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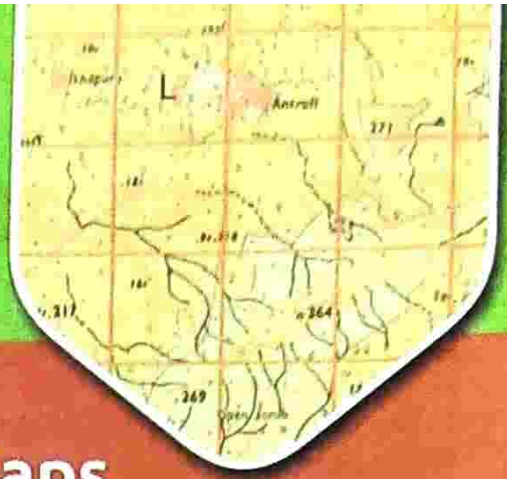


Syllabus

Interpretation of Topographical Maps

Locating features with the help of a four figure or a six figure grid reference.

MAPS AND THEIR SIGNIFICANCE

The Earth is a huge planet with varied relief features like mountains, plateaus, valleys, rivers, lakes, seas and oceans. Due to its enormous size and spherical shape, it is not possible to view the entire Earth at the same time. Consequently, it is not possible to represent the whole of the Earth on a flat surface. This difficulty has been resolved by using various models of the Earth like the *Globes* and the *Maps*.

A Globe is a three-dimensional representation of the Earth. It is the most accurate device to study the whole Earth. In fact, a globe is the only true representation of the Earth, indicating its shape, direction, area and other features. However, a globe has certain limitations. Due to its limited space, it cannot represent physical features and other characteristics in detail. Further, topographic details cannot be shown on a globe.

Therefore, to represent three-dimensional features like mountains, valleys, rivers and other geographical phenomena, special techniques are used so that these features can be drawn on a uniform basis. This art and science of mapping is called *cartography*. The word 'Cartography' has been derived from two French words 'carte' and 'graphie' meaning 'map' and 'drawing' respectively.

A map is defined as a representation of the earth's surface or a part of it, showing natural or man-made features, drawn to scale on a flat surface. This description of the earth's surface helps us to understand various types of phenomena such as soil, climate, vegetation, rivers, mountains, volcanic eruptions and earthquakes as well as their inter-relationships. Thus, maps help us to obtain maximum information in minimum space.

With the advancement of cartographic techniques, maps have become more accurate and give precise and greater details. As such maps have become an indispensable tool.

A Map

ELEMENTS OF A MAP

There are six basic elements of a map:

1. Title: It indicates the subject of the map, *e.g.*, distribution of natural vegetation, water bodies, climate, *etc.*

2. Scale: It denotes the relationship between map distances and actual ground distances.

3. Direction: It refers to the cardinal directions, *i.e.*, North, South, East and West. Conventionally, a map is aligned with the North towards the top.

4. Grid System: It is a network of lines that help in pinpointing the location of a place on a map. Usually a grid is formed by lines of latitudes and longitudes.

5. Conventional Signs: These symbols are used to represent different objects such as roads, railways, rivers, canals, mountains, oceans, *etc.*

6. Key or Legend: It explains the meaning of the symbols that are used in the map.

TYPES OF MAPS

I. On the basis of their size, maps can be classified as *large scale* maps and *small scale* maps.

Large Scale Maps

(i) Topographical Maps: These maps are prepared after a careful and accurate survey of the area. In India, these maps are prepared by the Survey of India. They are drawn on scales of 1: 50,000 and 1:25,000. These maps are multi-purpose and they show natural features (such as hills and rivers) and man-made features (such as railways, buildings, and canals). These maps are very useful for planning, defence, tourism, *etc.* Details about these mapes are given later in this chapter.

(ii) Cadastral Maps: Cadastral maps provide complete details of an area such as the boundaries of properties and individual buildings. These maps are used to demarcate the boundaries of fields and buildings to register the ownership of landed property. They are maintained by the government for public record; *eg.* administration and realisation of taxes, management of estates and identification of property in legal documents. The examples of Cadastral maps are—*Revenue maps, Settlement maps, Village maps* and *City plan maps.*

Small Scale Maps

(i) Wall Maps: These maps are meant to represent large areas that could be viewed at a glance. They show features like railways, roads, physical, political, relief, temperature, population, industries and vegetation. They are used for display purposes in classrooms and museums.

(ii) Atlas Maps: These maps are drawn on a smaller scale and are used to represent a whole country on a single sheet. Since these maps are drawn on a smaller scale, they give a

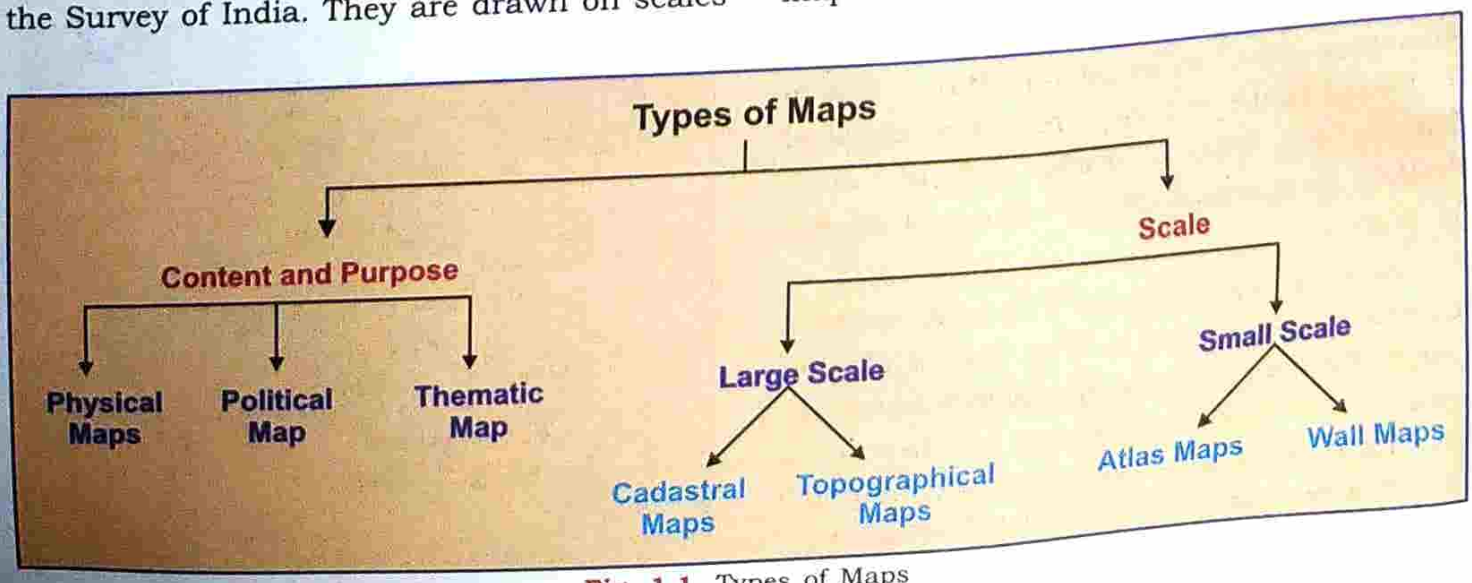


Fig. 1.1. Types of Maps

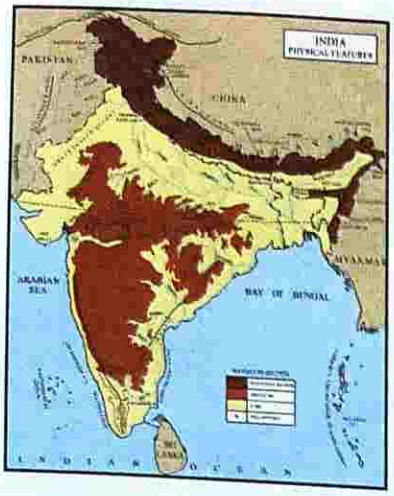


Fig. 1.2. Physical Map*

Fig. 1.3. Political Map*

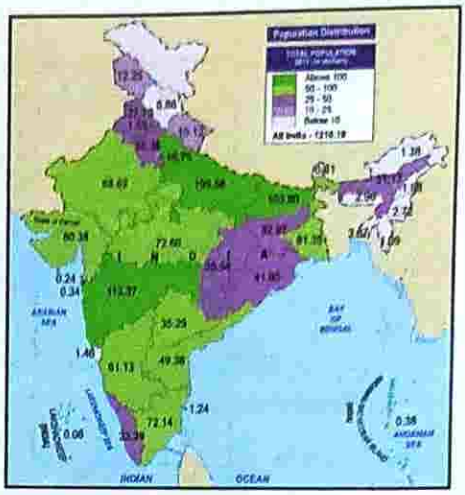


Fig. 1.4. Thematic Map*

condensed and generalised picture of different areas of the world. The features generally shown by Atlas maps include relief, drainage, vegetation, soils, crops, minerals, industries, population, cities, *etc.* Despite lack of details, these maps are best suited for educational purposes.

II. Maps can also be classified on the basis of their purpose and content as:

(i) Physical Maps: These maps provide details about the natural features of an area or a country.

(ii) Political Maps: These maps portray different countries of the world along with their states, national and international boundaries, political units and administrative divisions, *etc.*

(iii) Thematic Maps: These maps show a particular feature or theme of the area like vegetation, climate, population density, *etc.* All types of cultural maps, most of the atlas maps, industrial maps, agricultural maps, military maps, linguistic maps fall in this category.

TOPOGRAPHIC OR ORDNANCE SURVEY MAPS

The term 'topography' has been derived from two Greek words 'topos' meaning 'a place' and 'grapho' meaning 'to draw or depict'. Thus, a topographical map shows the surface of the earth in detail. A topographical map is also known as 'Topographical Survey Sheet' or simply 'topo-sheet'. Topographical maps are drawn on a number of sheets where each sheet depicts the details of only one particular part of the whole area. These sheets are joined to give a complete picture of the entire area.

Topographical maps are also known as *Ordnance Survey maps* as these maps were originally drawn in Britain for the army under the direction of the Surveyor-General. These maps are prepared in every country. In India, Ordnance maps are published by the Survey of India, Dehradun.

A topographic map is similar to a physical map in the sense that it shows different physical landscape features. However, it is different from a physical map as it uses contour lines to show changes in the landscape. All topographical maps show two types of features:

(a) **Physical features:** These include valleys, hills, plateaus, peaks, passes, waterfalls, *etc.* They are depicted by '*Contours*' *i.e., the lines that join places having the same height above mean sea level.* By noticing the pattern and density of the contour lines we can determine the shape, height and gradient of a particular area with its specific features.

(b) **Cultural or Man-made Features:** These include roads, railways, bridges, buildings, canals, *etc.* They are represented by symbols called *Conventional Signs.*

We shall study contours and conventional symbols in detail in the next chapter.

*Sketch (not to scale) to aid in understanding concepts.

Fig. 1.5. Image of a Portion of Topographical Survey Sheet

GRID REFERENCE

A grid is a set of lines used to find the exact location of places on a map. On an ordinary map or a globe prepared on small scale, one can easily find out the position of a town with the help of the grid formed by latitude and longitude lines. Topographical maps are, however, large scale maps, so exact locations cannot be expressed accurately by the grid of latitudes and longitudes. To overcome this difficulty, a grid reference system comprising a square grid with grid lines intersecting each other at right angles and numbered sequentially from the origin at the bottom left of the map, is used. It indicates the location of a place in terms of a series of vertical and horizontal lines identified by numbers or letters.

The points at which the vertical and horizontal lines of the grid cross are called **coordinates.** These lines are numbered. The vertical lines that increase in value Eastwards are known as *Eastings* whereas the horizontal lines that increase in value northward are called *Northings*.

These Northings and the Eastings, cut across each other to form squares or grids. The origin of the grid system is in the South-West corner of the map. These lines are the basis for reference to landmarks and places shown on the map. Whenever grid references are given, the Eastings are given first and then the Northings.

There are two types of grid references:
(a) Four-figure grid reference; and
(b) Six-figure grid reference.

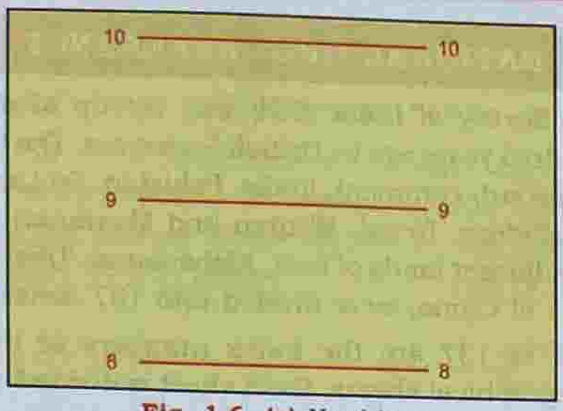


Fig. 1.6. (a) Northings

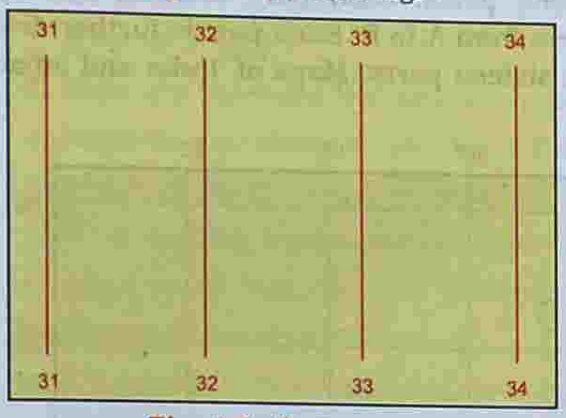


Fig. 1.6. (b) Eastings

Four-figure reference: The four-figure grid reference is used to find out the location that lies within a particular square. In this type of reference, the first two figures give the Eastings, whereas the last two give the Northings. For example, large lakes, meanders, streams, settlements, embankments, physical features, *etc.*, which occupy some space on the map can be located by using a four-figured reference.

Note the four figure reference in the figure 1.7(a) is 3211. Thus, if the four-figure

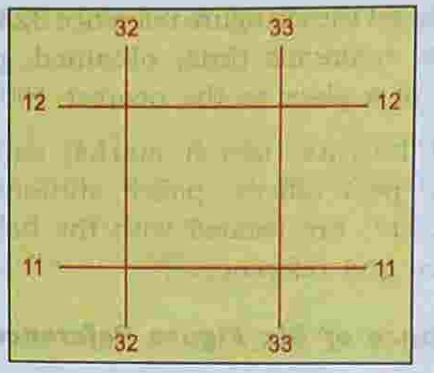


Fig. 1.7. (a) Four-figure Grid Reference

reference of a place is 3211, it means that the place is located in the 1 km square with Easting of 32 and Northing of 11.

Six-figure reference: Study the figure 1.7(b). In the six-figure grid reference of *X*, the first three figures are the Eastings and the last three are the Northings. These pinpoint locations with greater accuracy. To get the six-figure grid reference divide the square into ten equal parts vertically and then horizontally. You will now get the third figure in the Eastings and the sixth figure in the Northings. In this case

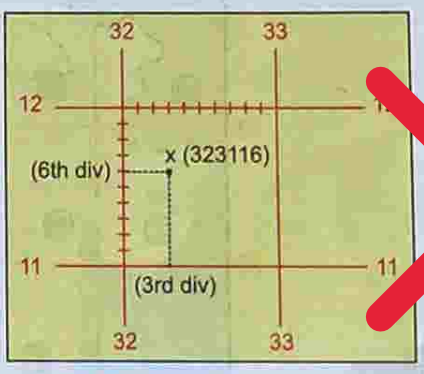


Fig. 1.7. (b) Six-figure Grid Reference

Eastings	Northings
1. The vertical lines running from North to South in a topographical map are called Eastings.	1. The horizontal lines running from East to West in a topographical map are called Northings.
2. In grid reference, the Eastings are given first.	2. In grid reference the Northings are referred after Eastings.
3. They represent a distance east of the origin of the grid reference.	3. They represent a distance north of the origin of the grid reference.
4. While representing the object the Easting left of the object is read.	4. While representing the object the Northing below the object is referred.
5. The Eastings increase in value eastwards.	5. The Northings increase in value northwards.

3 and 6 to get the six figure reference 323116. The *six-figure refe...ce* thus, obtained gives the location of a pla... to the ...arest 100 metres.

Spot heights, b... marks, causeways, temples, post offi..., police stations, wells, bridges, *etc.*, ar...ocated with the help of the six-figure grid reference.

Importance of Six Figure Reference

- It helps in pin-pointing a place or an object on the map nearest to 100 metres.
- It gives greater accuracy to a map.

NATIONAL GRID REFERENCE

The Survey of India (SOI) was set up about a hundred years ago by British Surveyors. The then Indian sub-continent, (India, Pakistan, Sri Lanka, Bangladesh, Nepal, Bhutan and Myanmar) and the adjacent lands of Iran, Afghanistan, Tibet and parts of China, were divided into 137 divisions.

1 to 137 are the index numbers of these topographical sheets. Each sheet is divided into sixteen parts, each part denoted by capital letters from A to P. Each part is further divided into sixteen parts. Maps of India and adjacent

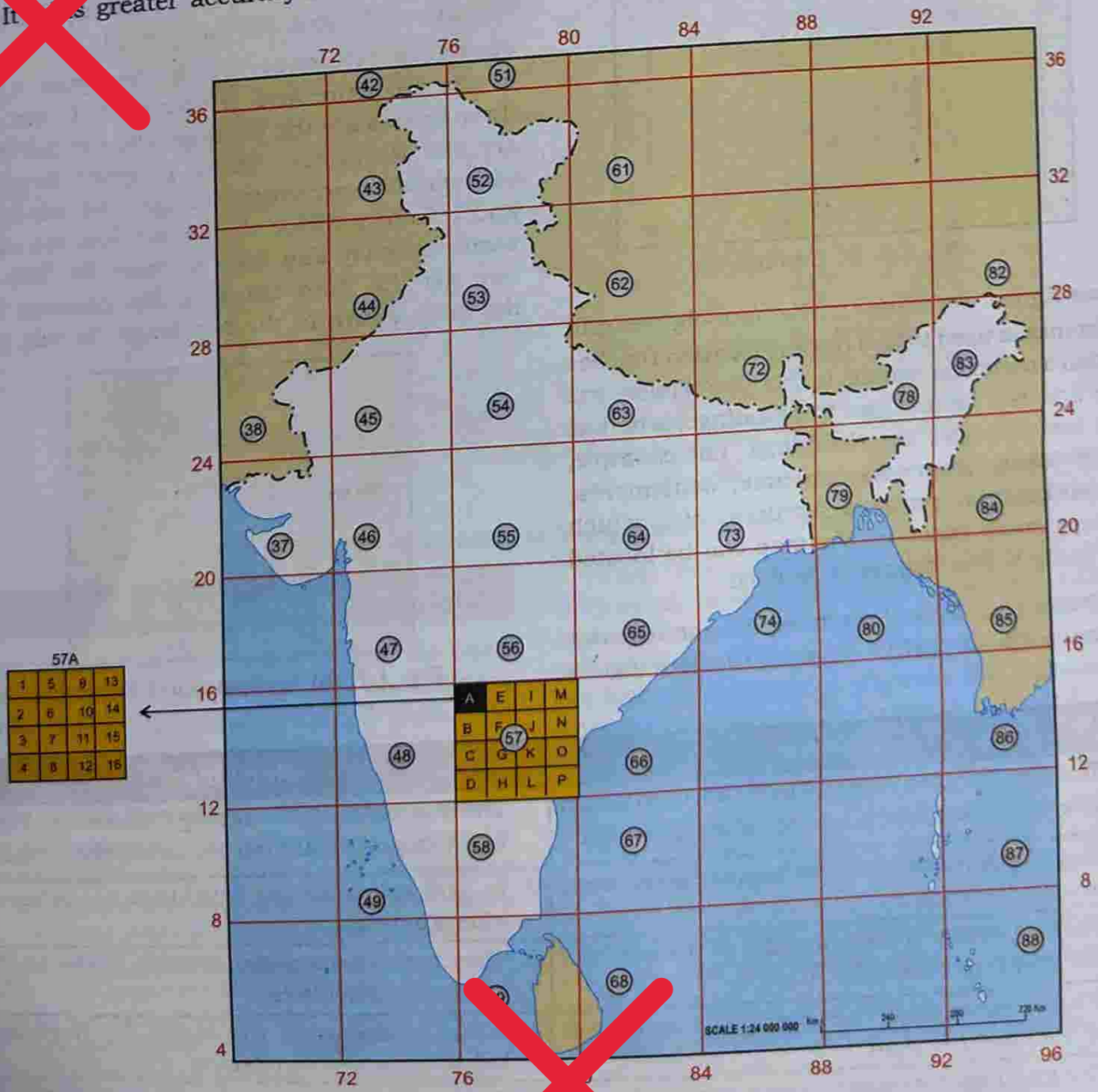


Fig. 1.8. National Grid ...ce (Survey of India)

countries series' were prepared on a scale of 1:1,000,000. Therefore, they are commonly known as the one 'Million-map'. See figure 1.8.

After the Government of India adopted the metric system of measurement, all the Ordnance Survey maps issued by the Survey of India (SOI) began to be drawn to the scale 2 cm = 1 km. In this system of coordinates, the area is divided into 100 km × 100 km squares, with each square identified by two letters such as PQ, UA, UQ, etc. Each 100 km square is further subdivided into squares of one km. This system of map drawing is known as *National Grid Reference*.

EXERCISES

I. Short Answer Questions

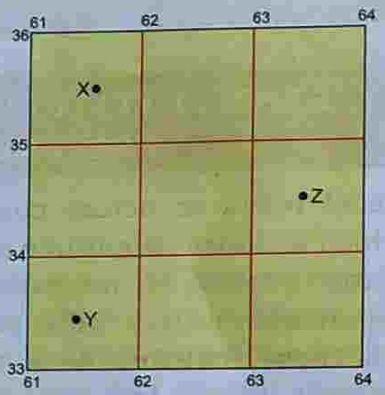
1. What is a 'map'?
2. State the essential features of a map.
3. What do you mean by the 'Key' of a map?
4. Into how many categories have the maps been classified?
5. What are the topographical maps?
6. What is the National Grid Reference (NGR)?

