (Banas, Saraswati and Sabarmati) in the plains of Gujarat.

Table No. 32.11 : Place of Work

Sembelpani	Total Workers	In the same Village	Other Villages With distance short duration	With distance long duration
	123 (100.00%)	107 (86.95%)	7 (30.0 Kms) 4 Months (5.71%)	9 (8.0 Kms) 8 Months (7.34%)

Table No. 32.12 : Economic Interaction for Purchase & Sale of Goods
For Purchases

Ambaji	Sembelpani	**Total**
20	4	24

Table No. 32.13 : Forest Products and their Place of sale

Products	**Fuel Wood**	**Guggal**	**Grass**	**Honey**	**Dholi Musli**	**Bor**
Place	Ambaji	Sembelpani	Sembelpani	Ambaji	Ambaji	Ambaji

The tribal population accounts for about 8 percent of the total population of India. They are commonly found in remote rural areas of highlands. The ownership of resources such as forests, grazing grounds etc. is joint for the community. Tribal people are known for the protection and promotion of plants as well as wild animals. For exchange of goods and services tribal people generally practice barter system.

Suggested Planning For Tribal Area Development

Tribal area development seeks to promote tribal cultural heritage keeping balanced ecological growth and economic development. Since tribal societies are largely based on pastoralism, subsistence cultivation, fishing, hunting etc. as their means of subsistence, development of land, water, plants and wild animals are basic components for tribal area development. A brief discussion on different aspects of planning proposals related to the study area are given below:

Ecological Planning

Waste lands, hill slope sites, river valley areas and road sides deserve plantation of drought resistant plants like neem, shishan, mahua, bamboo etc. To ensure the survival and growth of these plants, provision of tanks, wells, tubewells need to be made. It is likely to increase the employment to the local people and create permanent physical structures. The increased water sources will help in transforming the land into green pastures and increasing the farm and forest productivity. Green pastures, wood lands and water bodies will regenerate the endangered ecosystem, so essential for wild life promotion.

Planning the Social Facilities

To ensure social development, provisions for social facilities need to be made.

Village Sembelpani has a primary school and three shops to serve the local people. The source of water supply to the village is through two wells, one tank and a nearby river. A rural road (semi metalled) connects the village to Ambaji market centre. As such, social facilities that need to be planned are the provision for one senior basic school, one lady doctor, one veterinary doctor, dispensary, P.C.O. and a post office. Road has to be made metalled with a public transport system upto Ambaji town.

Planning the Economic Development

The existing local economy which is at its subsistence level, deserve technological back up for surplus production. Dairy cattle, which yield very little milk need to be replaced by high yielding breeds of cows, sheep and buffaloes. The quality of local breeds of animals could also be improved through hybridisation. Similarly, meat giving animals and those carrying loads can also be improved qualitatively to yield better economic returns. Cash crops like cotton, groundnut and fodder crops need to be encouraged for more agricultural out put. Agro-based industries, cottage industries and handicrafts need to be established to process the surplus agricultural produce.

Overall Perspective in Tribal Area Development

Given the chance, the tribal community will excel in the socio-economic development and will match with their non-tribal counter parts. Despite the fact that tribals have a traditional mode of production and are economically poor, they possess enormous knowledge of herbs, roots, plants, stones which they utilise in maintaining their health status. The tribal dances, music and performing arts are of higher quality. Thus, the tribal practices and knowledge about local medicines and culture could be promoted further and need to be utilized for employment and income generation. The scenic significance and hill surroundings are better suited for the promotion of adventure tourism like mountaineering, rock climbing, river rafting etc.

The provision of basic social facilities, assured irrigation and water supply system, availability of power etc. will accelerate the pace of plantation, afforestation, commercial pastoralism and cultivation. This, in its turn, will increase the employment and income levels of the tribal households. Tribal culture, heritage and knowledge need to be promoted on continuous basis. It will promote a sense of pride and will accelerate the pace of local area development through people's participation and favourable policies.

INTEXT QUESTIONS 32.4

1. Write the appropriate words to complete the following sentences:

   Statements

   a) The proportion of tribal population to total Indian population is_____.

b) The small conical huts in which tribal population of sembelpani lives are known as___________.

c) The major source of income among tribal communities is__________.

d) The tribal practice of movement along with herds of animals in search of pastures is called as___________.