II. Distinguish between:

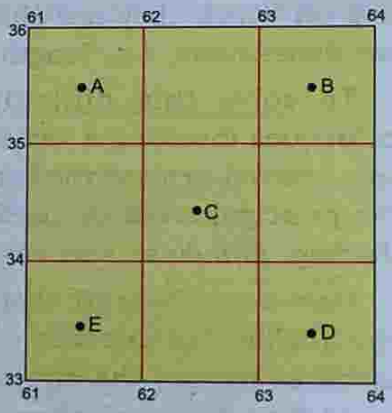
(a) Eastings and Northings (b) Four-figure grid reference and Six-figure grid reference.

III. Structured Questions

1. Give the four-figure reference for points X, Y, Z in the figure given on the right hand side.



2. Give the six-figure reference for A, B, C, D, E in the figure given on the right hand side.



IV. Project/Activity

1. Identify the survey sheet for your city. Make a list of the important features both man-made and natural.

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Chapter 2 Contours

Syllabus

Contours

Definition of contour and contour interval. Identification of landforms marked by contours (steep slope, gentle slope, hill, valley, ridge/water divide, escarpment), triangulated height, spot height, bench mark, relative height/depth.

Interpretation of colour tints and conventional symbols used on a topographical survey of India map.

REPRESENTATION OF RELIEF FEATURES

Relief refers to actual configuration of land which includes its altitude and slope. The relief features found on the earth's surface include mountains, valleys, hills, plains and plateaus. All these features have three dimensions, namely length, breadth and height. But the map on which they are shown represent only two dimensions, *i.e.*, length and breadth.

To solve this difficulty, a number of techniques involving a variety of methods have been evolved to show the earth's relief features. The principal methods used are *hachures, hill shading, form-lines* and *contours.*

Hachures: These are short disconnected lines which follow the direction of the slope. In fact, hachures portray the direction in which water would flow down the slope over the surface, if allowed to flow freely.

The lines are closely drawn and thick if the slopes are steep. If the mountain slope has a gentle gradient then the lines are drawn thin and wide apart. Flat regions like a valley bottom and top of plateaus are left blank. However, the hachures only provide an impression of the slope and not the height of the land above sea level. Moreover, hachures are difficult to draw and interpret and are time-consuming. They also obscure other topographical details in hilly regions.

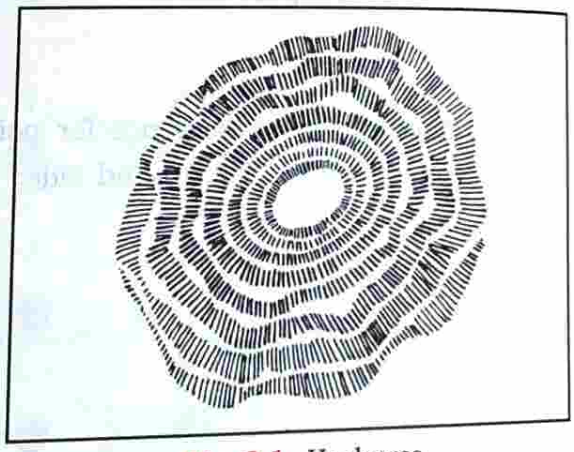

Fig. 2.1. Hachures

Hill-Shading: This method aims at producing the same effect as hachures in an easier and cheaper way. In hill shading method, the relief of an area is shown by 'light and shadow effect' *i.e.*, it is based on the assumption that when a source of light like a big lamp is used to illuminate the relief model of the concerned area, shadows of landforms are obtained. The shades vary according to steepness. The slopes, which face the source of light, will have a lighter shade while those away from the source of light will be in shadow. Like

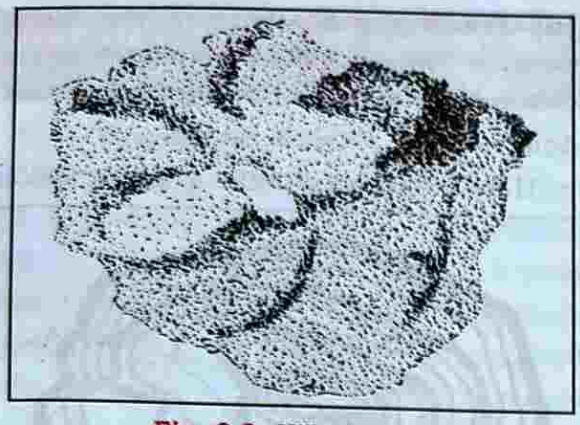

Fig. 2.2. Hill Shading

hachures it gives no indication of the relative or actual height. Moreover, no distinction can be made between uphill and downhill slopes, between spur and valley or between plain and plateau. This is because the hill slopes are shaded dark, whereas the valley and plains are shown in a lighter tint. Thus, hill shading sometimes obscures other features of the map. The shading is done by stippling (by dots) and it is used in small scale maps.

Form-lines: Form-lines are broken contour lines joining places with same height above the sea level. They represent only the general pattern of the ground and give no idea about definite heights. This method is resorted to when relief of an area is complicated and accurate data is not available. Other principles of these form-lines regarding the direction and shape, *etc.*, are the same as those of contours. They are referred to as approximate contours. Form-lines are used along with contour lines to show minor details of a mountainous or a hilly tract.

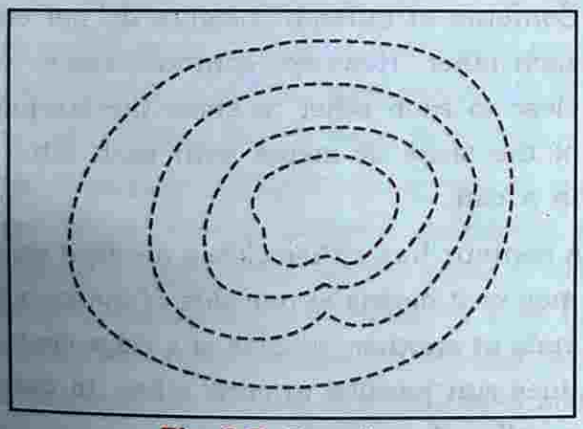

Fig. 2.3. Form-lines

CONTOURS

Contour lines are imaginary lines joining places which have the same height above mean sea level. Thus, a contour marked 50 means that all places which are connected by it are located at a height of 50 metres (depending on the unit used). The contour lines are shown by brown colour in two ways: (i) thick brown lines; and (ii) thin brown lines.

Contour lines show:

(a) *Elevation of land:* The height of a contour is indicated by figures inserted in a break in the line.

(b) *Steepness of its slope:* When the contours are very close, they represent steep slopes. When they are farther apart, they represent gradually increasing slopes. Absence of contour lines indicates that the land is flat *i.e.* a low land.

(c) *Shape of land at various heights:* The contour lines indicate the shape of land. For example, almost circular contours whose value decreases inside represent a lake.

Contour Interval

Contour interval means the difference of height between two consecutive contours. In Figure 2.4 one thick contour shows the height 300 metres and the next thin contour depicts the height of 320 metres. The contour interval is 20 metres.

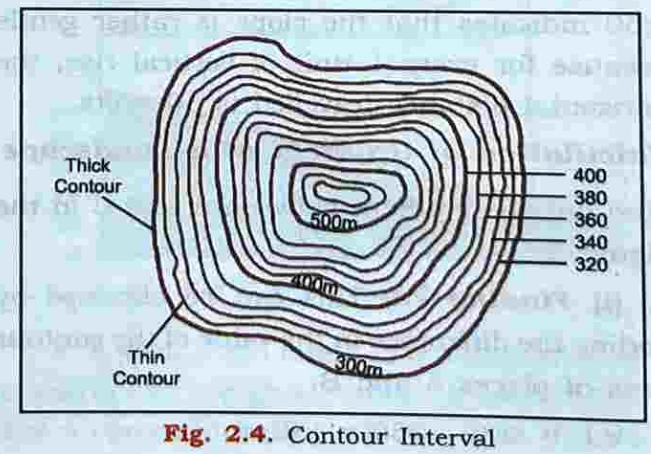

Fig. 2.4. Contour Interval

Vertical Interval (V.I.): It is the vertical distance between any two contour lines. In most of the British ordnance maps, the vertical interval is either 50 or 100 feet. In 1 : 50,000 Survey sheets of India, the contour interval is 20 metres.

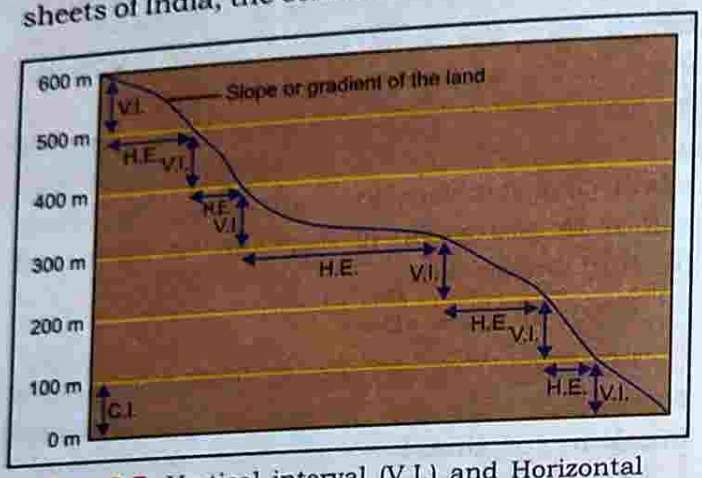

Fig. 2.5. Vertical interval (V.I.) and Horizontal Equivalent (H.E.)

Horizontal Equivalent (H.E.): Horizontal Equivalent is the actual distance between two points on two contour lines.

Gradient (G): Gradient refers to the slope of land. It determines the steepness of a slope. It is the ratio between the vertical height and the horizontal distance measured along the ground, *i.e.*,

$$\text{Gradient} = \frac{\text{Vertical Interval}}{\text{Horizontal Equivalent}}$$

For example, a gradient of 1:5 means that for every five units of horizontal distance, there is rise of one unit in the vertical distance. This is a rather steep slope. On the other hand, 1:50 indicates that the slope is rather gentle because for every 1 unit of vertical rise, the horizontal distance travelled is 50 units.

Calculation of Gradient of a Landscape

Find out the gradient between A and B in the Figure 2.6.

(i) *Finding V.I.* This can be obtained by finding the difference in the value of the contour lines of places A and B.

V.I. = 400 – 250 = 150 m

(ii) *Finding H.E.* Measure the distance between A and B with the help of a ruler. Distance AB = 3cm. According to the scale

1cm = 1km

∴ H.E. = 3km or 3000m (1km = 1000m)

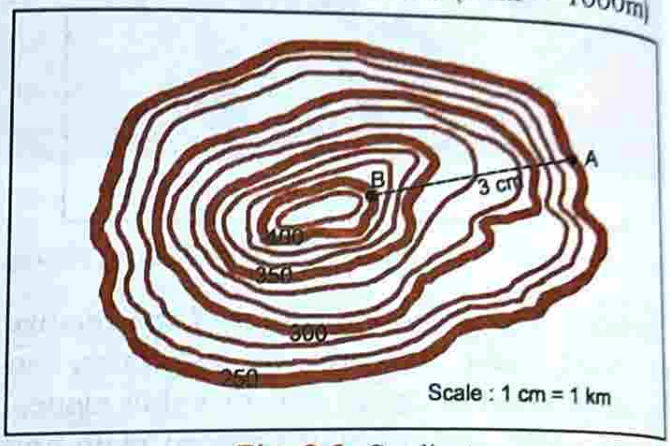

Fig. 2.6. Gradient

(iii) *Calculate Gradient*

$$\text{Gradient} = \frac{\text{V.I.}}{\text{H.E.}} = \frac{150}{3000} = \frac{1}{20}$$

Thus, the gradient between A and B is 1 :20.

Principles of Contours

(a) Contour lines join places having the same height above mean sea level.

(b) Contours are curved lines, whose curvature depends upon the configuration of land. They are never broken.

(c) The spacing of the contour lines indicates the nature of the slope.

(d) Contours of different heights do not cross each other. However, contours come very close to each other to show the steepness of the slope or merge with each other as in a cliff.

(e) A contour line either closes on itself on the map or it begins at one side of the map and ends at another. In case of a ridge contour, lines run parallel to each other. In case of a valley they point upstream.

IDENTIFICATION OF LANDFORMS MARKED BY CONTOURS

1. Triangulated Height: When the point has been accurately surveyed, and shown with a triangle, it is called a *triangulation point eg.* (Δ340). The height of such a point is called triangulated height and is determined trigonometrically. For example, the mountain peaks are indicated by triangulation points on a map.

2. Spot Heights: It refers to the height of a point on the ground above the mean sea level. It is indicated on a map but not on the ground. It is represented by a dot followed by a number on the map (•500). The number shows the height above mean sea level of that place. A spot height gives information about the height of a specific point only. It gives no idea about the relief features like mountains, plateaus, plains, ridges, valleys, *etc.*

3. Bench Marks: These are marks etched on a stone or shown on a building to indicate the accurate height determined by surveys. They serve as a reference for surveyors. On most survey maps, a Bench Mark is written as 'BM' and followed by a number. The number indicates the height of the surface level at the marked point. There is a difference between Spot Height and Bench Mark. Spot Height indicates only the height of the ground above mean sea level; whereas, Bench Mark indicates the height of some point marked above the ground and includes the height of the object on which a Bench Mark is etched.

4. Relative Height: In areas of steep slope, the difference between maximum and minimum is represented by the letter 'r' which indicates relative height. Thus, if one finds 3r• or •3r written on a topo-sheet, this means that the concerned place is higher by 3 metres than its natural lowest place.

CONTOUR DIAGRAMS

Slopes

1. Steep Slope: When the land suddenly slopes up or down, it is known as a steep slope. In a steep slope the contours are drawn close to one another.

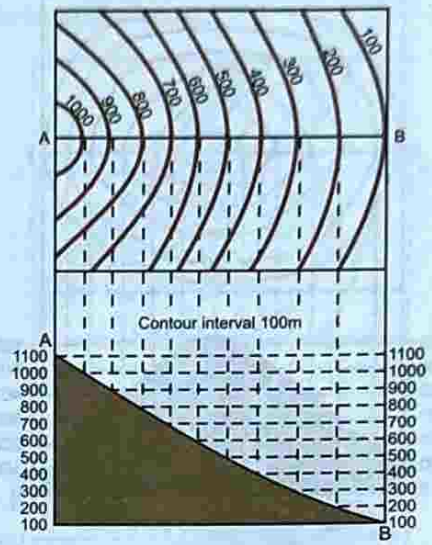

Fig. 2.7. A Steep Slope

2. Gentle Slope: In such a slope, the change of elevation is gradual. Normally about 1:25 gradient is called a gentle slope. The contours in such a slope are placed wide apart.

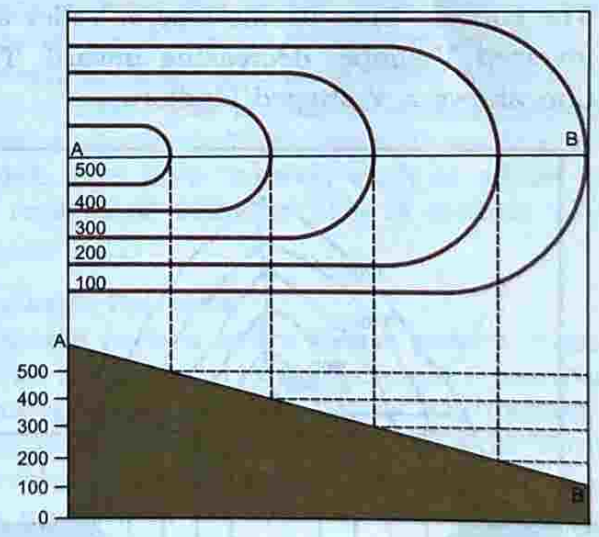

Fig. 2.8. A Gentle Slope

3. A Hill: A hill r[illegible]fers to a landform having a summit at a high ele[illegible]tion. A conical hill is like a cone which has a [illegible]oad base. Its slope

is almost the same on all sides. Contours showin conical hill are almost circular with peak of hill as their centre. Th ontours are drawn ost at regular nces, the value of whic creases tow the centre.

A *mountain* is r in el n than a conical hill and has more c es representing it.

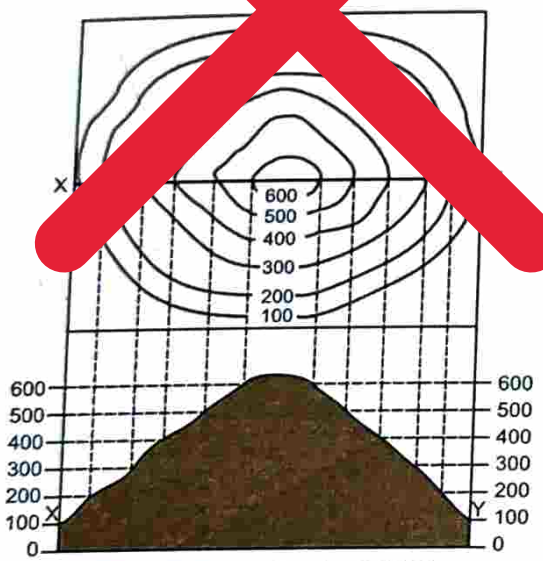

Fig. 2.9. A Conical Hill

4. Valleys: (a) *V-shaped Valley.* When the two sides of a river valley are very close and steep (there is rdly any flat land betwe the two sides), the s-section of the valley -shaped. They occur e upper coast river.

The contour s of this e of Valley are in inverted V-sha ing inward. The section shows a V-sh landform.

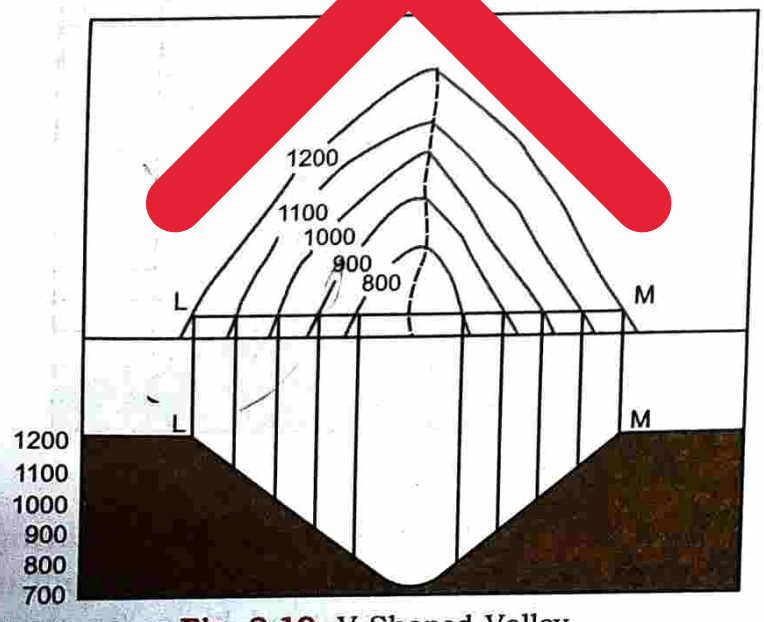

Fig. 2.10. V-Shaped Valley

(b) *U-shaped Valley*: They are broad flat-floored valleys formed in the middle course of a river, or they may be formed by the action of glaciers.

(c) *Hangi Valley*: It is ned where the tributary valley eets the ain glacier. The tributary valley is her an the floor of the main valley because main glacier erodes a deeper 'U'-shaped than its tributary.

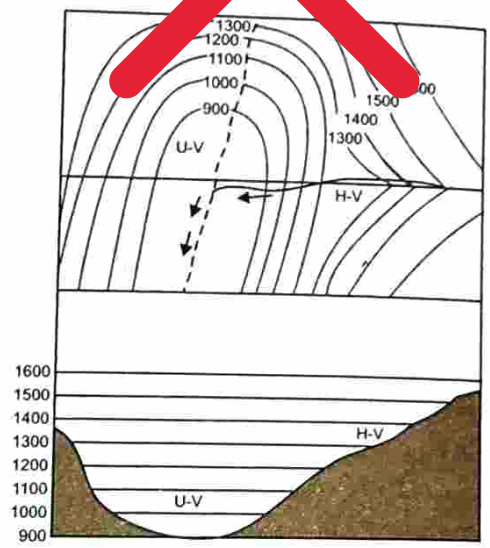

Fig. 2.11. U-Shaped Valley (U-V) and A Hanging Valley (H-V)

(d) *Gorge or anyon*: It is a de and narrow valley having steep lopes. Its c ours are same like that of a V-shap valley e only difference being that the contou a gorge are closely spaced and the V forme hem is very narrow.

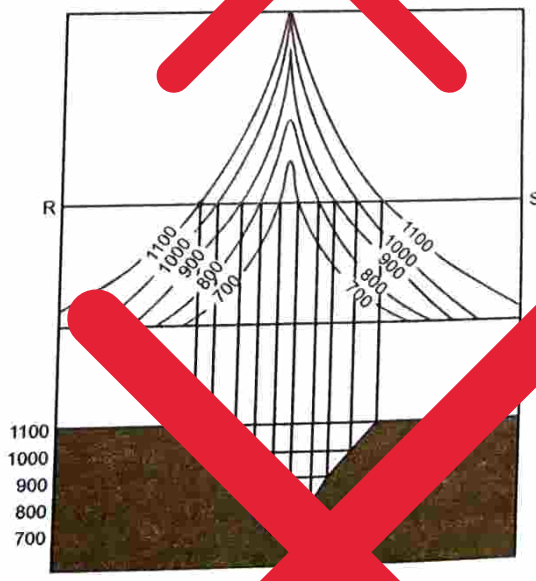

Fig. 2.12. A nyon

5. Ridge: It is g and n w highland sloping steeply d wards on its It has a

number of summits. Contours showing a ridge are elongated and are closely spaced. Sometimes there occur peaks and passes across a ridge.

Fig. 2.13. A Ridge

6. Water Divide: A line which separates two adjacent drainage basins is known as water divide. It resembles the shape of a ridge on both sides of which a number of streams flow. It is a ridge, which separates the tributaries draining towards one side of it from those draining towards the other. On the two sides of the watershed or water divide the slopes must be opposite and downwards (Fig. 2.14). The side on which the ridge is steeper the contours are drawn closely together, whereas the side on which the ridge is gentle, the contours are drawn far apart.

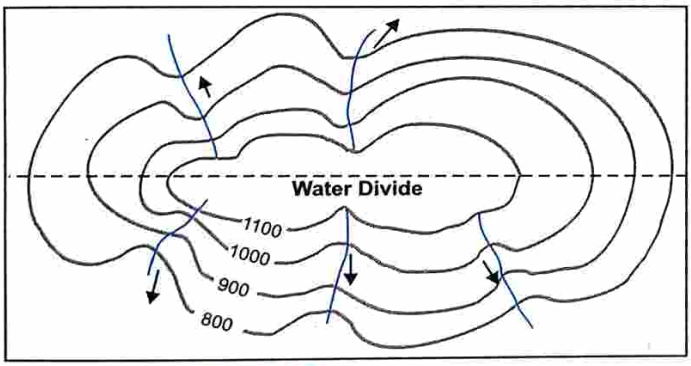

Fig. 2.14. A Watershed

7. Escarpment: It is an abrupt, comparatively long and regular steep face of a hill, a ridge or a plateau. An escarpment has a narrow top with a steep slope (scarp) on one side and a gentle slope (or dip) on the other. The steep slope has a gradient of 1:3 and close contour lines, whereas the gentle slope has a gradient of about 1:12. A ridge with a steep scarp in the front and a dip slope on the back is called a *Cuesta*. They are caused by uneven erosional work of rocks on both the sides. The higher part is called the crest. The scarp and dip always occur together.

Sometimes erosion by running water leads to the formation of shallow valleys on the dip side of an escarpment. Such an escarpment is called *Dissected Scarp*.

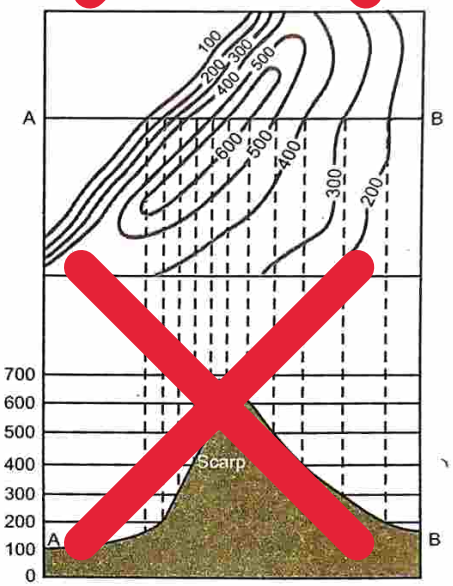

Fig. 2.15. Escarpment

8. Drainage Systems

When it rains the water slides down in the form of small streams that join other small streams forming bigger main streams and finally form a river. The course of a well-developed river can be divided into three stages — upper, middle and lower course; each of which can be recognised with the help of contour lines. [Figure 2.17]

Drainage Patterns

Drainage pattern refers to the pattern formed by the streams, rivers and lakes in a particular drainage area. These patterns are formed in response to the topography of the land, nature of rocks, tectonic activities, supply of water and the gradient of the land. The most important drainage patterns are:

(a) Dendritic Drainage Pattern: It is a branching tree-like drainage pattern which is generally found on flat lands. Most of the rivers of the Indo-Gangetic Plains are of dendritic type.

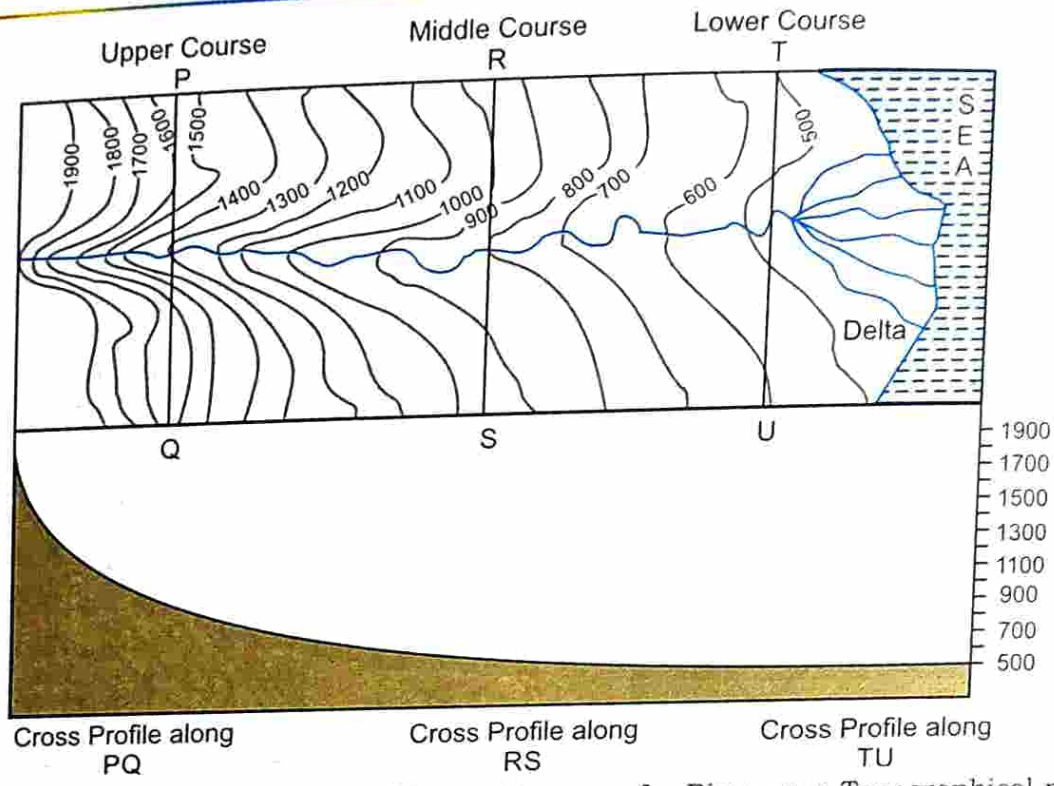

Fig. 2.16. The Upper, Middle and Lower Courses of a River on a Topographical map

(b) Trellised Drainage Pattern: It is a rectangular drainage pattern with streams flowing parallel to each other and joining the main stream at right angles. It is generally seen in areas with alternating hard and soft rocks or in regions of limestone rocks.

(c) Radial Drainage Pattern: It is a drainage pattern with streams spreading out in all directions like spokes of a wheel. It can generally be seen where a conical hill or a volcano exists.

(d) Disappearing Streams: When rivers or streams do not have enough water, they dry up or disappear into the sand. They are known as disappearing streams and are indicate by broken lines. This phenomenon is know as the underground drainage in context topographic maps.

CONVENTIONAL SIGNS AND SYMBOL

Topograph l maps use nbols to represe certain relief ures an uman activities. Thes are called *conve ion igns and symbols*. The are used on a ma ecause they give plenty information in a na space and maps can b drawn easily ey are imple to read. Man of the sign nd symbols standardised an

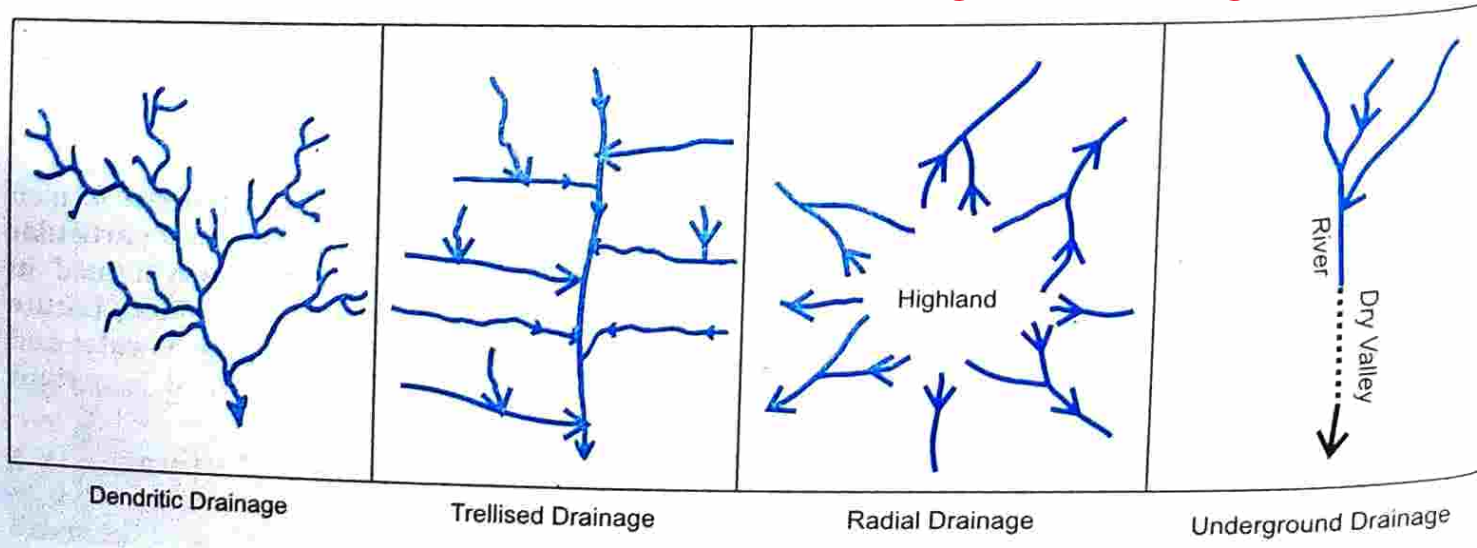

Fig. 2.17. Drainage Patterns

Symbols and Conventional Signs

Monuments and Buildings	
	Fort
	Church
	Tomb
	Pagoda
	Graveyard
	Chhatri
	Mosque
	Battlefield
	Temple
PO	Post Office
PS	Police Station
RH	Rest-House
CH	Circuit House
DB	Dak Bung
IB	Inspectio galow
Brick Kiln	Brick Kiln
	Railways
R.S.	Railway Station
	Broad Gauge Railway
	Level crossing
	Cutting with tunnel
20	Single Gauge with distance stone
	Roads
	Metalled Road
20	Metalled Road with kilometre stone
	Pack-track
	Cart-track
	Bridges
	Road wit
	Brid rs
	ransport
	Aerodrome
	field
	nication
	Di
	Telegra lephone line
	Drainage
	Perennial Stream
	Dry Stream
	River with islands
	Tidal River
	Dry River-bed with water channel
6r	Dry River-bed with relative height 6 metres
	Canal perennial
	Canal non-perennial
	Means of Irrigation
	Dam with masonry work
	Dam with earth work

	Tidal Stream
	Lined Well
	Tube Well
	Unlined Well
	Tank
	Tank
	Tank with wa
	Broken ground
	Spring
	Embankmen
	Subm
	n trellis
	Palm trees
	Coniferous trees
	Grass
	Bamboos
	Scrubs
	Swamp
Dense Jungle	Dense Jungle
Open Mixed Jungle	Open Mixed Jungle
RF	Reserved Forests
PF	Protected Forests

Other Symbols	
	Sand dune
Stony Waste	Stony Waste
Sheet Rock	Sheet
Rock outcrop	p
	Nucleated Settlement
	Radial settlement
	Dispersed Settlement
	Linear Settlement
CG	Camping ground
	Hachures
	Map-North
	rmlines
	rs
	ited)
X	Deserted site
TO	Telegraph Office
PTO	Post and Telegraph Office
•240	Spot Height
Δ340	Triangulated Height
• BM 215	Bench Mark
	International Boundaries
	State Boundaries
	District Boundaries
	Tehsil Boundaries

used throughout the world. The key or legend of a map has the list of signs and symbols as well as their meanings. The chart given in this Chapter shows the conventional signs and symbols.

Hindi Terms Used in Survey Maps

- *Nadi* – river;
- *nala* – small stream;
- *phar* – hill;
- *parbat* – hill or mountain;
- *piao* – place where drinking water is available generally along roads or at railway stations. This is found mostly in north and northwest India where it becomes very hot and water is scarce.
- *Police chowki* – police outpost;
- *talab* – tank or reservoir or pond;
- *khera* – kiln for baking bricks;
- *tahsil or taluk* – part of a district under a tehsildar who collects revenue from the area;
- *dak bungalow* – a government-owned bungalow for travellers to stay for a night or two.

Colours in Contour maps

Apart from conventional signs, different colours are used to show the distributional pattern of different land uses on the topographical sheets.

1. *Black*

- names;
- lines of latitude and longitude;
- surveyed trees, heights and their numbering;
- river banks, broken ground, dry streams, *etc.*;
- railway, telephone and telegraph lines.

2. *Blue*

- water related features;
- perennial rivers.

However, minor non-perennial streams are shown in black and irregular erratic streams are shown by dotted lines.

3. *Green*

- forests (dark green);
- grasslands (light green);
- orchards;
- scattered trees and shrubs.

4. *White*

- rocky or bad lands;
- uncultivated lands.

5. *Yellow*

- cultivable lands.

6. *Brown*

- sand features like sand dunes and hills;
- contour features like contour lines, their numbering;
- form-lines.

7. *Red*

- Grid lines, *i.e.*, Eastings and Northings, as well as their numbering;
- Man-made features such as roads, cart tracks, buildings, huts, *etc.*

EXERCISES

I. Give the terms used in contours for each of the following:

1. A number preceded by a dot.
2. The numerical difference between two contour lines.
3. A number preceded by a triangle.
4. The difference between maximum and minimum height in areas of steep slope.
5. The accurate height of some point marked above the ground.

II. Describe the following terms:

1. Contour Interval
2. Vertical Interval
3. Horizontal Equivalent
4. Gradient

III. Explain how would you distinguish between the following on the basis of contours:

1. Gentle Slope and Steep Slope
2. Scarp and Dip
3. Ridge and Water Divide

IV. Short Answer Questions

1. What is a 'Contour'?
2. Give two points of difference between Bench Mark and Spot Height.
3. What do you understand by V.I. and H.E.?
4. What advantages do contours have over hill shading and hachuring?
5. Why two contours never intersect each other?

V. Structured Questions

(a) What is meant by relief?

(b) State the three methods used to show the earth's relief features.

(c) What do the contour lines represent?

(d) How do contour lines show different slopes of land?

VI. Project/Activity

1. Draw conventional symbols for the following using appropriate colours where necessary.
   (i) Cart-track (ii) Broken ground (iii) Nala (iv) Perennial tank (v) Stream (vi) Dry-stream.
2. Draw and compare the following contour diagrams by placing them side by side in pairs:
   (a) V-shaped Valley and U-shaped valley
   (b) Steep Slope and Gentle Slope
   (c) Conical hill and mountain
   (d) Ridge and Water Divide

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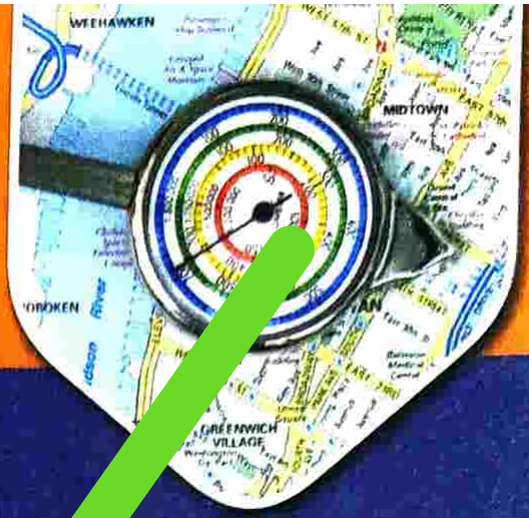


Chapter 3 Scales and Direction

Syllabus

Identification and definition of types of scale given on the map.

Measuring distances and calculating area using the scale given therein.

Marking directions between different locations, using eight cardinal points.

SCALES

A map represents the features of the surface of the earth in a miniature form. Hence, a map needs to be drawn to scale to depict the features of the areas it represents.

The scale of a map denotes the proportion that the distance between any two points on a map bears to the distance between the same two points on the surface of the earth.

The scale is also defined as the ratio between the distance of any two points on the map and the actual distance of the same points on the ground. It can be expressed as:

$$\text{Scale} = \frac{\text{Map distance between two points}}{\text{Ground distance between the same points}}$$

There are three main methods of representing the scale on the map.

(i) A Statement: In this method, scale is stated in words or we make a statement about it: *e.g.*,

1 cm. to 1 km

1 inch to 5 miles.

The value on the left hand side usually represents the map distance. This method is not suitable, as we require to know the units of measurement in different countries. Moreover, when the map is reduced or enlarged from the original, the scale does not remain the same. This creates problems in measurement.

(ii) Linear or Graphic Scale: In this method, the scale is represented by a straight line divided into equal parts (primary and secondary) to show what these markings represent on the actual ground. The Primary Divisions are the major divisions on the scale graduated from left to right. The Secondary Divisions are smaller units graduated from right to left on one primary division as shown in Figure 3.1. The total length of this linear scale represents a distance of 25 kilometres. Each primary division denotes a distance of 5 kilometres. Each secondary division denotes a distance of one kilometre on the actual ground.

(iii) Representative Fraction: In this method, the scale is represented as the ratio of the length of a line on the map and the corresponding actual distance on the earth's surface. The numerator is always expressed as unity *i.e.*, one unit map distance is equivalent to a number of units of ground distance. This fraction is called *Representative Fraction.*

$$\text{Representative Fraction (R.F.)} = \frac{\text{Distance on the map}}{\text{Distance on the ground in the same unit}}$$

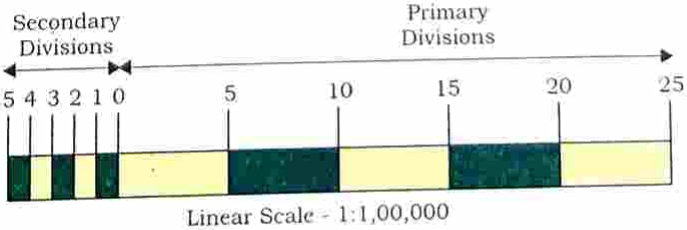


Fig. 3.1. Scale represented by Graphical Method

The most important point in a Representative Fraction is that the unit of measurement of distances in the numerator and the denominator is the same. For example, if R.F. of a map is 1/1,00,000 or 1:1,00,000, it means that one unit on the map represents 1,00,000 units on the ground. If the unit of measurement is centimetre, we will say that 1 centimetre on the map represents 1,00,00[illegible]entimetres on ground. If, however, the unit [illegible]easurem[illegible] is inch, then we will say that 1 [illegible] on [illegible]map represents 1,00,000 inches on [illegible]nd.

The main advantage of R.F. is [illegible]t is only a fraction and is independent of any particular unit of measurement. It can be converted into any unit of measurement and has universal application. It is therefore, also known as *International Scale* or *Natural Scale*.

Example 1.

The distance between two cities A and B is 50 km. It is represented by a line of 5 cm on the map. Calculate R.F. and draw a linear scale.

Ans:

$$R.F. = \frac{\text{Distance on the map}}{\text{Distance on the ground}}$$

$$\frac{5\text{ cm}}{50\text{ km}} = \frac{5\text{ cm}}{50,00,000\text{ cm}}$$

(1km=1,00,000 cm)

R.F. = 1:10,00,000

Fig. 3.2(a) Linear Scale for Example 1

Example 2.

If a scale is 1 inch to 4 miles

(a) What is the RF?

(b) Mark it on the scale line.

Ans:

$$R.F. = \frac{\text{Distance on the map}}{\text{Distance on the ground}}$$

$$= \frac{1\text{ inch}}{4\text{ miles}}$$

$$= \frac{1\text{ inch}}{4 \times 63,360}\text{ inches}$$

(1 mile = 63,360 inches)

$$= \frac{1}{253440} = 1:253440$$

Fig. 3.2(b) Linear Scale for Example 2

Example 3.

If R.F. is 1:500,000

(a) Convert the scale into a verbal statemer

(b) Mark it on a linear scale.

Ans:

$$R.F. = \frac{\text{Distance on the map}}{\text{Distance on the ground}}$$

$$= \frac{1}{500,000} = 1\text{ cm to }500,000\text{ cm}$$

(1km=100,000cm)

Hence, scale is 1 cm to 5 km.

Fig. 3.2(c) Linear Scale for Example 3

Note: The graphical method is preferred t represent scale of a map for the following reason

1. It combines both R.F. and verbal statemer
2. This is valid if the map is reduced, enlarge or only a small portion of it is used.

MEASUREMENT OF DISTANCES ON A MAP

The following methods are used to measu distances on a map:

(a) To measure distance along a straight lin

(i) Place the straight edge of a strip of pap along the required line.

(ii) Mark the limits of the distances on t strip by means of a sharp pencil.

(iii) Place the strip along the linear scale, a measure the distance.

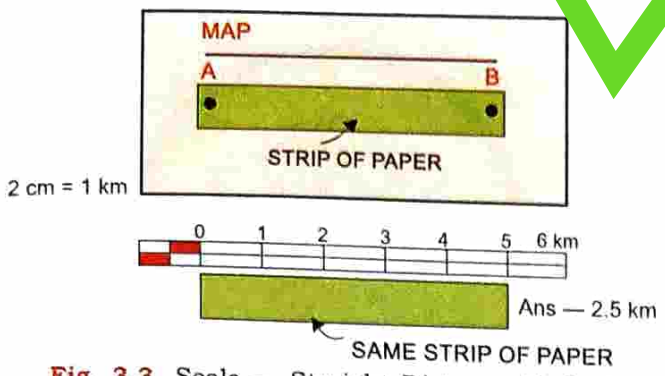


Fig. 3.3. Scale — Straight Distance Method

For example:

Distance between two places A and B
= 5 cm

Given scale is 2cm = 1km

1cm = 0.5 km

5cm = 0.5 × 5

= 2.5 km

- A divider can also be used to measure straight distances.

(b) To measure distance along curves

To measure distances like the course of a river or a winding road, a straight edge of a paper can be used. First you mark the starting point on the strip of paper, and at every bend hold the paper and fold the paper until the end of the course. Now, by using the graphical scale, the actual distance on the ground can be calculated in miles, yards or kilometres.

(i) Thread: A winding road or a river course can also be measured by placing a thread along its course. The thread is then measured against the linear scale to calculate the actual distance.

(ii) Opisometer: It is an instrument used to measure a road, a rail line or a river. It is a small spiked wheel that moves along the curved surface. Its one revolution is graduated on a scale. The revolutions are recorded manually or on a calibrated dial and thus, the distance can be measured.

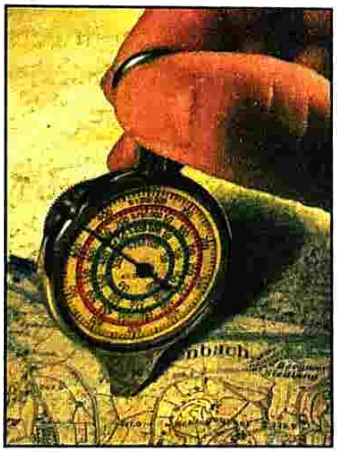


Fig. 3.4. Opisometer

(c) Area by the Grid Square Method

On topographical maps, each grid square measures 2 cm × 2 cm or 1 km × 1 km since 2 cm is equal to 1 km. Therefore, the area of each square is 1 sq. km.