2. List three characteristics of a tribal community.

   a).________________ b) .________________ c) .________________

3. Enumerate three planning priorities for tribal area development.

   a).________________ b) .________________ c) .________________

32.5 CASE STUDY - IV

STUDY OF HILL VILLAGE : RANGDOOM

(District Kargil – Jammu and Kashmir)

Rangdoom is a hill village lying across Great Himalayan Range in the state of Jammu and Kashmir. Geographically, it lies at 33° 42' N and 76°12' E in the Kargil district of Laddakh region. It has an altitude of 3820 metres above mean sea level. The Kargil - Padum National Highway passes through Rangdoom. Being located in the middle part of the National Highway, Rangdoom is at a distance of about 118 Kilometres towards south from Kargil. The distance between Kargil to Leh is approximately 176 Kilometres. It is a backward monastery village situated on the valley floor in relatively more isolated upper Suru valley. The village has a school, a post office and a camping ground. There are a few shops that deal with general provisions for the house holds. With a population of about 300 persons, there are 72 households in the village. Hill areas have usually small sized villages and they are scattered. The village has a polyandry system of family to avoid further division of available land resources.

Rangdoom is located on the right bank of river Suru which is a left hand tributory of the mighty river Indus. The river Suru originates from the water divide of Panji La (Pass). This water divide separates the catchment area of river Zanskar from that of Suru. It joins Indus to the north of Kargil town which is situated on its left bank. Suru is a perennial river. The flow of water in the river remains remarkably high during summer season when the snowfields and glaciers melt, while the river channel shrinks in the winter season they do not melt owing to below freezing temperatures.

Rangdoom is situated in a wide valley where a number of streams join Suru and is made of two hamlets namely **Juldo** and **Tshi Tungda** situated at a distance of about 9 kms. from each other. In between is situated Rangdoom Gompa on a hillock. The land is full of boulders and pebbles and is not very fertile.

Rangdoom Gompa

Gompa refers to a Buddhist Monastery. It is a religious institution and plays a very important role in all aspects of the life of Laddakhi Buddhists. All land in Rangdoom is owned by the Gompa and the villagers work on it as tenants. Lama, the Buddhist monk, is not supposed to do any manual work. It is believed that if he undertakes any manual work, it would lead to death of numerous life bearing objects. Rangdoom Gompa is centrally located on a hillock and controls socio-economic life of Juldo and Tshi Tungda hamlets. An elderly Lama who is looking after financial matters of monastery is known as Chakk-Zod. The land, therefore, belongs to the community and managed by the Gompa system of local administration. People in the village work as permanent tenants on hereditary basis and follow the rules set by the Gompa. A part of the produce is given to the monastery. However, proportion of the share from the produce varies from time to time depending upon local situations and requirements.

Climate

The village records extreme continental type of climate. Its climate is characterised by scanty rainfall, high range in the annual and diurnal temperatures, warm summers and severe cold winters. The mean monthly temperature varies from -12°C in January to 12°C in July. The approximate annual range of temperature is about 24°C. The village lies in the rain shadow area and receives less than 15 cms of annual precipitation. Unfortunately, larger amount of precipitation occurs in the form of snow during winter months. Gulmatango is the nearby observatory for recording the weather and climatic data.

Vegetation

Rangdoom has a hostile environment due to high altitude and extremely rugged terrain on the one hand and cold arid climate on the other. Climate dictates the overall pattern of vegetation. It presents a system of alternating valleys and mountain ranges. The barren rocky surfaces of mountain ranges are devoid of soil and vegetation cover. Most of the plants require a minimum of 6° C temperature for germination of seeds and plants to grow. The high diurnal range of temperature makes mean temperature values quite deceptive. The growing season is restricted to less than 6 months in a year. Plants are almost all ground - hugging shrubs and short woody trees. All the leaves are packed with nutrients. The vegetation type is dominated by grasses, bushes and small trees.

Scanty vegetation cover large areas because of cold dry conditions. Vegetation is very sensitive to grazing and is poor in species. The type of vegetation varies with altitude. Pasture grasses and weeds (Polygonum tortuosum etc.) are common near Rangdoom. Grazing is the most common activity during summer. The village presents, a very desolate picture with very little greenery. Locally known as **'Tsermang'**, the seabuckthorn is used for food, fire and fodder. It is a medicinal plant and its juice does not freeze in sub zero temperature.