To calculate a certain area on a topographical map, the following steps are involved.

(i) Find out the number of complete grid squares within the area;

(ii) Note the number of remaining squares within the area which are not complete squares;

If the squares covered are more than half take them to be 2/3 squares and if less than half take them as 1/3 squares and count.

(iii) Add all the squares to get the area of portion required.

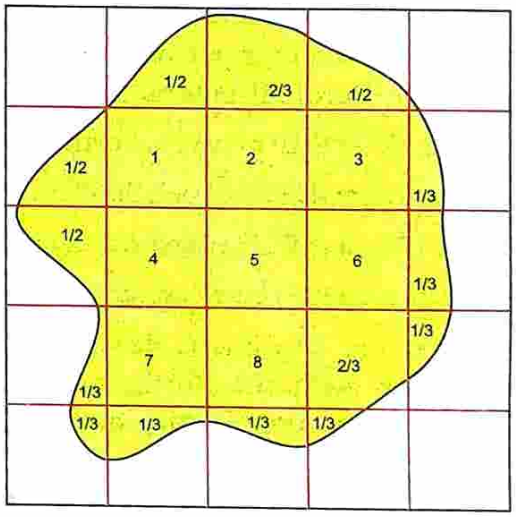


Fig. 3.5. Area by Grid Square Method

In Figure 3.5, the area enclosed can be calculated in the following manner:

(i) No. of complete squares = 8

Area of complete squares = 8.0 sq. km.

(ii) No. of $\frac{1}{2}$ squares = 4

Area of $\frac{1}{2}$ squares = 2.0 sq. km.

(iii) No. of $\frac{2}{3}$ squares = 2

Area of $\frac{2}{3}$ squares = 1.3 sq. km.

(iv) No. of $\frac{1}{3}$ squares = 8

Area of $\frac{1}{3}$ squares = 2.6 sq. km

Total area = 13.9 sq. km.

DIRECTION

Direction forms an important element of a map. It helps us in locating a place. Knowledge of directions is obtained from the rotation of the earth. The earth rotates on its axis. The northern end of its axis is called *North Pole* and its southern end is known as *South Pole*. Any two points lying on the line joining these poles are said to be in the north and south of each other. Any line at right angles to the north-south line indicates east-west direction. Thus, we have four main directions *i.e.*, North, South, East and West. These four main directions are called *Cardinal Points*. There is another set of four directions between these Cardinal Points. They include:

(i) North-East (NE) between North and East.

(ii) South-West (SW) between South and West.

(iii) North-West (NW) between North and West.

(iv) South-East (SE) between South and East.

The direction of a line is described by the angle it makes with the North, measured in the clockwise direction. Thus, direction is a relative term. Direction can be found with the help of the following:

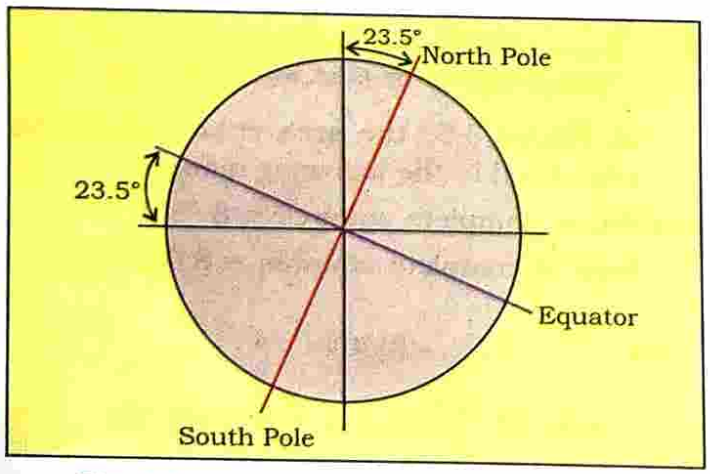


Fig. 3.6.(a) Earth showing North Pole and South Pole

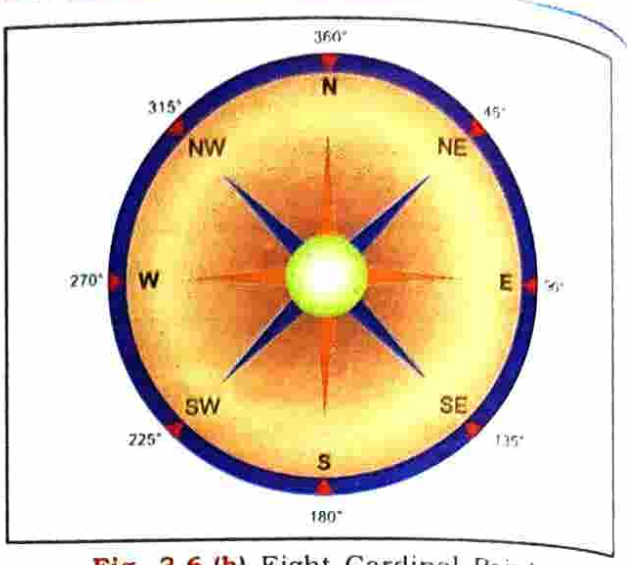


Fig. 3.6.(b) Eight Cardinal Points

BEARING

Direction can be indicated by a system of angular bearing. Bearing is the horizontal angle between the North and line joining the position of the observer and the object in a clockwise direction.

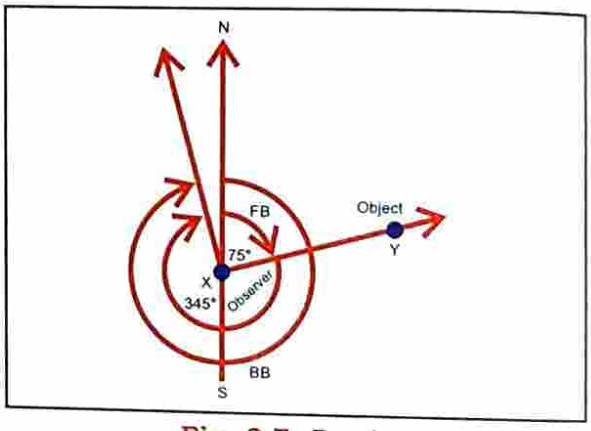


Fig. 3.7. Bearing

In Figure 3.7, X is the position of the observer. The line XY connects the object Y with X and makes a clockwise angle of 75° with the north-south line (NS) passing through the observer. Thus, the bearing of the object Y with reference to the observer X is 75°. The bearing from the observer to the object is called *Forward Bearing* (FB). The bearing from the object to the observer is called *Backward Bearing* (BB).

Bearing of a line pointing towards East is 90° and N.E. is 45°. We can locate any point on the map from a fixed point if its distance and bearing are known.

Fig. 3.8. The Compass

Note : BB=FB +180 (if FB <180);
BB=360-FB (if FB>180).

A bearing with reference to magnetic north-south line is called *magnetic bearing* and that with reference to true (or geographic) north-south line is called *true bearing.*

Magnetic North and True North

The Magnetic Compass is an instrument used to find directions. The 'North' to which the compass needle points is called *Magnetic North.* When there are no magnetic substances near the magnetic compass, its needle points to the magnetic north. It differs from the *Geographic or True North.* True North is the direction indicated by the North Star. On a globe all the lines of meridian converge towards the True North. The angle between the true north-south line and the magnetic north-south line is known as *Magnetic Declination.* Magnetic North is not fixed but it moves slowly from time to time. This results in variation of the magnetic declination. Hence, it is also called *magnetic variation.* The angular difference between Magnetic North and True North varies from place to place and time to time. These variations are same while travelling

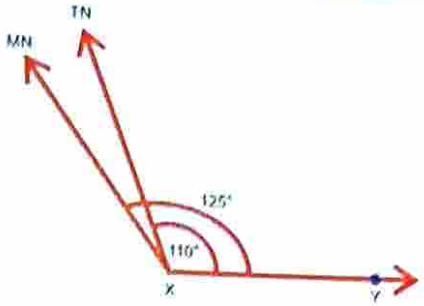


Fig. 3.9. Magnetic Bearing and True Bearing

in a certain direction. Lines that are drawn joining the points of similar variations between the magnetic north and the true north are called Isotonic lines.

Hence, True North at a place can easily be found if the Magnetic North is found and the magnetic declination is known. Suppose that magnetic variation is 15° West and magnetic bearing is 125°. Then the true bearing will be 125° – 15° = 110°. In Figure 3.9, X is the observer and Y is the point. MN is the Magnetic North and TN is the True North. Thus, magnetic bearing of Y with respect to X is 125° and its true bearing is 110°.

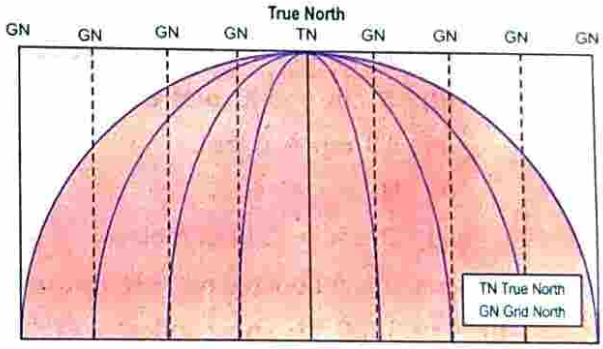


Fig. 3.10. Grid North and True North

Grid North and Grid Variation

Semi-circular lines of longitude are assumed to be straight when they are represented in maps. The North so represented is *Grid North.* It differs from True North due to the spherical shape of the earth. The variation between the Grid North and True North is called *Grid Variation.*

EXERCISES

I. Short Answer Questions

1. How is direction shown on a map?
2. What do you mean by R.F.?

3. What is the advantage of R.F.
4. Explain Magnetic declination with the help of a diagram.
5. Why are 'True North' and 'Grid North' different?
6. Convert the following numerical scale (R.F.) into statement scales:
   (a) 1:1000; (b) 1:50,000; (c) 1:5,00,000.
7. Convert the following into numerical scales (R.F):
   (a) 10 centimetres to kilometre; (b) 1 centimetre to 20 kilometres;
   (c) 2 cm to 5 km; (d) 6 inch to 1 mile;
   (e) 1 inch to 2½ miles; (f) 7 cm to 6.3 km;

II. Distinguish between:

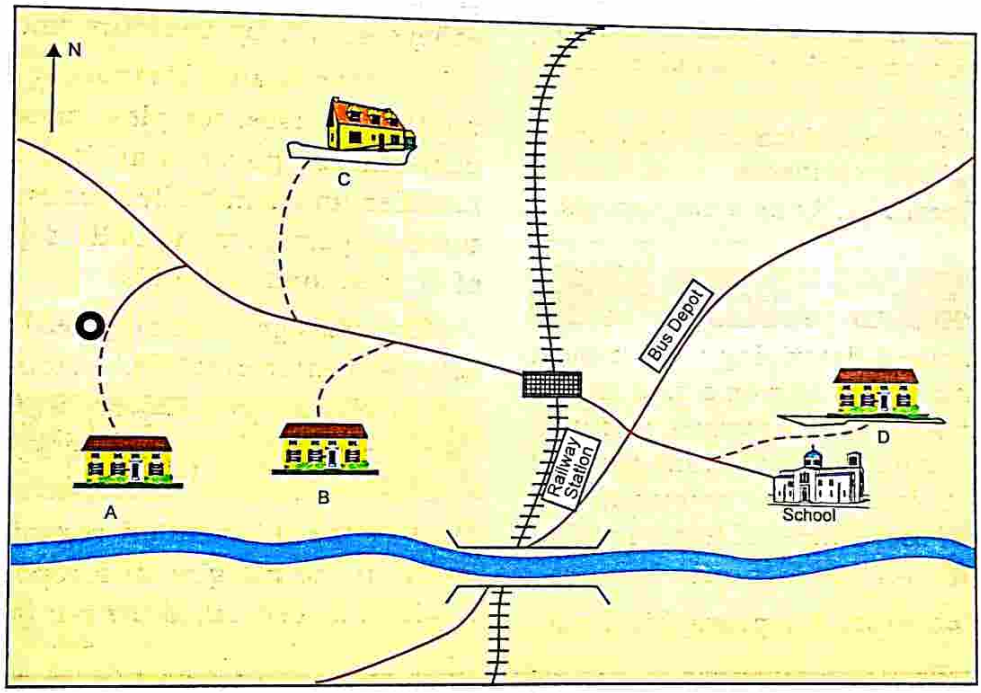
(a) Statement Scale and Graphic Scale.

(b) True North and Magnetic North.

III. Answer the following questions:

1. With regard to scale, answer the following questions:
   (i) What is a Scale? Name the main methods of representing the scale of a map.
   (ii) Convert the following statements into R.F.
      (a) 25 cm on the map = 5km on ground.
      (b) $2\frac{1}{2}$ inches on the map = 5 miles on ground.
      (c) 7 cm on the map = 63000 metres on ground.
      (d) 5 cm = 500 metres.
      (e) 15 cm = 6 km.
      (f) 10 cm =1 km.
      (g) 12 cm = 72000 metres.
2. Convert the following representative fractions into statements:
   (i) 1: 63360 (to show miles).
   (ii) 1: 1000000 (to show kilometres).
   (iii) 1: 100 (to show metres).
   (iv) 1: 10 (to show metres).
   (v) 1: 200,000 (to show kilometres).
   (vi) 1: 50 (to show metres and centimetres).
3. Draw linear scales and mark the following distances on them.
   (i) 1cm = 1 km (9km).
   (ii) 1cm = 100 km (1100 km).
   (iii) 1: 500000 (13km).
   (iv) 1: 20000 (250 metres).
4. The distance between New Delhi Station and Safdarjung Enclave bus stop is 20km. On map of Delhi it has been shown by a line of 3.5cm. Draw the linear scale of the map calculate the R.F.

5. On the map of India the cartographer got to draw the scale of the map. The student who knows the distance between Meerut and Delhi (70km), was asked to complete the scale. How will the student draw the scale if he measures the distance between Delhi and Meerut on the map to be 5 cm? Give the procedure, draw the scale and find out the R.F.
6. The map given below depicts the houses of four friends A,B,C and D. Find the distances using the main road and the kutcha road to answer the following questions.
   (a) Which child would reach school first if all, A,B, and C, leave their houses at the same time and walk at the same speed?
   (b) Which child lives closest to the school, according to the road distance?
   (c) How far must D walk to reach the village well?
   (d) How far is B's house from the bus depot?
   (e) How much distance will C have to walk to reach the railway station?
   (f) In what direction is C's house from the school?



Bridge — Railway line
Level Crossing — River
Main Road — Village Well
Kucha Road — R.F. = 1:10,000

IV. Fill in the blanks:

	R.F.	*Distance on the map*	*Distance on the ground*
(i)	1:1,26,720.	4 inches	.....
(ii)	.....	2cm	1km.
(iii)	1:6,000,000	4.4 inches	.....

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Chapter 4 Map Reading and Interpretation

Syllabus

Identify: Site of prominent villages and/or towns, types of land use/land cover and means of communication with the help of the index given at the bottom of the sheet.

Identification of drainage (direction of flow and pattern) and settlement patterns.

Identification of natural and man-made features.

MAP READING

Map Reading involves describing the physical and cultural features as shown on a map as well as the interrelation between various features. For example, one can identify different physical features like relief, drainage and vegetation and then interpret how these physical features affect the cultural or man-made features.

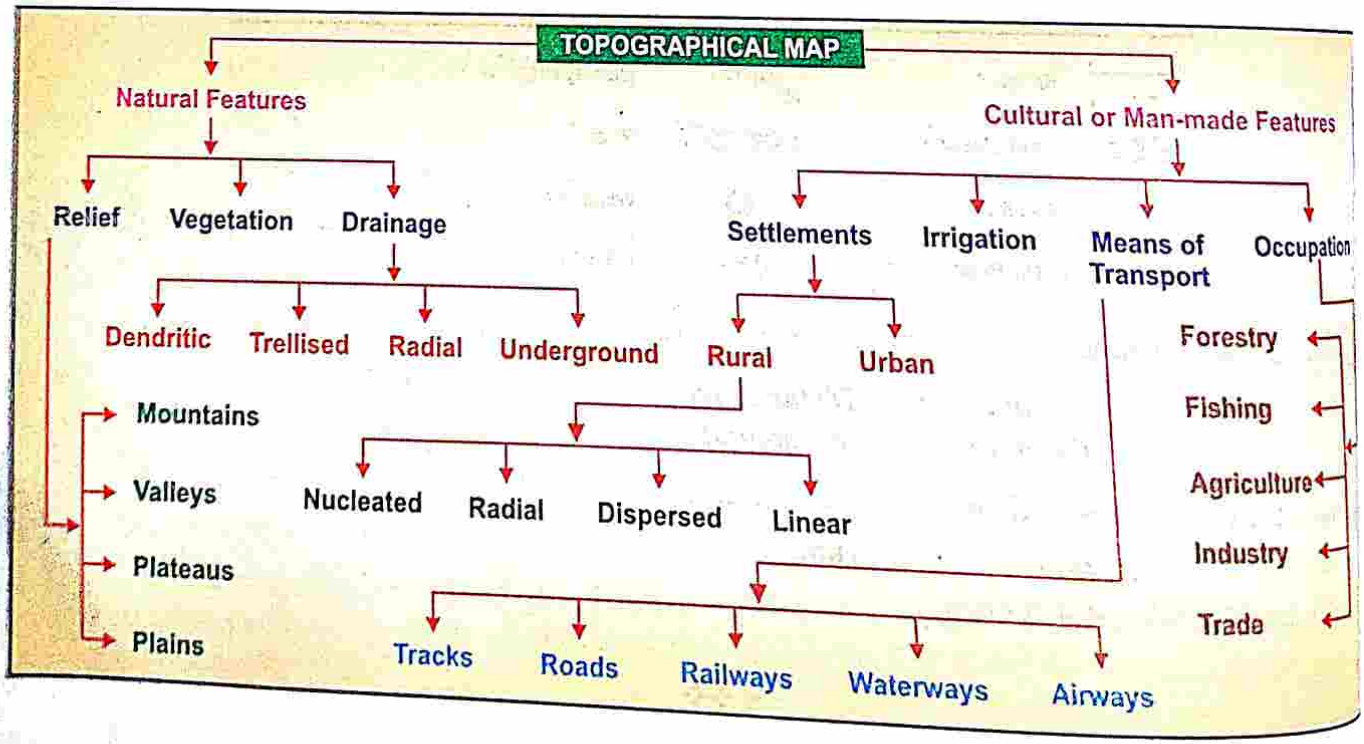
1. Natural Features: A topographical map shows various natural features like mountains, plateaus, plains, rivers, streams, broken grounds, unlined wells, cliffs, waterfalls and valleys shown by contours and their heights.

2. Man-made Features: These include quarrys, houses, temples, mosques, churches, post-offices, police stations, artificial lakes, metalled and unmetalled roads, embankments, tunnels, ports, etc., usually depicted by means of conventional symbols.

The chart given below gives the outline of the scheme of interpretation of a topographical map.

PRIMARY INFORMATION OR MARGINAL INFORMATION

Most of the information regarding the map is given on the margins of a topo-sheet and this is why it is also called the *marginal information*



Information on the Margins of a topo-sheet includes:

1. Number of the sheet: The topo-sheet number (like 45D/7 and 45D/10) gives an idea as to which part of India is being depicted by the map.

2. Latitudinal and Longitudinal Extent: In a topographical map of 4 degree, four lines of latitude and longitude are drawn. The number of latitudes goes on decreasing with the increase in scale of the topo map. On a degree map, only two lines of latitude are drawn.

3. Eastings and Northings: In every map, two-figure Eastings and Northings are pointed at intervals of 1 km along the north and east edges of the map. The Grid of Eastings and Northings enable us to:

(i) find the exact location of a place; and

(ii) estimate the area of a region.

4. Scale of the Map is given below the map, *e.g.*, 1:5,00,000. (For details see Chapter 3)

5. Contour Interval: It refers to the vertical distance between two consecutive contours on a map. It depends on the scale of the map, the amount of vertical height involved and the purpose for which the map is to be used.

6. Direction of True North and Magnetic North: North-South line has to be indicated on a map. Most large-scale maps have two arrows starting from a common point printed on the margin, one shows the *true north and* the other, *magnetic north.*

7. Legend or Character-sheet: A list of commonly used conventional signs and symbols is given at the bottom of the topo-sheet.

8. Year of Survey and publication: It is indicated at the bottom of the topo-sheet.

RELIEF FEATURES

1. Relief features: The relief features on a topo-sheet include highlands (mountains, hills, plateaus) and lowlands, which can be identified by the comparative density of contour lines:

(a) *Highland areas* like hills have the alignment of ranges and the steepness of slopes. Locate the peaks and hill tops. Gaps between two hills may be marked. Determine, whether it is a pass or a saddle. Find out the average height of the region. Maximum heights may also be located with grid reference.

(b) In highland areas like the plateau, find out the nature of the surface, whether it is a rolling upland or a dissected plateau. Find out the rock-types available.

(c) In lowlands find out the direction and the gradient of the slope. Look for the important rivers, their tributaries and their course. Note the soil-type.

2. Drainage System: The drainage system in hills, plateaus, and lowlands is different. River valleys can be identified as V-shaped or U-shaped. Waterfalls can be located. A dendritic drainage pattern would indicate soft surface-rock material. A trellised drainage pattern indicates presence of limestone.

3. Coastal Topography: If the region is a coastal area, the coastal landscape has to be carefully studied. The study of shore-lines would indicate shore-lines of emergence and of submergence. Shore-lines of emergence are unindented and have spits, bars and lagoons. Shore-lines of submergence are fairly indented with bays, gulfs, cliffs and stacks.

4. Vegetation and Climate: Natural vegetation provides an indication of the climate, soil, land use and occupations. For example, deciduous forests are the most widespread natural vegetation found on hills in India. Absence of vegetation indicates erosion of land. Scattered trees, found on lowland areas, indicate that agriculture is the occupation of the people in these areas. Scattered scrub land and stony waste indicate desert conditions with poor soil, suitable for rearing goats, sheep, camels and horses. Region of heavy rainfall is shown by 'Dense forest' (or jungle) written on the map.

Topo-sheets do not provide any direct information about the climate of a place such as rainfall, temperature and humidity. But this can be inferred from the latitudinal extent of the area covered by the topo-sheet and the type of vegetation found there. For example, the climate of a place at 10°N latitude would be warmer than the place at 35°N latitude.

Vegetation type also gives an indication of the climate of a place. For example, rain forests are found in the heavy rainfall areas, where temperature is between 25°C and 27°C and average annual humidity exceeds 77 per cent. Similarly, the presence of scanty growth of cactus, thorny bushes and grass suggest arid and semi-arid climate.

RELATIONSHIP BETWEEN PHYSICAL FEATURES AND HUMAN ACTIVITIES

The human activities such as land use, occupation, trade routes, trade centres, settlement and pattern of population, are directly controlled by the physical environment. Therefore, from the topographical sheet we can state the factors governing a particular activity. In the Indian topo-sheets, the settlements are shown in Chinese vermilion colour. The size of the symbols and the size and style of letters used give an idea of the size of the settlement. The distribution of settlements is greatly influenced by the relief; but it remains interrelated with other aspects of human geography.

1. Relief Features and Land Use

Relief features are closely related to land use.

(i) Highland areas such as mountains, plateaus, river valleys can be determined from the contour pattern.

If there is sufficient number of contours, they follow irregular path and their value varies from 200 to 1000 metres, it is a *plateau*. In such an area, waterfalls, knolls, ridges, escarpments and undulating slopes can be found.

If there is no contour or if the contours are very few and are spaced wide apart the area represented is a *plain*. In such an area, the river valleys are broad and shallow and the course of the river is meandering and braided.

If the contours are larger in number, are closer together and their value exceeds 1000 metres, it represnts a *mountainous area*. It shows steep slopes, V-shaped valleys, gorges, waterfalls and watersheds.

Deciduous forest or mixed forests might be found here. Most highland areas with steep slopes are unsuitable for agriculture and may be fit only for grazing. Sometimes the flat top of plateaus is used for cultivation.

The evidence of land use is shown by various symbols on topographical maps as follows:

Symbol	Land use
Open Scrub	Sheep and goat rearing.
Stony waste	Uncultivable land
Sheet rocks	Uncultivable land
Rock outcrop	Uncultivable land
Yellow coloured area	Agriculture
Tanks, canals, wells and tubewells, *etc.*	Agriculture
Green coloured area	Orchard, forest, scrub etc.

(ii) Lowland areas can be identified from the distant spacing of contours.

(a) Well-drained and undulating lowland areas support mixed farming.

(b) A very flat lowland may be subject to seasonal flooding. This can be confirmed by noting the presence of broken ground.

(c) Broken ground indicates the presence of soft soil, silt deposited by the river which is very good for agriculture.

(d) Intensive use of the land for agriculture is indicated by the presence of canals, tanks and tube wells.

(e) The presence of dry streams, dry ponds and dry wells indicate an area of scanty rainfall or an arid region where cultivation is not possible.

(iii) Rivers

(a) In its upper course a river flows down steep slopes; so cultivation is not possible.

(b) A meandering river would indicate a flat gradient. The river plain would be suitable for agriculture.

(c) The flood plains of rivers are most fertile and indicate intensive agriculture.

(d) Settlements are generally found on either side of a river or where irrigation is possible

Irrigation is indicated by canals, perennial wells *etc.*

(e) Many causeways on a map indicate a dry river and desert regions which receive only seasonal rainfall.

(iv) Drainage Pattern

Drainage of an area refers to the study of main rivers and their tributaries, their size, direction of flow, drainage basin, slope of the valley and other waterbodies like lakes, tanks, ponds and reservoirs. The study of the drainage pattern indicates the following:

(a) A *dendritic drainage pattern* shows soft surface rock material suitable for agriculture.

(b) A *trellised pattern* shows presence of limestone indicating the unsuitability for agriculture.

(c) *Radial pattern* of drainage is seen from high lands regions where rivers radiate in all directions.

(d) A *disappearing stream* would indicate dry conditions with sandy soil, which is unsuitable for agriculture.

(e) The presence of perennial rivers with their tributaries, dams and canals indicate that it is an agricultural area, well-irrigated by rivers.

(f) The presence of non-perennial rivers, streams show that region gets moderate to low rainfall. In such areas, man-made resources of irrigation like wells, canals, tanks are found.

(g) In a limestone area, the streams may suddenly appear or disappear.

2. Settlements

A settlement is a group of human dwellings in urban or rural areas.

Thickly settled areas are found:

(i) over fertile plains; and

(ii) on wide river valleys.

Thin*ly settled* areas may be found:

(i) over plateaus with poor agricultural land;

(ii) in forests;

(iii) on terraced mountain slopes;

(iv) over flat hill tops; and

(v) in deserts with poor vegetation.

Absence of settlements or empty space may be seen over:

(i) marshes and swamps;

(ii) inaccessible forest;

(iii) steep mountain slopes;

(iv) areas of possible flooding; and

(v) sandy deserts.

Factors Affecting Settlements

(a) The relief and climate of the area: Settlements are not found in steep hill sides or marshy lands or areas that become waterlogged. People tend to settle where the land is flat and arable. Settlements generally develop on level land where the construction of buildings, roads and railways is easier. In highland areas, settlements may develop on floors of valleys.

(b) Security: In order to have security for people and property, settlements usually develop on higher ground to avoid flooding. The settlement may grow in a place which has a strategic position as a defence centre. The settlement could be a result of the advantage of protecting people and property from enemies and controlling access to important passes, harbours and factories.

(c) Availability of transport and communication: Towns and villages develop where roads, rivers, railways, *etc.*, help in transport and trade. Ports develop at mouths of rivers, which are also connected by roads and railways.

(d) Centrally located settlement: A settlement may develop if it is centrally located with regard to other settlements (villages). It becomes the administrative as well as the trade centre for the other settlements around it. Many small towns and villages in India hold markets and fairs (*melas*) for this purpose. A police station (PS), a post office (PO), hospitals, offices and other headquarters of the government may be located here. The names of such buildings will be marked on the map.

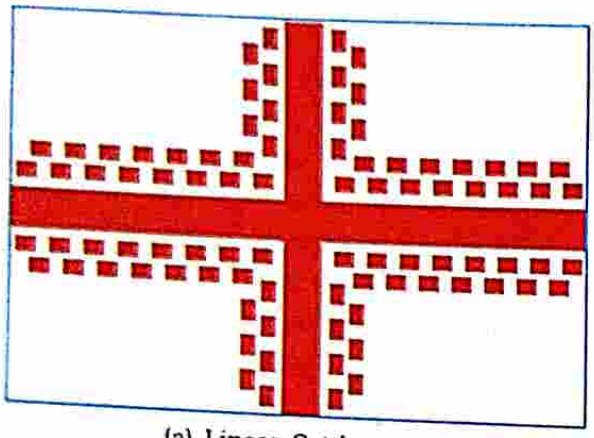
(e) The availability of water and land for cultivation and other purposes.

(f) The potential for mining and industry.

Types of Settlements

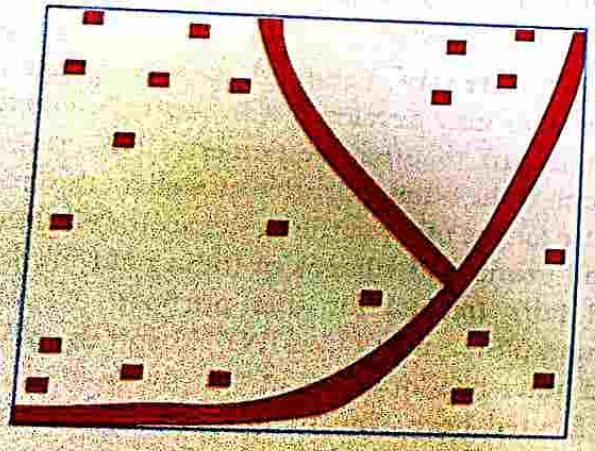
Classification of settlements based on a pattern are given below:

(a) Linear Settlements: In linear settlements houses are usually stretched out along the local road, river, canal or railway line. Linear settlements are also known as *Ribbon-patterned Settlements.*



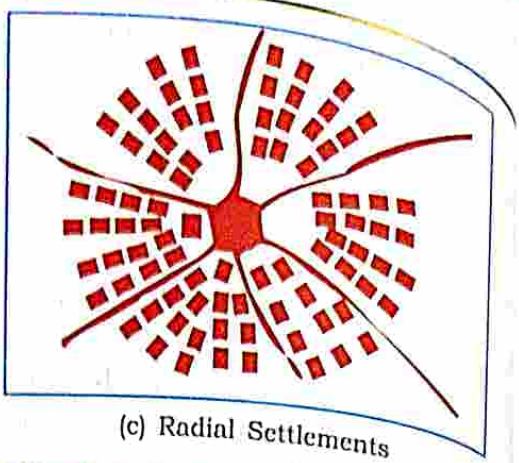
(a) Linear Settlements

(b) Dispersed or Scattered Settlements: It is the pattern of rural settlement in which most of the population lives in farms, houses, and cottages scattered over a large area. This type of settlement is generally associated with regions of high land, poor soils and an abundance of available sources of water. This pattern is also associated with large farms and sparse population. These settlements are shown in the survey maps by red squares over a wide area.



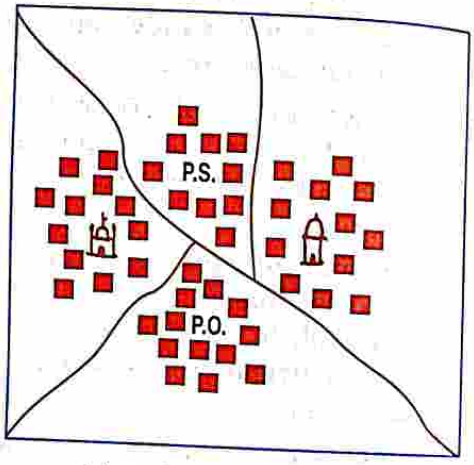
(b) Dispersed Settlements

(c) Radial Settlements: In such settlements houses are in a star-like cluster around a tank, lake, factory, *etc.*



(c) Radial Settlements

(d) Nucleated Settlements: It is a for of rural settlement in which farms ar other buildings are clustered together, ofte around some central feature like a churc or temple or police chowki, *etc.* Some of th factors which encourage nucleated or compac sites include the need for defence, th availability of water supply at particular location and the development of modern means o transport.



(d) Nucleated Settlements

The major functions of towns are trad transport, resource extraction, industri production, defence, administration, cultu and recreation. The importance of settlementi reflected by its size and the number of route which meet there. The network of roads an railways is an indication of economic activity and thus, an indicator of development of region.

Settlements, which are remote and isolated a the end of only one route or at the junction o only minor roads, are generally less important Here, the communication network follows

a diffused pattern. A town, which is at the junction of many routes, is usually known as the *nodal centre*. A nodal centre has generally a dense settlement with a radial pattern of communication. The availability of minerals helps the growth of big towns. Large towns have a dense or compact pattern of roads; whereas, modern planned cities have a rectangular or grid pattern of communication.

3. Occupations

Occupations have to be inferred from topo-sheets as there are no symbols to show the occupations of people. Sometimes, certain names like 'farms', 'orchards' provide some evidence of these occupations. The following list shows how we can get information about the occupation of people from a topo-sheet:

Occupations	Evidences
(a) Forestry	Forest or Green Patch
(b) Agriculture	Yellow Patch or orchards
(c) Cattle-grazing or sheep rearing	Meadows or Scrub
(d) Quarrying and mining	Mines and Quarries
(e) Trade	Settlement near main roads, ports, rivers, *etc.*
(f) Industrial Development	Factories and mines
(g) Entertainment and Cultural development	Golf Courses, Parks, Rifle Rangers, *etc.*
(h) Fishery	Coast, lakes, rivers, *etc.*

Thus, the occupation of the people of an area can be inferred from the following:

(i) Topography of land;
(ii) Size of settlement;
(iii) Presence of quarries and mines; and
(iv) Communication network indicating trade.
(v) Water bodies.

4. Means of Transport and Communication

Generally, every settlement is connected by a mode of transport like foot path, cart-track, camel track, roadways, railways, waterways and airways. A topo-sheet depicts railways (broad gauge and metre gauge). The roads are shown by means of symbols of cart-tracks, pack-tracks, metalled roads, unmetalled roads and footpaths with a bridge. In the coastal areas, the location of ports, harbours, anchorages and roads and railways connecting the port with its hinterland are shown on topo-sheets.

Besides transportation, means of communication such as Post Office, telephone lines, etc., are shown on topo-sheets. A close network of means of transportation and communication represents economic prosperity of the area.

The distribution of railways, roads and navigation-channels and aerodromes are provided on topo-sheets and can be studied with the help of the characteristic sheet. Mark the bridges, tunnels, embankments and cuttings constructed for laying out railway-tracks and roads. It is possible to link routes with relief and occupation.

(a) A relationship exists between the relief features and the routes because it is not only convenient but also cheaper to make routes through a level ground specially for the railways. So, the railway-network is more dense on the plains than in the hilly areas.

(b) Due to the restriction of gradient, roads and railways must follow valleys and passes through mountain ranges. Embankments and tunnels are constructed to maintain the gradient necessary for roads and railways.

(c) Embankments in low-lying land or along roads and railway-lines, would indicate the danger of floods from the adjoining areas.

(d) Rivers are cheap means of transportation for mining, industry and other urban developments. However, river transportation in India is poorly developed compared to roads and railways.

SURVEY OF TOPO-SHEET NO. 45 D/7

Area

The area shown on the topo-sheet 45 D/7 lies in the western part of India on the border of Rajasthan and Gujarat.

District

Banaskantha (Gujarat) and Sirohi (Rajasthan)

Location

Latitude — 24° 15'N – 24° 30'N

Longitude — 72° 15'E – 72° 30'E

Physical Features

Based on the relief, three distinct regions can be found on the topo-sheet:

(a) Hilly Region

- The hills in the north-eastern region rise upto 700 m. The two hills mentioned on the topo-sheets are *Jawar hill* and *Jasor hill.*
- The hill slopes have many cliffs.
- The hilly area is dissected by many streams which join the *Banas* river in the south and the *Khariya* nadi in the north.
- At several places on the lower hill slopes, rock outcrops are found.

(b) Lowland

- It is located at elevations between 170 to 220 metre and slopes gently from east to west.
- It is dissected by rivers and has gullies or ravines along the river banks.
- It is not completely flat as it has an undulating surface, represented by small enclosed contours pointing to low hills.

(c) Desert area

- It lies to the west of the *Balaram* nadi and south of the *Banas* river.
- The relative height of the sand hills vary from 9 to 14m as can be noticed from 9r, 10r, 12r, 14r, 15r marked on the topo-sheet.

Drainage Pattern

Main Rivers: *Banas* river, *Balaram* nadi and *Khariya* nadi.

- Banas river flows into the swampland area of the Little Rann, north-east of the Gulf of Kutch. It flows from north-east to south-west.
- Banas river has two right bank tributaries — *Sarod* and *Arado* nadis and a left bank tributary — *Balaram nadi.*

  The Arado nadi flows from north to south. The blue line on the topo-sheet in the Arado nadi indicates that it is a perennial stream.
- *Banas river* has a broad bed with its width varing from 1/4km to over 1km, but it has a narrow perennial water course. Its dry part fills during the rainy season.
- *Sipu nadi* is a tributary of the Banas river which flows from north-east to south-west. The two main tributaries of Sipu nadi are — *Varka nadi* and *Mahadeviyo Nala*, which rise in the hilly region to the east and join the Sipu nadi on its left bank.
- There are numerous streams, besides the main rivers. These streams rise in the higher ground adjacent to the main rivers and their courses show large tracts of broken ground indicating soft soil easily eroded by water. Most of these streams are seasonal and depend on the rains for water supply.
- The sandy nature of the river beds indicate that a large volume of flow occurs in the rainy season.
- Due to the high river banks, ravines have developed along the banks of the river, which are well-developed to the south of the Banas river and on the side of the Balaram nadi.

Climate and Vegetation

Climate

- There are three climatic seasons:

  Summer, hot and dry from March to June

  Monsoon, hot and wet from July to September

  Winter, cool and dry from October to February.
- Maximum temperature in summer is 47°C

  Minimum temperature in winter is 0°C
- Since this region is located in the western part of India, it receives comparatively less rainfall than other parts of the country.

- The annual rainfall is between 50 to 100 cm during the monsoon season.
- Due to high temperature, excessive evaporation occurs, which gives rise to scrub and semi-desert vegetation.

Vegetation

- The hilly region in the north is covered with mixed jungle, referred to in the topo-sheet as 'Open Mixed Jungle' and 'Dense Mixed Jungle'. The green colour indicates that the area has been categorised as forest.
- The vegetation in these forests comprise short trees (dry deciduous type) and tall grasses.
- In the hilly region, where the forests have been cleared, 'Open Scrub' is marked on the topo-sheet, indicating that the area receives only moderate rainfall.

Settlements

- Almost all the villages are located in the lowlands drained by rivers. These areas have level ground and alluvial soil deposited by the rivers.
- The hilly region and the sand hills do not have any settlements because of the unfavourable topography and lack of cultivated lands.
- Except for *Chitrasani*, which is a rail/road centre, all the settlements are small and scattered in the lowland area and are either nucleated or dispersed in pattern.

Transport and Communication

- Except for the main line of the western Railway and the roads that run across the south-east corner through Chitrasani and a motorable road connecting Badarpura and Bhutedi villages, there are no roads.
- The villages are connected by cart tracks and footpaths only.
- There are no bridges or causeways on the rivers.
- Since the rivers are generally dry and contain water only during the rainy season, the carts can cross the river beds without any difficulty.

Occupation of the People

- Most of the people are likely to be engaged in agriculture as many areas have yellow wash, which indicates cultivable land.
- Rearing of sheep and goats may be prevalent in the hilly areas.
- People living in the villages adjoining the forest may be engaged in collecting forest products and firewood.
- There are few lime kilns, but the absence of roads, shows there is no evidence of quarrying.

Thus, the main occupation of the people appears to be rain-fed agriculture, along with rearing of animals and gathering of forest produce.

SURVEY OF SHEET NO. 45 D/10

Area

This region lies in western India on the borders of Rajasthan and Gujarat at the southern end of the Aravali hills.

District

Sirohi and Banaskantha

Location

Latitude — 24°30' North - 24° 45' North

Longitude — 72° 30' East - 72° 45' East

Physical Features

Based on the relief features, two distinct regions can be found on the topo-sheet.

Hilly Region

- In the south-east corner of topo-sheet lies the *Aravali hills*, rising to a height of over 1400 metres. The Aravali hills run from north-east to south-west and the ranges are more or less parallel.

Plains

- The remaining portion of the topo-sheet is occupied by a large plain area.

Drainage Pattern

Main River

- The Sipu nadi rises in the hills north of Abu and flows in south-west direction.
- The right bank tributaries of Sipu nadi are: *Sukli nadi, Undawala, Dior nadi.*
- The left bank tributaries of Sipu nadi are: *Devengan* nadi, *Gogua* nadi and another unnamed river flowing past Dhavli.
- The pattern of drainage in the hilly region is *radial.* From Abu, the highest point of the region, the rivers radiate. In the plain region, the upper courses of rivers are *dendritic.*

Climate and Vegetation

- The area has three climatic seasons: Summer, hot and dry, from March to June.

  Monsoon, hot and wet, from July to September.

  Winter, cool and dry, from October to February.
- Maximum temperature in summer season remains high, with the temperature rising up to 47°C, whereas the minimum temperature in December/January drops to 0°C.
- The rainfalls between 50 to 100 cm during the monsoon season.

Vegetation

- In the hilly region, dry deciduous forests, with short trees are found. In the plain region, scrub and thorny bushes are found, where no agriculture is practised.

Settlements

- Most of the settlements have either nucleated or dispersed settlement pattern.
- Mt Abu is a hill station situated at a high altitude which provides pleasant climate.

  There are a number of temples like Anjini Devi ka Mandir, Adhor Devi ka Mandir, Raghunathji Mandir, Dilwara Temple, *etc.*

  It has Nakhi Talao which is a tourist attraction point.

Transport and Communication

- The two main modes of transport are:

  (i) metalled road; and (ii) cart tracks.
- Abu is connected eastwards by two roa One road runs south-east to Abu road; the other runs north-east to Oriya.
- Important settlements connected with metall roads are: (i) Revdar with Karaunti; (ii) Gulabga with Sirori; (iii) Andra with Gulabgan (iv) Vajna with Was.
- Important settlements connected with ca track are: (i) Marol and Mitan; (ii) Fatehpu with Butri; (iii) Bhatana with Gore (iv) Mitan with Nimora; (v) Sirori with Asaw (vi) Bhamra with Dantrai.

  Roads are motorable in dry season sho that the area cannot be crossed by cars o motors during rainy season as the groun becomes wet and muddy, but in dry seaso when the ground is hard and dry motors ca cross this area. This indicates that rainfal is seasonal.
- There are a number of causeways on th rivers and streams.
- Anadra is an important settlement which ha many facilities like Police Chauki, Dispensary Dak Bungalow and metalled road.
- Dantrai, Pamera, Wahan, Bhatana an Dattani have Post and Telegraph Office.

Occupation of the People

- The main occupation of the people in th plains appears to be agriculture as depicte by yellow wash, which represents cultivabl land.
- The people in this region depend on th periodic rainfall for irrigation. Besides, there are tanks, wells and a canal in th north-east beginning from the reservoir in the grid square 2222.
- The green colour in the hilly region indicates the presence of forests. Fairly dense mixed jungle and open mixed jungle are present in the region. People here may be occupied in animal rearing especially goat and sheep.
- Some people may be employed in Post Offices, Police Chowkies, Dak Bangalow and Rest Houses. Some others may be working in brick kilns.

Drainage Pattern

Main River

- The Sipu nadi rises in the hills north of Abu and flows in south-west direction.
- The right bank tributaries of Sipu nadi are: *Sukli nadi, Undawala, Dior nadi.*
- The left bank tributaries of Sipu nadi are: *Devengan* nadi, *Gogua* nadi and another unnamed river flowing past Dhavli.
- The pattern of drainage in the hilly region is *radial.* From Abu, the highest point of the region, the rivers radiate. In the plain region, the upper courses of rivers are *dendritic.*

Climate and Vegetation

- The area has three climatic seasons: Summer, hot and dry, from March to June.

  Monsoon, hot and wet, from July to September.