Agriculture

The total geographical area of the village is 289.76 hectares. The total cropped area is 94.29 hectares. The culturable waste accounts for 49.37 hectares and remaining 104.82 hectares is not available for cultivation. As such, less than 40 percent of the total land was found to be under plough. About 68.2 percent land holdings are less than I hectare, 27.3 percent between 1 to 2.5 hectares and remaining 4.5 percent between 5 to 10 hectares. It is further observed that 35.8 percent leased in land for agriculture belongs to less than 1 hectare, 32.7 percent between 1 to 2.5 hectares and remaining 31.4 percent between 5 to 10 hectares. As such over 95.5 percent peasants in Rangdoom village were cultivating land measuring less than 2.5 hectares. The distribution of land as a resource is very uneven.

The agriculture is subsistence type in this village. The important crops grown in the region include grim (Naked Barley), wheat and peas. The mixed grim, wheat and peas are roasted and then ground to make Tsampa (Sattu) which forms the main food. Grim is used for making Chang, a popular drink with the Buddhists in the region. The chhang is made through fermentation of grim. Peas are used both as vegetable and for making Tsampa. Other crops include Oal (alfalfa) for fodder and also some Trumba (Buck wheat) and Garasl Bakla (Beans). Recently some vegetable crops have also been introduced to meet the demand of tourists and nearby market areas. However, most of these crops are grown mainly for self consumption. The relative share of different crops reveal that grim accounts for about 64.6 percent of the total cultivated area. It is followed by peas (23.1 per cent), fodder (4.8 percent), Garas/Bakla (4.1 percent), wheat (2.4 percent) and other crops (1 percent). Thus agriculture is a seasonal activity which lasts for about 5 to 6 months in a year. Agriculture is practised through traditional tools. The animal power of Yak or **Dzo** is used for ploughing and thrashing. Human labour is used for most of the operations. Use of modem machinery, fertilizer and high yielding variety seeds is very limited. The collective form of agriculture is also common in the village. It is known as **Phaspun** in which a group of households join together to complete labour intensive works such as sowing, harvesting etc.

Manure is an important input in agriculture. It consists of animal dung/droppings and night soil. Since winters are too cold, there is a provision of toilet in every house. It is usually built on the first floor with a hole in the Wooden floor. The excreta gets collected in the ground floor. This is mixed with soil and is used as manure in the agricultural fields.

Pastoral Activities

Livestock rearing is the other important component of the economy. Most of the livestock, except those required for agricultural operations, are taken to natural pastures during summer months. Most of the pastures are located on the higher grounds. Sheep, goats, ponies, and yaks are the most common animals reared on these pastures. Large flocks of sheep and goats are kept in these areas. Usually, one family from each village takes the cattle to summer pastures and live there in a hut, called **Daksha**. It is a temporary structure. The activity or animal herding is carried out among all households of the village on yearly basis. Milk and milk products are made in the **Daksha**. Besides milk and milk products, meat and wool are the other important products obtained from animal herding.

Tourism

Rangdoom is an important centre for summer tourism. Tourists and trekkers visit Rangdoom during summer season. According to an estimate, there are about 1000 visitors to the place during a summer season. Of the total tourists, about 47.3 percent are trekkers, 38.2 percent scientists and about 14.5 percent other unclassified visitors. Nearly 78 percent tourists are international and remaining 22 percent are domestic tourists. There are two important festivals that attract tourists to Rangdoom Gompa. The **Ladakh Festival** is celebrated on 15th September and **Sindhu Darshan** in June every year. Both domestic as well as foreign tourists take interest in participating in these festivals.

Prospects for Development

The overall analysis reveals that villagers in Rangdoom practise subsistence agriculture and nomadic herding on seasonal basis. The role of collective operations, both in agriculture and pastoralism, is still dominant in the economy of the village. People in this remote hilly village rely on barter system for exchange of goods and services. However, the role of **Phospun** (collective operations) is declining and it is getting replaced with hired labour. The changes are slow and dynamic. Nature is a major determinant of human activities in hill areas. Tourism is a new dimension in hill economy. The society is largely well knit and composed. The scope of development in hill areas depends upon the provision of essential infrastructures like roads, social facilities, markets etc. Mechanisation in agriculture and commercial pastoralism are the other important areas that can accelerate the pace of development in hill areas like that in Rangdoom.