  Winter, cool and dry, from October to February.
- Maximum temperature in summer season remains high, with the temperature rising up to 47°C, whereas the minimum temperature in December/January drops to 0°C.
- The rainfalls between 50 to 100 cm during the monsoon season.

Vegetation

- In the hilly region, dry deciduous forests, with short trees are found. In the plain region, scrub and thorny bushes are found, where no agriculture is practised.

Settlements

- Most of the settlements have either nucleated or dispersed settlement pattern.
- Mt Abu is a hill station situated at a high altitude which provides pleasant climate.

  There are a number of temples like Anjini Devi ka Mandir, Adhor Devi ka Mandir, Raghunathji Mandir, Dilwara Temple, *etc.*

  It has Nakhi Talao which is a tourist attraction point.

Transport and Communication

- The two main modes of transport are:

  (i) metalled road; and (ii) cart tracks.
- Abu is connected eastwards by two roads. One road runs south-east to Abu road; and the other runs north-east to Oriya.
- Important settlements connected with metalled roads are: (i) Revdar with Karaunti; (ii) Gulabganj with Sirori; (iii) Andra with Gulabganj (iv) Vajna with Was.
- Important settlements connected with cart track are: (i) Marol and Mitan; (ii) Fatehpur with Butri; (iii) Bhatana with Goreli (iv) Mitan with Nimora; (v) Sirori with Asawa (vi) Bhamra with Dantrai.

  Roads are motorable in dry season show that the area cannot be crossed by cars or motors during rainy season as the ground becomes wet and muddy, but in dry season when the ground is hard and dry motors can cross this area. This indicates that rainfall is seasonal.
- There are a number of causeways on the rivers and streams.
- Anadra is an important settlement which has many facilities like Police Chauki, Dispensary, Dak Bungalow and metalled road.
- Dantrai, Pamera, Wahan, Bhatana and Dattani have Post and Telegraph Office.

Occupation of the People

- The main occupation of the people in the plains appears to be agriculture as depicted by yellow wash, which represents cultivable land.
- The people in this region depend on the periodic rainfall for irrigation. Besides there are tanks, wells and a canal in the north-east beginning from the reservoir in the grid square 2222.
- The green colour in the hilly region indicates the presence of forests. Fairly dense mixed jungle and open mixed jungle are present in the region. People here may be occupied in animal rearing especially goat and sheep.
- Some people may be employed in Post Offices, Police Chowkies, Dak Bangalow and Rest Houses. Some others may be working in brick kilns.

EXERCISES

I. Short Answer Questions

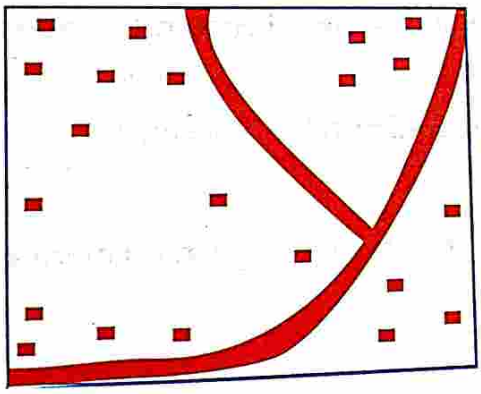
1. State what is indicated by the following symbols about the land use:
   (a) Tanks and canals.
   (b) Open scrub.
   (c) Stony waste.
2. Where are the thickly settled areas located in a village?
3. What does a dendritic drainage pattern indicate about the land?
4. How can the climate of a place be inferred from the topo-sheet?
5. What are the factors that affect settlements in an area?

II. Match the following:

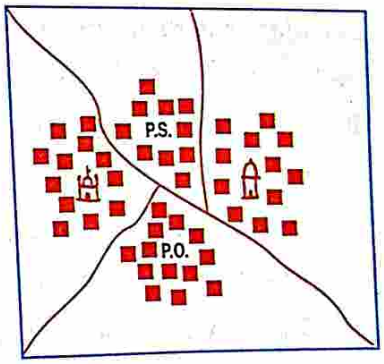
Evidences	Occupations
(i) Settlement near the main road	(a) Agriculture
(ii) Parks	(b) Forestry
(iii) Coast, Lakes	(c) Cattle grazing
(iv) Yellow patch	(d) Fishery
(v) Meadows	(e) Entertainment
(vi) Green patch	(f) Trade

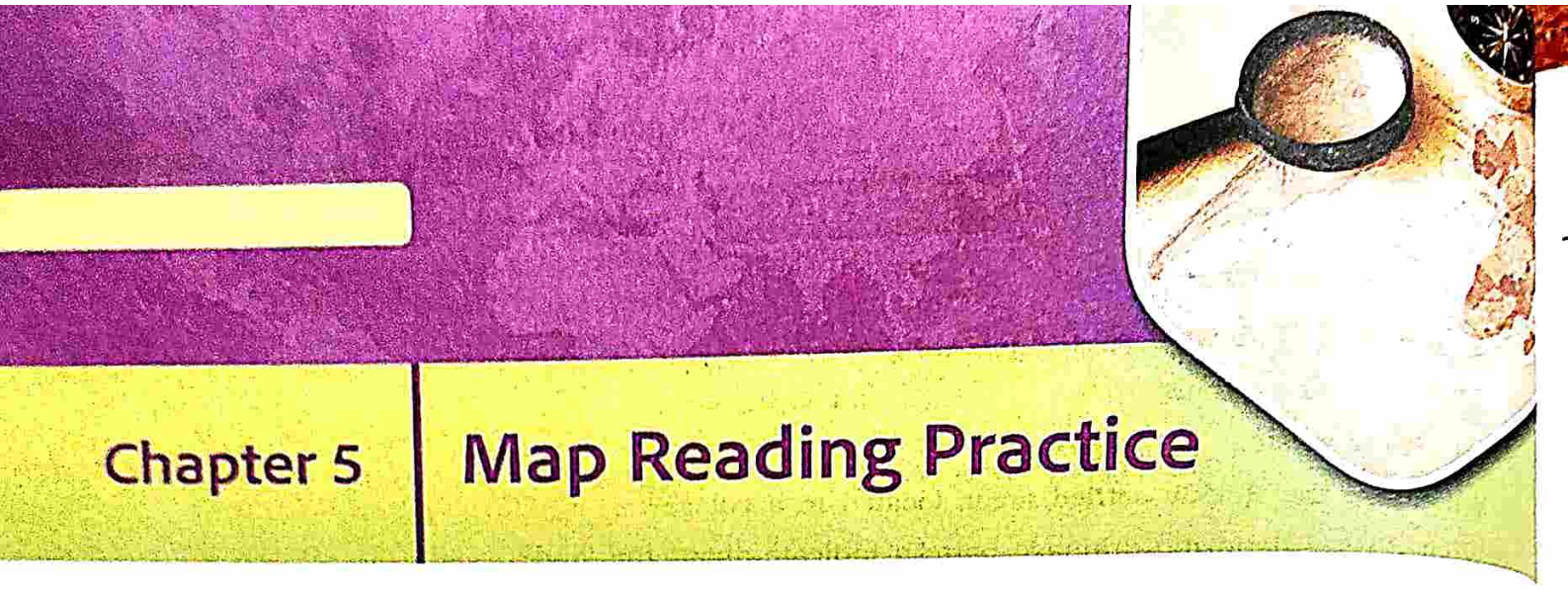
III. What do the following diagrams indicate? Write short notes on the features as indicated by each diagram.

(i)



(ii)





Chapter 5 | Map Reading Practice

Question 1

Study the extract of the Survey of India Map Sheet No.45 D/10 (Map 1 given at the end of the book) and answer the following questions:

a. Give the six figure grid reference of:
   (i) the brick kiln near village Serua.
   (ii) the temple near Asav.

b. What is the difference in the pattern of drainage in grid square 0916 and 0712?

c. Give the four figure grid reference of each of the following:
   (i) Stony waste.
   (ii) Open scrub.

d. Calculate the distance in kilometres along the metalled road between the causeways in grid square 0512 and 0808.

e. (i) What do the tiny curved black lines in grid square 0315 indicate?
   (ii) What is the main cause for this feature?

f. (i) What is the geographical name that you would give to the general pattern of settlement in the region shown on the map?
   (ii) Give a reason for your answer.

g. What is the general direction of flow of the Sipu Nadi, given in the map extract? Give a reason to support your answer.

h. Name two probable occupations of the people in the settlement of Revdar in grid square 0313 and 0413.

i. What kind of roads connect
   (i) Marol with Mitan?
   (ii) Revdar with Karaunti?

j. Give two reasons to show that the area depicted in the map, experiences seasonal rainfall

Solution
Sheet No. 45 D/10 (Year 2011)

a. (i) 058131, (ii) 059128.

b. In the grid square 0916 the drainage pattern is Radial whereas in the grid square 0712 it is Trellis.

c. (i) Stony Waste – 1014.

(ii) Open Scrub – 0816.

d. The distance along the metalled road between the causeways in grid square 0512 and 0808 is 5.7 km.

e. (i) The tiny curved black lines in the grid square 0315 indicate Broken ground.

(ii) Broken ground is caused either by flooding, or hot and dry weather.

f. (i) The general pattern of settlements in the region on the given map is Nucleated.

(ii) Settlements are found close together.

g. NE to SW, because spot heights are receding from NE to SW for example, •261, •257, •249 ....

h. Two probable occupations of the people of Revdar include agriculture, working in brick kiln or Post Office.

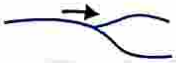
i. (i) Cart track connects Marol with Mitan.

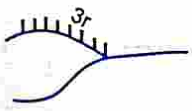
(ii) Metalled road connects Revdar with Karaunti.

j. The area depicted in the map experiences seasonal rainfall. This is indicated by the presence of Dry tank and Dry streams.

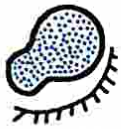
INTERPRETATION OF THE SIGNS AND SYMBOLS USED ON TOPOGRAPHICAL MAPS

1.  Seasonal or non-perennial stream (depicted in black).

2.  Confluence: Meeting of tributary and main river.

3.  Relative height of a river bank; indicates the relative difference in height between the top and bottom of the embankment.

4.  The distance or gauge between the rails is 1.6 m.

5.  Reservoirs are perennial water bodies artificially constructed to store water for various purposes.

Question 2

Study the extract of the Survey of India Map Sheet No.45 D/7 (Map 2 given at the end of the book) and answer the following questions:

a. Give the six figure grid reference of:
   (i) Triangulated height 307.
   (ii) The spot height 196.

b. Give the four figure grid reference of each of the following:
   (i) The confluence of the Sipu River and the Mahadeviyo Nala.
   (ii) Sheet rock.

c. Measure the cart track between Bhakodar 8188 and Ganeshpura 8089.

d. What do the following represent?
   (i) Black curved line in 7788.
   (ii) The blue line in the bed of the Sipu River.

e. (i) What is the general pattern of the settlements in the region shown on the map?
   (ii) Give a reason for your answer.

f. Which is the main source of irrigation shown in the map extract? Why is it necessary?

g. (i) What is the main form of transport in this region?
   (ii) Give the map evidence for your answer.

h. (i) What is the compass direction of Dantiwada, 8582, from Bhadli Kotha, 7886?
   (ii) What is the general direction of flow of the Arado N?

i. (i) Name the type of drainage pattern found in grid square 8584.
   (ii) What do you mean by 25r in grid square 8286?

j. (i) What is meant by 'R.F.'?
   (ii) What is the R.F. shown on the map extract?

PRACTICE EXERCISE

Draw the symbols for the following features on a map.

1. temple	5. light-house
2. brick kiln	6. tidal stream
3. pontoon bridge	7. river with islands
4. airfield	8. fort

Solution
Sheet No. 45 D/7 (Year 2010)

a. (i) 859843. (ii) 834916.

b. (i) 8189. (ii) 8188.

c. The distance between the cart track at Bhakodar in grid square 8188 and Ganeshpura in grid square 8089 is 3 cm on map that means 1.5 km on ground.

d. (i) Broken ground. (ii) Perennial stream.

e. The pattern of settlements is nucleated as the settlement are found close together.

f. The chief form of irrigation shown in the map extract is perennial wells. It is necessary because the rivers are seasonal.

g. (i) There are number of cart tracks so the main form of transport is carts.

(ii) Single red lines.

h. (i) South-east. (ii) South-west.

i. (i) Dendritic.

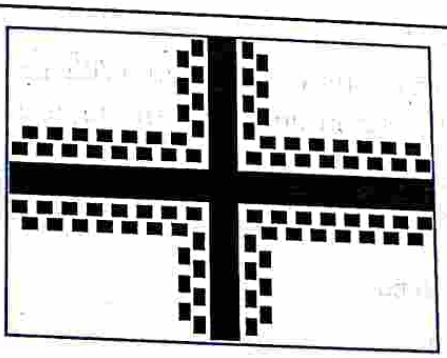
(ii) The relative depth of the perennial well is 25 metres.

j. (i) R.F. stands for Representative Fraction. It is the ratio of the horizontal distance between two points on the map to the distance of the corresponding points on the ground.

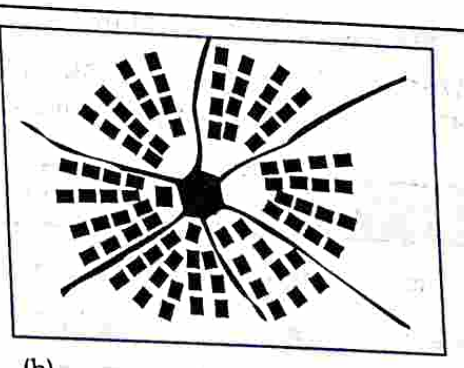
(ii) R.F. of the map is 1 : 50,000.

PRACTICE EXERCISE

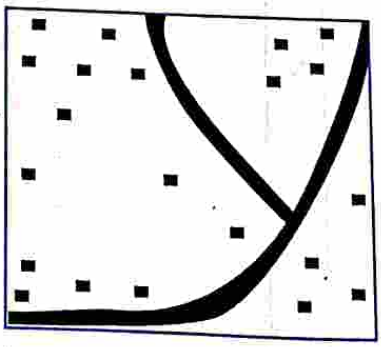
Identify the following settlements:



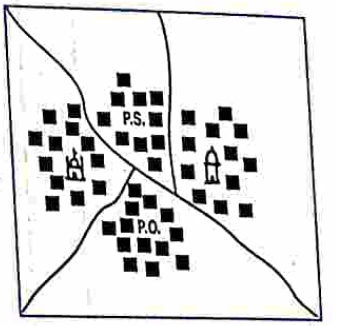
(a) .....



(b) .....



(c) .....



(d) .....

Question 3

Study the extract of the Survey of India Map Sheet No.45 D/10 (Map 3 given at the end of the book) and answer the following questions:

a. Give the four-figure grid reference of a settlement with
   (i) Spot height 261.
   (ii) Post office.

b. What is the difference in the pattern of drainage in grid square 1606 and in 1007?

c. Name two natural features seen in grid square 0910.

d. Calculate the distance in kilometres along the metalled road from the causeway East of Was to the distance stone 10.

e. (i) Which is a universally accepted scale?
   (ii) State the length of the given map in kilometres.

f. Give the six-figure grid reference of:
   (i) A temple south of Dhavli settlement.
   (ii) Spot height 277.

g. Which are the two different kinds of roads shown in the map extract?

h. Mention two main occupations shown on the map extract.

i. How are the gentle and steep slopes shown on the map?

j. What do the following mean?
   (i) 3r in 1103.
   (ii) Open scrub in 1502.

k. What is the direction of Dattani and Dhavli from Chandela?

l. Name two man-made features in grid square 1210.

m. What do the words Motorable in dry season in grid square 1701 and 1702 refer to? What do they indicate about the rainfall received by the region shown in the map extract?

PRACTICE EXERCISE

Draw contours to represent the following features:

(i) Conical Hill, (ii) V-shaped Valley, (iii) Watershed.

Solution
Sheet No. 45 D/10 (Year 2009)

a. (i) 1107.

(ii) 1003.

b. (i) 1606 – Radial.

(ii) 1007 – Trellised.

c. Two natural features seen in grid 0910 are : (i) seasonal dry stream; (ii) Palm trees.

d. 8.1 km.

e. (i) Universally accepted scale is Representative Fraction (RF).

(ii) The length of the given map is 9 km scale 2 cm = 1 km.

f. (i) 111073; (ii) 177057.

g. (i) Metalled road; (ii) Cart track.

h. Two occupations are: (i) Cultivation; (ii) Forest related activities.

i. Gentle slopes are shown by spacing contour lines far apart. Steep slopes are shown by closely placed contour lines.

j. (i) 3r in 1103 shows relative height of the embankment built on a dry tank.

(ii) Open scrub shows that the area is not cultivable land but is used for sheep or goat rearing.

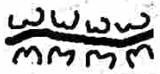
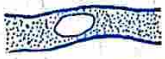
k. Dattani is West of Chandela. Dhavli is North-west of Chandela.

l. Two man-made features in grid square 1210 are settlements and cart track.

m. Motorable in dry season shows that the area cannot be crossed by cars or motors during rainy season as the ground becomes wet and muddy, but in dry season when the ground is hard and dry motors can cross this area. The map extract indicates that rainfall is seasonal.

PRACTICE EXERCISE

What do the following symbols indicate?

	.....		.....
	.....		.....
	.....		.....
	.....		.....

Question 4

Study the extract of the Survey of India M[illegible] Sheet No.45 D/10 (Map 4 given at the end of the book) and answer the following questions:

a. What is the compass direction of Sunset Point from the settlement of Anadra?

b. What is the pattern of drainage in grid square 2315?

c. Mention any two features in the map extract which indicate that the region has seasonal rainfall.

d. Calculate the distance in kilometres along the metalled road from the causeway in grid square 1715 to the distance stone marked 20 in grid square 1818.

e. What advantage does a Representative Fraction have over a verbal scale?

f. Give the six figure grid reference of : (i) Anjini Devi ka Mandir; (ii) Δ 1327

g. Name the three different kinds of roads in grid square 2411 and the one in grid square 2515.

h. Mention two occupations of the people living in the northern part of the region in the map extract. Give reasons to support your answer.

i. What is the difference between the slope in grid square 2115 and the one in 1811. Give a reason for your answer.

j. What is the purpose of : (i) the fire line in grid square 2316?; (ii) the pipeline in grid square 2209?

k. What the following represent?

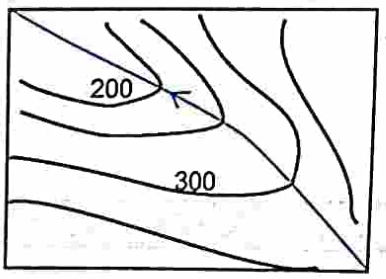
(i) The red square in grid square 2514.

(ii) 4r in grid square 1612.

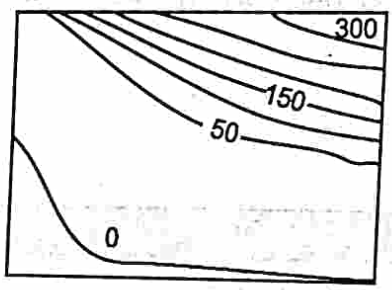
l. Abu is a popular holiday resort. Mention any three features seen in the map extract which attract holiday makers to Abu.

PRACTICE EXERCISE

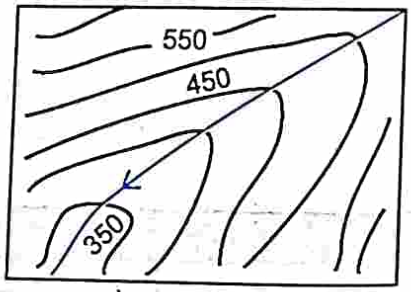
What do the following contours stand for?



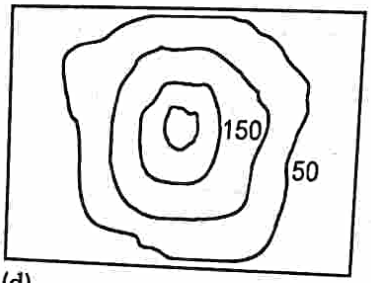
(a) .....



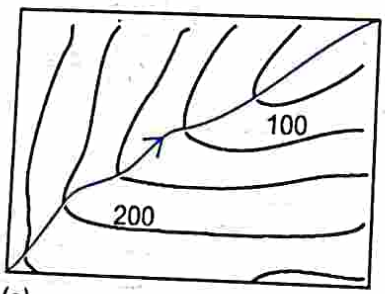
(b) .....



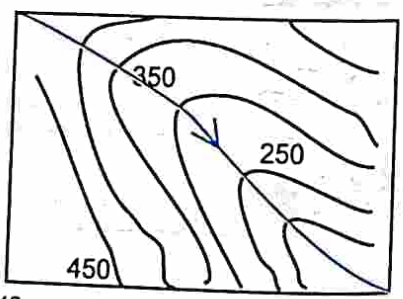
(c) .....



(d) .....



(e) .....



(f) .....

Solution
Sheet No. 45 D/10 (Year 2008)

a. The compass direction of Sunset point from the settlement of Anadra is South-East.

b. The drainage pattern in grid square 2315 is radial.

c. The dry Nadi flowing from *Lakhawa ka Khera* and some dry tanks indicate that the region has seasonal rainfall.

d. 3.25 km.

e. (i) Vertical scale uses unit of measurements which can be different at different places, however, there is no units in representative fraction.
(ii) Unlike a verbal scale, representative fraction can be converted to any unit.

f. (i) Six figure grid reference of Anjini Devi ka Mandir is 229160.
(ii) Six figure grid reference of Δ1327 is 217105.

g. The three different kinds of roads in grid square 2411 are : Metalled road, unmetalled road and pack track.

One kind of road in grid square 2515 is footpath.

h. Two occupations of the people living in the northern region are:
(i) Cultivation — The yellow wash in the region shows cultivable land.
(ii) Forestry — The green colour shows the presence of forest. Fairly dense mixed jungle and open mixed jungle are present in the region.

i. In grid square 2115 the slope is gradual and gentle as the contour lines are drawn in this region are far apart from each other whereas in 1811, slope is steep as contour lines are drawn very close to each other.

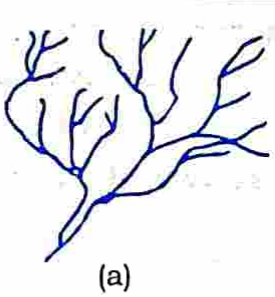
j. (i) Fireline is to prevent the spread of forest fire.
(ii) The pipeline in grid square 2209, takes the water from the perennial tank to the main town 'Abu'.

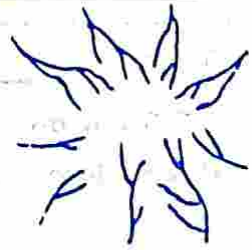
k. (i) The red square in grid square 2514 represents the 'temporary hut'.
(ii) The relative depth of the tank embankment is 4 metres.

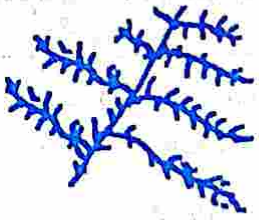
l. (i) Mt Abu is a hill station situated at a high altitude which provides pleasant climate.
(ii) There are a number of temples like Anjini Devi ka Mandir, Adhor Devi ka Mandir, Raghunathji Mandir, Dilwara Temple, *etc.*
(iii) It has Nakhi Talao which is a tourist attraction point.

PRACTICE EXERCISE

What type of drainage pattern is represented by the following?


(a)


(b)


(c)

(d)

(a) ..... (b) .....

(c) ..... (d) .....

Question 5

Study the extract of the Survey of India Map Sheet No. 45 D/10 (Map 5 given at the end of the boo and answer the following questions:

a. Give the six-figure grid reference of:

(i) the temple in village Dhavli.

(ii) [illegible] 480.

b. What do the following indicate?

(i) 6r in grid square 1903.

(ii) The word brackish in grid square 1403.

c. (i) In grid square 1909, several contours merge at one point. What does this represent

(ii) State the significance of the red dotted lines in the map extract.

d. Name the type of rainfall experienced in the region shown in the map extract. Give a reas to support your answer.

e. How does the drainage pattern in grid square 1606 differ from the drainage pattern in gr square 1708?

f. (i) What is the pattern of settlement in grid square 1904?

(ii) Name the settlement that has a post office.

g. Name two landforms represented by the pattern of contours in grid square 1608.

h. Calculate the ground distance in kilometres along the metal road between the causeway i 1502 and the distance stone marked "14" in grid square 1203.

i. State 2 reasons for the absence of human habitation in the north-eastern region of the ma extract.

j. (i) Mention the difference in height between the highest spot height in the map extract an the contour height in grid square 1006.

(ii) What is the compass direction of Patlawa ka Goliya (590) from Kacholi Dungar (443)?

PRACTICE EXERCISE

The distance between Town A and Town B is 5.5 cm on a map. The R.F. of that map is $\frac{1}{2,000,000}$. Calculate the actual distance between these two places in kilometres on the ground.

.....

.....

Solution
Sheet No.45 D/10 (Year 2006)

a. (i) 110073.

(ii) 137045.

b. (i) 6r in grid square 1903 indicates that the relative height of the embankment is 6 m.

(ii) The word Brackish in grid square 1403 indicates that the water of the lined well is salty.

c. (i) The merging contours in 1909 represent cliff.

(ii) Red dotted lines in the map extract show footpath.

d. The rainfall experienced in the region is seasonal because of the presence of dry streams.

e. The drainage pattern in 1606 is radial whereas in 1708 it is trellised.

f. (i) Scattered or dispersed.

(ii) Dattani.

g. River valley and Spur.

h. 3.5 km.

i. The region is very hilly or rugged and does not have drinking water.

j. (i) Highest spot height is 1023 in grid square 1907 and the contour height is 260. The difference between the two is 763 m.

(ii) North-West.

PRACTICE EXERCISE

What colour is used to represent the land features?

Land Use	Colour
1. Grassland	
2. Uncultivated area	
3. Cultivated area	
4. Water features	
5. Railway line	
6. Forests	
7. Built up area, *i.e.*, villages, towns, roads, *etc.*	

Question 6

Study the extract of the Survey of India Map Sheet No. 45 D/10 (Map 6 given at the end of the book) and answer the following questions:

a. (i) What is the brown line in grid square 1718 called?

(ii) What does the figure written along this line indicate?

b. Mention two main modes of transport used by the people in the area shown in the map extract.

c. On which bank of Sipu Nadi is the village Gulabganj (1920) situated? From where does the village get its supply of water throughout the year?

d. What is meant by the term 'Fire Line'? Account for the necessity of 'Fire Line' in the jungle area of the given map extract.

e. What is the nature of the canal shown in the map extract? Measure in kilometres the total length of the canal.

f. In what way does the pattern of drainage in grid square 2118 different from that in grid square 2114?

g. Which is the most important settlement in the map extract? Give one reason to support your answer.

h. (i) State the compass direction of Udwariya (2423) from Gulabganj (1920).

(ii) Mention one striking difference between these two settlements.

PRACTICE EXERCISE

Fill in the blanks:

Representative Fraction (RF)	Map Distance	Ground Distance
$\frac{1}{50,000}$	1 cm	.....
$\frac{1}{36}$	2 inch	.....
$\frac{1}{63360}$	.....	1 mile
$\frac{1}{100,000}$	.....	10 km
.....	1	2 miles
.....	15 cm	1 km

Solution
Sheet 45 D/10 (Year 2005)

a. (i) Contour line.

(ii) The figure 280 written along the line indicates that the height is 280 m above sea level or the contour height is 280 m.

b. The two main modes of transport are (i) metalled roads; and (ii) cart tracks.

c. Gulabganj is situated on the right bank of the Sipu Nadi. This village gets its supply of water throughout the year from perennial lined wells.

d. 'Fire Line' refers to a clearing made in the forest to prevent the spread of forest fires. The area is dry and is susceptible to forest fires in hot and dry season. Therefore, fire line is necessary to prevent the spread of forest fires to other areas.

e. The nature of canal shown is perennial. The total length of the canal is 5.7 km.

f. In grid 2118, the drainage pattern is radial whereas in grid 2114 the drainage pattern is dendritic.

g. Anadra is the most important settlement in the map extract. This is because it has many facilities like Police Chauki, Dispensary, Post and Telegraph Office, Dak Bungalow, metalled road.

h. (i) The direction of Udwariya from Gulabganj is North-East.

(ii) Udwariya is a linear or ribboned settlement whereas Gulabganj is compact or nucleated settlement.

PRACTICE EXERCISE

What do the following colours indicate on topographical sheets?

Black	Blue	Green

Question 7

Study the extract of the Survey of India Map Sheet No.45 D/7 (Map 7 given at the end of the book) and answer the following questions:

a. Give a six-figure grid reference of

(i) △ 592.

(ii) The temple where the Annual fair is held in the month of February.

b. (i) State the general direction of Arado N.

(ii) What does the blue in Arado N indicate?

c. Calculate the distance in kilometres along the cart track between Velavas (868895) and Rand(883888).

d. (i) What does 7r in grid square 8689 indicate?

(ii) State the main source of irrigation at Dhanawada (Fatepura).

e. What type of rainfall is experienced in the region shown in the map extract? Justify your answer giving one reason.

f. Name and explain the term used for the brown lines in the map extract.

g. Name any two types of vegetation found in the map extract. Give a four figure grid reference for each.

h. (i) What is the main relief feature seen in grid square 9284.

(ii) Which prominent feature can be seen in the river bed, grid reference 9380?

i. State the pattern of:

(i) Human settlement in grid square 8989 and

(ii) Drainage in grid square 9185.

j. What inference can be drawn about the general occupation of the people of the region shown in the western half of the map extract? Give one reason to justify your answer.

PRACTICE EXERCISE

Distinguish between the following on the basis of their contours:

(i) V-Shaped Valley and U-Shaped Valley

(ii) Concave and Convex Slopes

(iii) Col and Saddle

Solution
Sheet No. 45 D/ (Year 2004)

a. (i) 928890

(ii) 912883

b. (i) South-West.

(ii) The blue line in Arado N indicates that is a perennial channel.

c. 2.0 km.

d. (i) 7r in grid square 8689 indicates that the relative depth of lined well is 7m.

(ii) Perennial-lined wells.

e. The rainfall experienced in the region is seasonal. As cart tracks are running right across the river, they indicate that the bed of the river is dry and can be crossed by the bullock carts during the dry season.

f. The brown lines shown in the map are contour lines. They are imaginary lines joining places of same height above sea level.

g. (i) Open mixed jungle (9187).

(ii) Dense mixed jungle (9385).

h. (i) Conical hill.

(ii) Island.

i. (i) Linear settlement.

(ii) Radial Drainage.

j. The general occupation of the people living in the western half of the map extract is agriculture because most of the area has yellow wash which indicates cultivable land.

PRACTICE EXERCISE

Draw conventional signs for the following:
(i) A metalled road with a milestone, (ii) Unmetalled road with bridge, (iii) Tidal river, (iv) Broad gauge railway line, (v) Deserted village.

Question 8

Study the extract of the Survey of India Map Sheet No. 45D/7 (given with Specimen Paper at end of the book) and answer the following questions:

a. Give the six figure grid reference of:
   (i) Triangulated height 217 (ii) A lined well near Chekhla.

b. (i) Name the left bank tributary of the main river.
   (ii) State the direction in which this left bank tributary is flowing.

c. (i) Mention a special feature associated with the streams in grid square 9879.
   (ii) Name the type of drainage pattern found in grid square 9382.

d. Give the four grid reference of each of the following:
   (i) Open scrub (ii) Bantawada

e. Name two relief features that can be seen in grid square 9782 and 9574.

f. Why do you find limited cultivation in the map extract? Give two reasons for your ans

g. What is the compass direction of Antroli (9576) and Chekhla (9281) from Sangla?

h. What type of rainfall is experienced in the region shown in the map extract? Justify answer by giving one reason.

i. Calculate the distance in kilometres along the cart track between Chitrasani (999747) Pirojpura (978753).

j. (i) What is the geographical name that you would give to the general pattern of settlem in the region shown on the map?
   (ii) Name one region shown on the map which is unsuitable for the cultivation of cro

Solution
Sheet No. 45 D/7 (Year 2013)

a. (i) 939797; (ii) 925814

b. (i) Balram nadi; (ii) Towards North-West

c. (i) Broken Ground; (ii) Trellised

d. (i) Open scrub: 9680; (ii) Bantawada: 9978

e. Conical Hill (9782) and Saddle (9574)

f. Limited cultivation is found in the given map extract because the rainfall experienced i region is seasonal as is evident from (i) broken grounds and presence of sand dunes sandy soil. (ii) presence of countours that show that there is a hilly region in a part o map.

g. Antroli—North-East; Chekhla North

h. The region in the given map extract experienced seasonal rainfall as is indicated by presence of: broken ground, open scrub, dry river bed, and presence of wells and dry t

i. The distance along the cart track between Chitrasani and Pirojpura is 2 kilometres.

j. (i) Nucleated Settlements. (ii) Southern region.

Chapter 6 Map of India

Syllabus

On the outline map of India, candidates will be required to locate, mark and name the following—Mountains, Peaks and Plateaus, Plains, Desert, Rivers and Water Bodies, Passes, Latitude and Longitudes, Directions of Winds, Distribution of Minerals, Soil Distribution, Cities, Population.

Mountains, Peaks and Plateaus: Himalayas, Karakoram, Aravali, Vindhyas, Satpura, Western and Eastern Ghats, Nilgiris, Garo, Khasi, Jaintia, Mount Godwin Austin (K2), Mount Kanchenjunga, Deccan Plateau, Chota Nagpur Plateau.

Plains: Gangetic Plains and Coastal Plains —(Konkan, Kanara, Malabar, Coromandel, Northern Circars.)

Desert: Thar (The Great Indian Desert).

Rivers: Indus, Ravi, Beas, Chenab, Jhelum, Satluj, Ganga, Yamuna, Ghagra, Gomti, Gandak, Kosi, Chambal, Betwa, Son, Damodar, Brahmaputra, Narmada, Tapti, Mahanadi, Godavari, Krishna, Cauveri, Tungabhadra.

Water Bodies: Gulf of Kutch, Gulf of Khambhat, Gulf of Mannar, Palk Strait, Andaman Sea, Chilka Lake, Wular Lake.

Passes: Karakoram, Nathu La Passes.

Latitude and Longitudes: Tropic of Cancer, Standard Meridian (82°30′E).

Direction of Winds: South West Monsoons (Arabian Sea and Bay of Bengal Branches), North East Monsoon and Western Disturbances.

Distribution of Minerals: Oil — Mumbai High (Offshore Oil Field) and Digboi. Iron — Singhbhum, Coal — Jharia.

Soil Distribution: Alluvial, Laterite, Black and Red Soil.

Cities: Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bengaluru, Kochi, Chandigarh, Srinagar, Vishakhapatnam, Allahabad.

Population: Distribution of Population (Dense and sparse).

The following maps are given as models of map filling exercises.

EXERCISES

I. On the outline map of India:

(a) Draw, name and number the Standard Meridian.

(b) Label the river Yamuna.

(c) Shade and name the Gulf of Khambhat.

(d) Mark and name the Nathu La Pass.

(e) Mark and name the Karakoram Range.

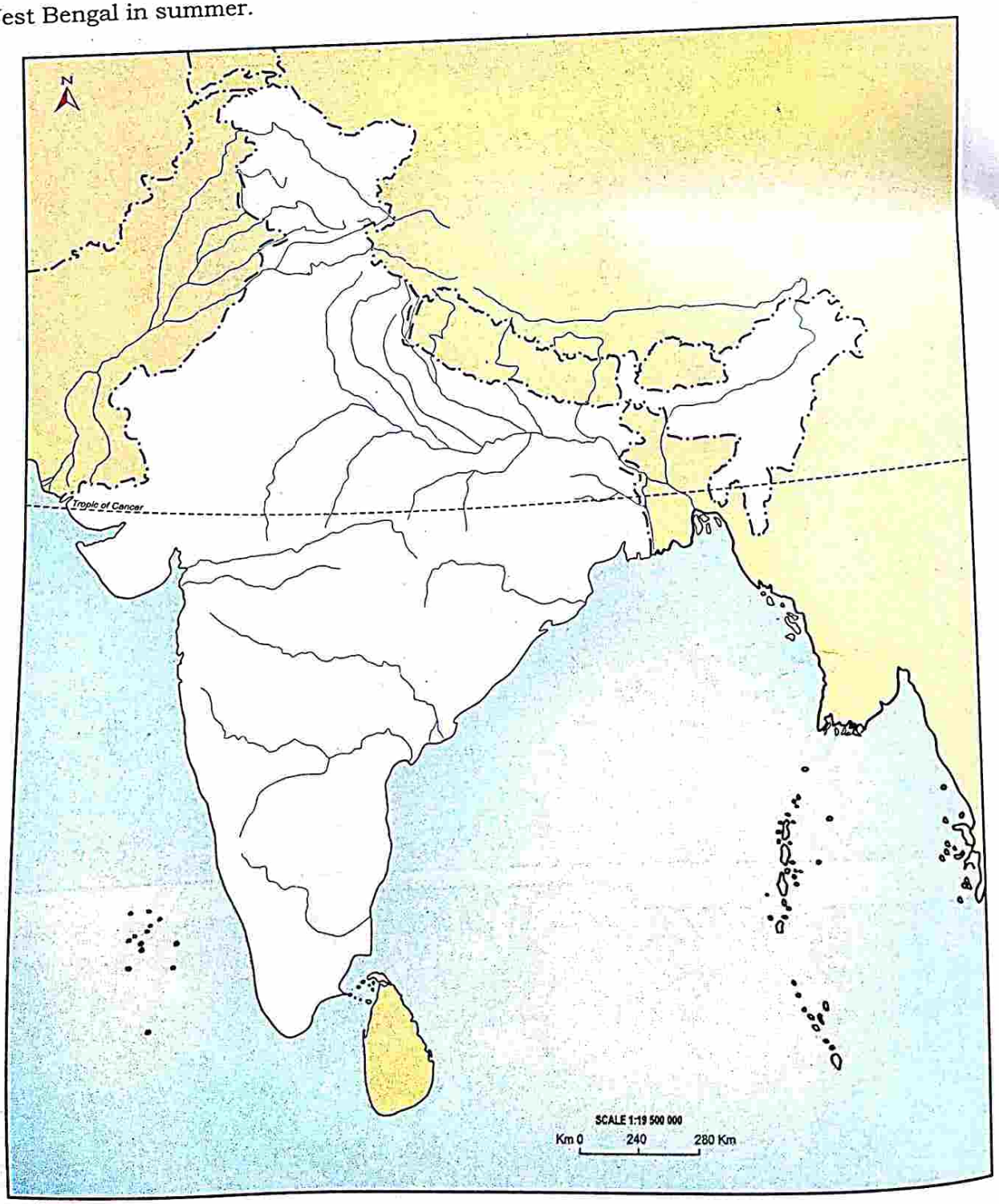
(f) Shade and name a sparsely populated State in Northeast India.

(g) Shade a region with Laterite Soil in Eastern India.

(h) Mark with a dot and name Vishakhapatnam.

(i) Mark and name the winds that bring rain to West Bengal in summer.

(j) Print S on the iron mines in Singhbhum.



II. On the outline map of India:

(a) Mark and name Chennai.

(b) Label the river Godavari.

(c) Shade and label the Chota Nagpur Plateau.

(d) Shade and name the Gulf of Kutch.

(e) Mark and name the Gangetic Plains.

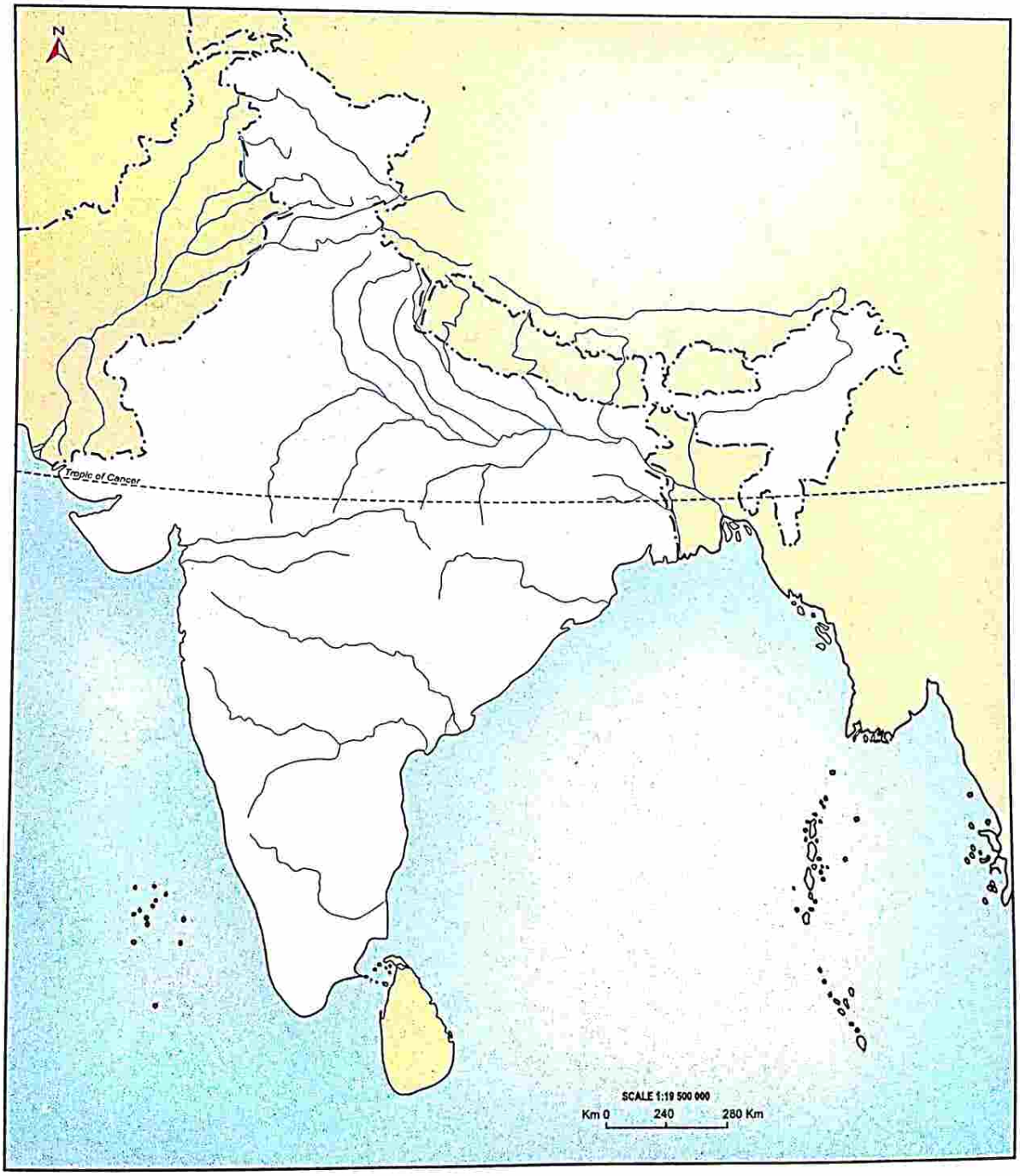
(f) Shade and label an area with Red Soil.

(g) Mark and name the winds which bring rain to Mumbai in July and August.

(h) Mark and name the Satpura Range.

(i) Mark and name the Jharia Coal Field.

(j) Shade and label the Northern Circars.



III. On the outline map of India:

(a) Draw, name and number the Tropic of Cancer.

(b) Label the river Narmada.

(c) Shade and name Wular lake.

(d) Mark and name the Aravali Mountains.

(e) Mark and name the Karakoram Pass.