Cultivable waste – The land that is suitable for cultivation but is not used for cultivation now.

Leased in land – The agricultural land taken on lease for some period.

Subsistence type of agriculture – It is a type of agriculture that has limited production which is mostly consumed locally.

Suggested Planning for Hill Area Development

Hill areas usually remain backward due to harsh climatic conditions and other natural constraints. However, planned efforts based on local needs could accelerate people's participation and local area development in a hill environment.

The following priorities of planning are suggested to develop the Rangdoom area.

1. **Provision for basic amenities and facilities**

   The basic infrastructures such as metalled road, means of transportation, highway restaurants and guest houses, health centres, weather stations, schools, veterinary centres, markets, banks, and postal services need to be upgraded and established along Kargil-Padum highway. It will act as a basis for human interaction and local area development.

2. **Provision for the improvement of ecological setup and economic basis**

   The ecological setup is largely devoid of vegetation. Large scale pastoral activities have resulted in degenerating the ecological setup. The pressure of animal population is on the ranges and is ever increasing. As such it is suggested that high altitude cold resistant trees be planted along the national highway and along the Suru valley areas. It is possible to grow Tsermang, a local berry tree which is known for its commercial value as its juice does not freeze even in subzero temperature. Similarly, pastures need to be managed through irrigation channels. Use of chemical fertilizers and assured irrigation to the land along Suru valley can improve the existing levels of agricultural development.

3. **Tourism Promotion**

   Rugged topography and glaciated landscape offer ideal natural conditions for expeditions, adventure tourism, rock climbing, sketting, trekking etc. Rangdoom occupies central location for promoting such tourism between Non-kun peaks and Panji La. However, provision of tourist amenities such as hotels, camping sites, guides, escorts etc. need to be made. Scientific and cultural tourism also have scopes to develop. Scientists and cultural tourists are already attracted to Buddhist Culture, Gompa organization, exploration of rocks, plants etc.

4. Development of commercial pastoralism and cottage industries. Pastoralism is an important economic activity of the area. However, animal products and the quality of animals are quite poor. As such there is an apparent need to upgrade the quality of animals such as sheep, goats, yak, ponies etc. The hybridization local breeds with karkuil sheep, goats etc. can improve the quality as well as quantity of wool, milk, etc. Cottage industries which form the basis for indoor winter activity need to be equipped with modern tools and markets. It will improve the economic status of the local people.

5. **Trade Relations and Regional Interactions**

   Trade relations of local surplus products need to be linked to the regional and national markets. Local people get minimum returns to their products due to distress sale. Govt support in establishing institutions of service centres, subsidies and support services can be most useful in mobilizing local and regional products. It will also improve the local economic conditions. Traditional routes and trade links need to be further strengthened.

INTEXT QUESTIONS 32.5

1. Complete the following sentences by appropriate words:

   Statements

   (a) Areas with sleeper slopes and higher altitudes are called_________.

   (b) A Buddhist monastery in Ladakh region is known as_________.

   (c) An elderly Lama who looks after the financial matters of the monastery is called_________.

   (d) The distribution of rural settlements in hill areas remains_________.

2. Match the list I with list II.

List I – Terms		**List II – Definitions**
(a) Phospun	(i)	A popular drink in Ladakh region.
(b) Chhang	(ii)	A hut used as temporary human habitation during summer pastures.
(c) Dzo	(iii)	A collective form of agricultural operation.
(d) Doksha	(iv)	An animal that is used for ploughing and thrashing operations.

3. Suggest three priorities of planning for hill area development.

WHAT YOU HAVE LEARNT

You have learnt, in this lesson, that field work is necessary for getting first hand basic information about people and places. The information, thus, collected is useful for developing general ideas and making meaningful explanations. However, field-work remains insufficient for making planning proposals on different themes and issues concerning area development. Theme or problem specific situations demand indepth informations related to particular issues which is covered through case studies. Since issues vary significantly from one situation to the other, the design of case studies varies with issues to cover it minute details of investigations. This lesson presents four case studies viz., market, slum, tribal and hill areas. The case study on market areas reveals marked variations in terms of structure and specialization for the items on sale in different markets. While weekly markets present temporary structure and mobile shopping system, whole sale markets present a permanent structure and routine shopping system. The case study on slums reflect the sites of deprivation of bare minimum facilities, large scale displacements and influx of rural poverty into urban poverty. Tribal areas are also underdeveloped. These are remote rural areas of highlands. The tribal people practice limited agriculture and grazing. Protection and promotion of plants and animals is common to tribal culture and heritage. The share of tribal population to total Indian population is nearly 8 percent. Hill areas are marked with rugged topography, mostly devoid of vegetation, poor accessibility and harshness of the climatic conditions. Consequently, hill areas have common grazing grounds, limited agriculture, prevalence of collective operations and barter system of exchange of goods and services. The community, in a back-word setup, remains well knit, organized and cooperative.

TERMINAL QUESTIONS

1. How are case studies important for better understanding of problems related to specific areas and issues concerning their planning priorities?
2. Explain how does nature and structure of shops varies from one market type to the other?
3. What factors are responsible for the growth of slums in cities?
4. Where does tribal people live?
5. What is the significance of plants and wild animal in a tribal setup.
6. Why is collective agricultural operations, animal rearing and barter system of exchange important in the life of hill people.

ANSWER TO INTEXT QUESTIONS

32.1

1. a. Geographical Setup b. Socio-economic conditions
   c. Developmental levels.
2. a) The field survey follows set norms of inquiry and generally remains systematic, whereas case studies follow problem specific approach of inquiry for different issues.

b) The field survey provides knowledge about the general background of the area or situations while case studies deal with particular issues and offer greater insight into the theme or issue of investigation.

3. (i) Market area – Priorities of planning

a) Provision for parking space

b) Alternative arrangements to reduce over crowding.

(ii) Hill Area – Priorities of Planning

a) Provision for Transportation

b) Environment regeneration

32.2

1. (a) Market

(b) Regular Markets

(c) Weekly Markets

(d) Specialized Markets

2. (i) Retail Market – Characteristics

(a) Number and variety of goods on sale remain limited.

(b) It serves to the locality and nearby places.

(ii) Wholesale Market – Characteristics

(a) Number and variety of goods on sale are in bulk and have great range of choices.

(b) Specialized items dealing with selected few serve to larger areas and population.

32.3

Characteristics of a slum locality:

1. (a) Low level of per capita income.

(b) Absence of bare minimum social amenities and facilities

(c) Prevalence of insanitary conditions.

2. Factors responsible for the increase in slum population.

(a) Increasing industrialization and concentration of services in cities.

(b) Growing capital investments in cities.

(c) Job opportunities in urban areas.

3. Suggested planning priorities for the improvement of slum areas.

(a) Making provisions for basic social facilities and amenities.

(b) Initiating welfare works of rehabilitation and resettlement.

(c) Facilitating economic persuits for self employment.

32.4

1. Appropriate words

(a) About 8 percent

(b) Khuba

(c) Animals

(d) Transhumance

2. Characteristics of a tribal community.

(a) Traditional mode of production.

(b) Grazing grounds are jointly shared by the community.

(c) Protection and promotion of plant as well as animal life is an integral part of the tribal culture and heritage.

3. Planning priorities for tribal area development.

(a) Making provisions for social facilities and amenities.

(b) Regenerating forest eco-system, green pastures and woodlands through lakes, ponds, wells tubewell and micro watersheds.

(c) Establishing small scale processing units based on forest, animal and agri-products.

32.5

1. Appropriate words

(a) Hill areas

(b) Gompa

(c) Chakk-Zod

(d) Scattered

2. Match of the Lists 1 with List II

   (a) iii, (b) i, (c) iv, (d) ii

3. Suggested planning for hill area development.

   (a) Making provisions for basic amenities and facilities.

   (b) Promoting cottage industries based on locally available raw material.

   (c) Developing tourism.

HINTS TO TERMINAL QUESTIONS

1. Refer to Section 32.1
2. Refer to Section 32.2
3. Refer to Section 32.3
4. Refer to Section 32.4
5. Refer to Section 32.4
6. Refer to Section 32.5