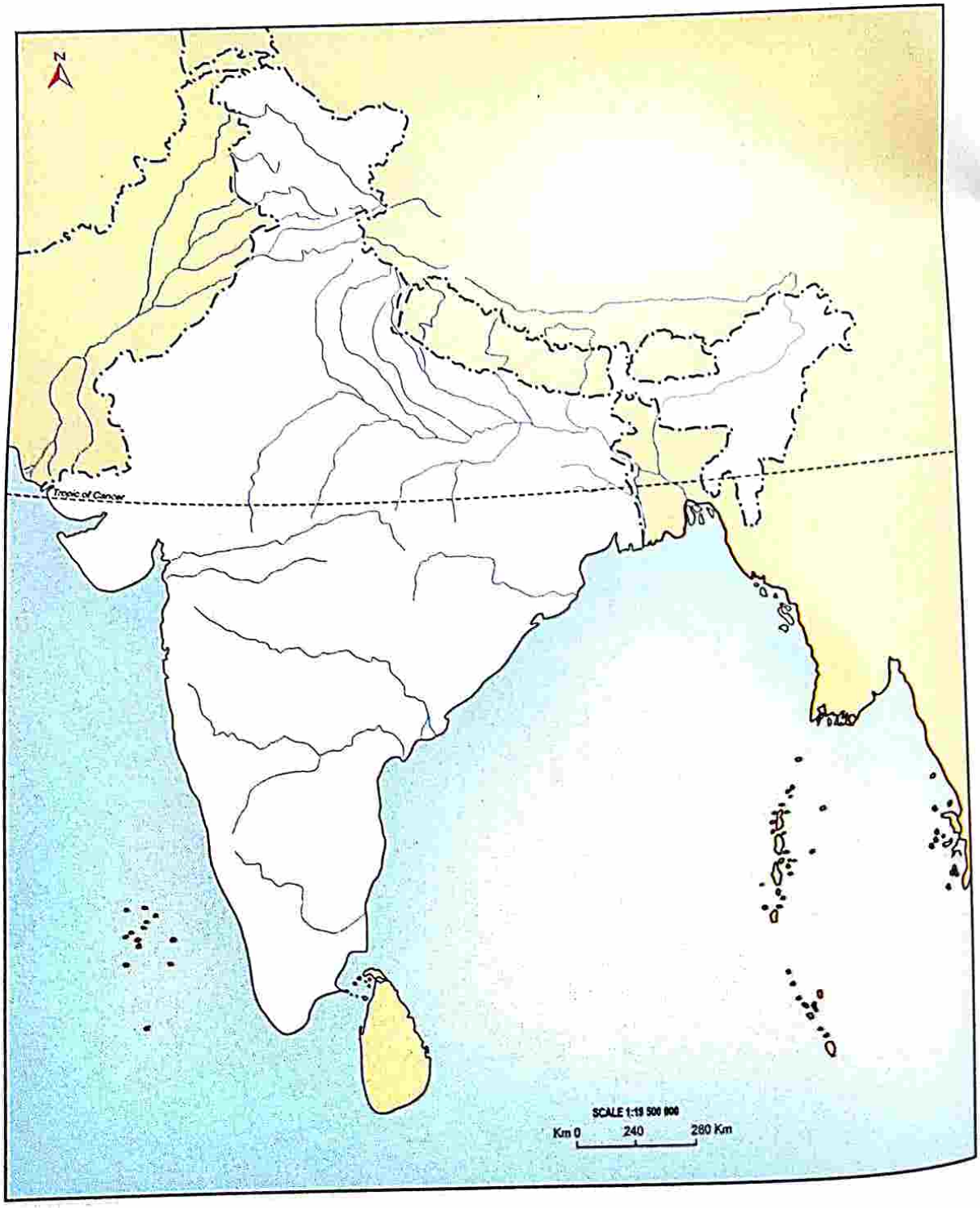
(f) Shade and name a densely populated state in South India.

(g) Shade and name a region with Black Soil.

(h) Mark with a dot and name Chandigarh.

(i) Mark and name the winds which bring rain in winter to the Coromandel Coast.

(j) Name and print S on an oilfield in North-eas India.



IV. On the Outline map of India:

(a) Shade an important area where Iron is found in India.

(b) Shade and name the Plateau in India known for black soils.

(c) Shade and name an offshore oilfield.

(d) Mark and name the Great Indian Desert.

(e) Mark and name the Konkan plains.

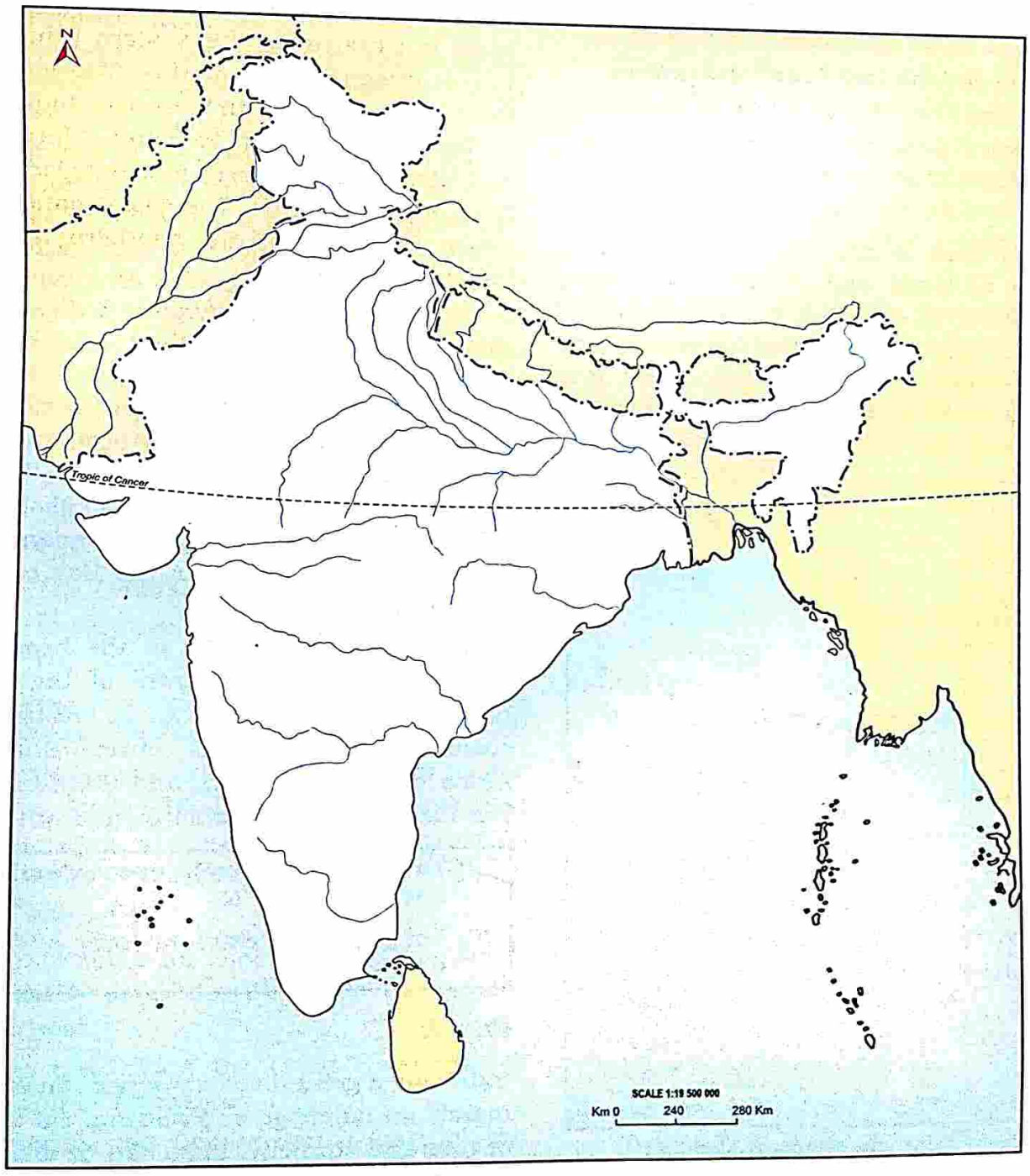
(f) Shade and name the Garo, Khasi and Jaintia hills.

(g) Mark and name two rivers in India draining into the Arabian Sea.

(h) Mark and name (i) Srinagar; and (ii) Kochi.

(i) Mark and name with arrows the direction of winds blowing in Kerala during summer season from the Arabian Sea.

(j) Shade and name the Chota Nagpur Plateau.



Part 2: Geography of India

Chapter 7 Location, Extent and Physical Features

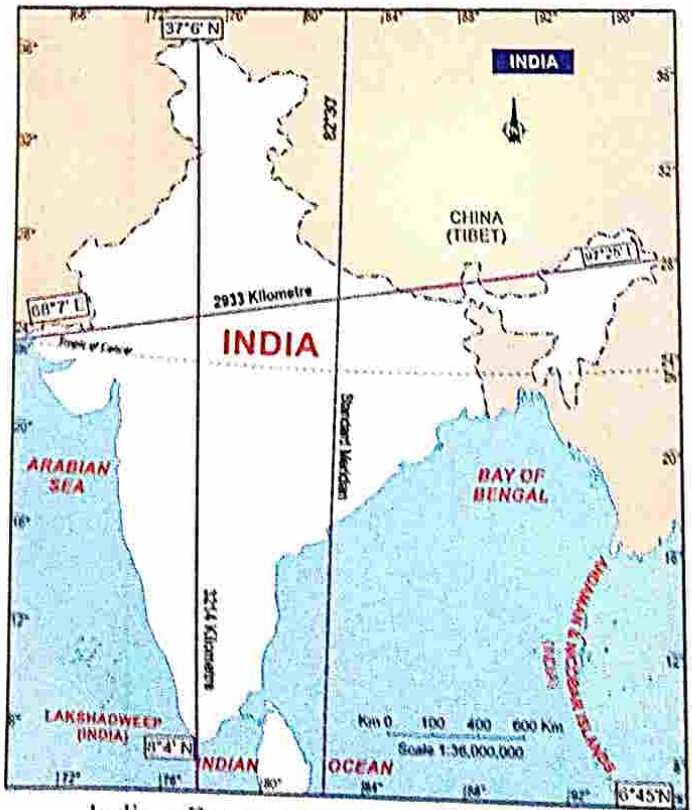
Syllabus

Location, Extent and Physical Features

Position and Extent of India (through Map only).

The physical features of India — mountains, plateaus, plains and rivers (through Map only)

India is a land of unity in diversity. It is a collection of lands and climates, of diverse races and creeds, of languages, religions and of contrasts. With all its physical dimensions and characteristics, it is truly a subcontinent. It is the second most populous country in the world (after China) and the seventh largest in size.



India : Extent and Standard Meridian*

*Sketch (not to scale) to aid in understanding concepts.

Location and Extent

India is situated on the western fringe of t Indian Ocean. It lies midway between Sou East Asia and the South West Asia. India shar its land frontiers with Pakistan, China, Nep and Bhutan in the north and Bangladesh a Myanmar in the east. The island nation of S Lanka is located off the southern tip of t Indian peninsula.

India is surrounded by water bodies on thr sides, *i.e.*, Bay of Bengal in the southeast, Indi Ocean in the south and Arabian Sea in t southwest. The Tropic of Cancer passes alm through the middle of the country and divi it in two halves—the tropical zone in the so and sub-tropical in the north. Lakshadw off the western coast and the Andaman a Nicobar islands, located in the Bay of Ben also form a part of India.

India lies strategically at the head of Indian Ocean, at the centre of the East hemisphere. Due to its strategic location, I commands the sea routes between Europe Africa on the one hand, and Southeast A Far East and the Oceania on the other.

(i) Latitude: The mainland extends b 8°4′ N to 37°6′ N.

(ii) Longitude: It extends from 68°7′ E 97°25′E.

People

India has a great diversity of population. M mainly on language and religion. On the b of race and ethnicity, India can be divided

five ethnic groups, namely, Proto-Australoids, Negritos, Mongoloids, Mediterranean or Dravidians and Nordic Aryans. So far as *religion is concerned, Hindus constitute the largest group, *i.e.*, about 79.8% per cent of the population; Muslims constitute 14.2 per cent, Christians 2.3 per cent, Sikhs 1.7 per cent, Buddhists 0.7 per cent, Jains 0.4 per cent and Parsis only a few thousand adherents.

Although more than 200 languages are spoken in India, there are 22 recognised languages in the Eighth Schedule of the Constitution of India.

PHYSICAL FEATURES OF INDIA

India occupies a major part of South Asia, *i.e.*, 73.4 per cent of the area. India has its borders in the north with China, Nepal and Bhutan. In the east, India has a common border with Bangladesh and Myanmar. In the west India has border with Pakistan. India is surrounded by water bodies on the three sides — in the southeast by the Bay of Bengal; in the south by the Indian Ocean; and in the southwest by the Arabian Sea.

The Indian subcontinent has five clearly defined physiographic divisions:

1. The Northern Mountain Wall;
2. The Plains of Northern India;
3. The Peninsular Plateau;
4. The Coastal Plains;and
5. The Islands.

THE NORTHERN MOUNTAIN WALL

The northern mountain wall is known as the Himalayan Range. The Himalayas consist of three parallel ranges, which are clearly distinguished on the basis of their height.

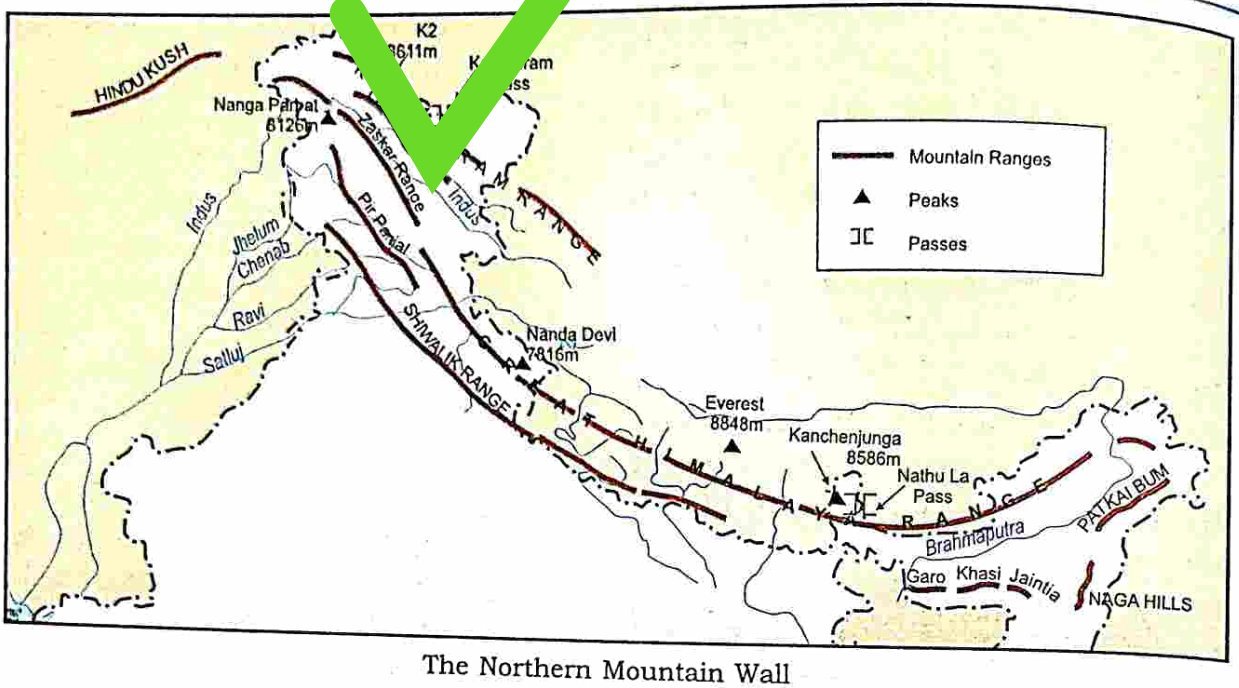
(i) The Himadri

- It is known as the *Himadri* because it remains covered with snow throughout the year.
- It is also called the *Great Himalayas* or the *Inner Himalayas*.
- It forms the northernmost part of the Himalayan range and is one of the world's highest mountain ranges.
- This range includes the world's highest peak, Mt. Everest (8,848m), Mount K2 (Godwin Austen), the second highest peak in the world and some other peaks, namely, *Makalu* (8,481m), *Mansalu* (8,156m), *Annapurna* (8,078m) all in Nepal, *Nanga Parbat* (8,126m) and *Kanchenjunga* (8,598m) in India.
- It also has some passes in Kashmir, Himachal Pradesh, Uttarakhand and Sikkim. It includes the Karakoram pass in Kashmir; Bara Lapcha La and Shipki La in Himachal Pradesh; Thaga La and Niti in Uttarakhand.
- To the north of the Himalayan ranges lies the Plateau of Tibet, the highest plateau in the world. It lies in the rainshadow area of the Himalayas.
- A number of glaciers descend from the Himadri such as the Gangotri and the Yamunotri. They lie in the Uttarakhand. These glaciers are the perennial source of water for the Ganga and Yamuna rivers, respectively.
- Sharda, Ghagra, Kosi and Gandak rivers originate from this range.

(ii) The Himachal

- This range is also known as the *Himachal-Himalayas* or the *Middle* or *Lesser Himalayas*.
- It runs parallel to the Himadri and lies to its south.
- Their heights range from 3700 m to 4500 m.
- Doons lie between the Himachal and Shiwalik ranges. They are flat-bottomed longitudinal valleys. Dehra Dun is one such valley.
- This range has a vast vegetative cover.
- A number of peaks having elevation of more than 5,050 m are located in this range. They are covered with snow throughout the year. *Eg.* Shimla in Himachal Pradesh height of 7025 m. These ranges range in height from 3500 m to 6000 m.

*Source: www.thehindu.com



The Northern Mountain Wall

- Some of the important ranges in this region are the Pir Panjal, Dhaula Dhar, Mussoorie range and Mahabharat range (Nepal).
- The Dhaula Dhar range forms the southern-most range of the middle Himalayas. This range rarely attains elevations higher than 4,000 m. It continues eastward into the Mahabharat range (Nepal).
- The Pir Panjal range located in Kashmir, extends from the Jhelum river to the upper Beas river for over 300 km. This range is separated from the Zaskar range by the valley of Kashmir.
- Most of the hill stations in India lie in this range. They include Shimla, Mussoorie, Nainital, Almora, Ranikhet, Chakrata, Chail, *etc.*
- The valleys here include Kullu, Jammu and Srinagar.

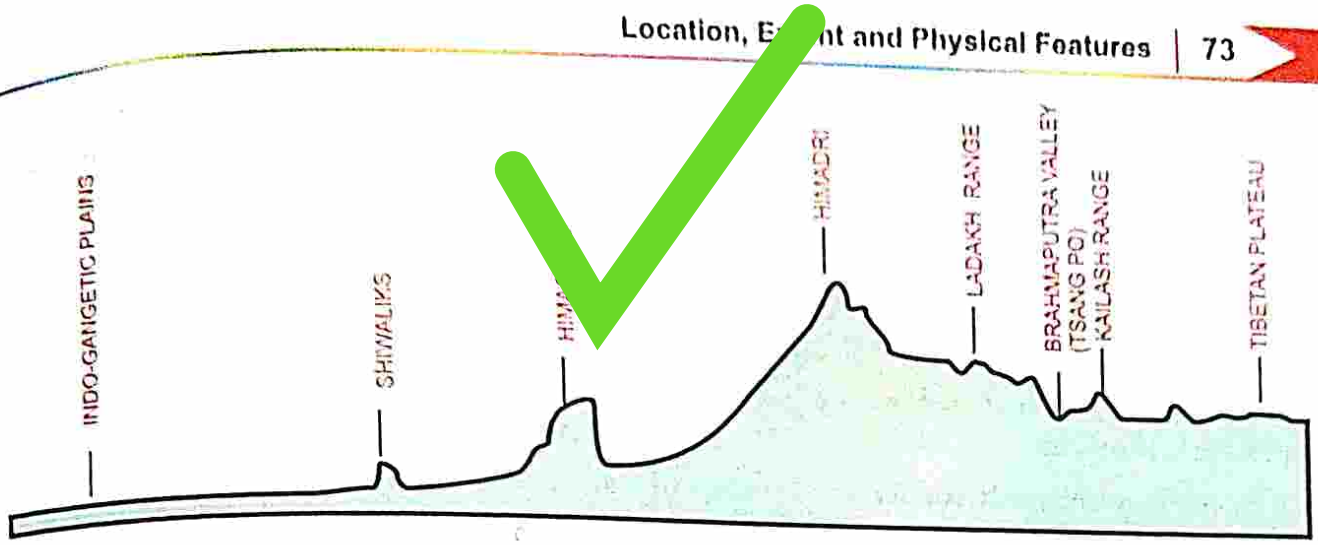
(iii) The Shiwalik Range

- It is also called the *Outer Himalayas*.
- It is not a continuous range.
- The slopes facing the subcontinent are steep, while those facing north are gentle.
- It is known by different names in different places — Jammu Hills in Jammu and Miri, Abor and Mishmi Hills in Arunachal Pradesh.
- The average elevation is about 1000 m above sea level.
- Some of the valleys which fall in this region include Udhampur in Jammu region and the Doon valleys.

OTHER FEATURES OF THE HIMALAYAS

- **Doons:** These 'doons' were originally temporary lakes formed due to the blockade of the river water coming down from above during the uplift of the Himalayas. As the rivers carved out their own courses, these lakes dried up. The boulders and debris filled the lakes and turned them into valleys. These flat valleys lie between the Himachal and the Shiwalik ranges. Dehra Dun, Patli and Kota are situated in such flat bottom valleys.
- **Bhabhar Areas:** These are porous, gravel-ridden plains at the foot of the Himalayas where the Himalayan streams descend on to the plains. These streams are seen only in the rainy season. In other seasons they get lost in the ground due to the high porosity of the surface.
- **Terai:** It is a strange terrain—an area consisting of marshy underground seepage. It is formed when water from the Bhabhar areas seep down in the soil and suddenly appear, when the flat plains begin. It, thus, creates a swampy area.

  The Terai region is ill-drained and heavily forested. Many wild animals—elephants, tigers, rhinoceros and deer are found in



Cross-Sectional Division of the Himalayas

these forests. Terai areas are more widespread in the eastern regions than in the west because the Eastern Himalayas get heavier rainfall than the Western Himalayas. The Terai areas have now been drained, cultivated and developed for growing sugarcane, wheat, tea, *etc.*

- **Khadar and Bhangar:** The new alluvium brought down by the rivers in low lying zones, which are liable to inundation during flooding and rainy season is known as *Khadar*. The older alluvium in riverbeds in the form of terraces found above the flood plain level is known as *Bhangar*. We shall study this in detail in a later chapter.

SIGNIFICANCE OF THE GREAT NORTHERN WALL

1. Climatic Barrier: The Himalayas act as an effective barrier by blocking the inflow of cold, dry air masses into north India during winter. They, thus, protect northern India from severe cold in winters. During the summer season, the Himalayas deflect the moisture-laden monsoon winds and cause the moist winds to bring rain to the North Indian plains and the Brahmaputra valley. In the absence of the Himalayas, the monsoon would have travelled further northwards.

2. Feeding Ground of Perennial Rivers: The glaciers in the Himalayas give rise to many perennial rivers. These include Ganga, Yamuna, Sharda, Ghagra, Kosi, Gandak and Brahmaputra. These rivers not only provide water for drinking but also for year-round irrigation in the North Indian plains.

3. Source of Hydel Power: The rivers originating in the Himalayas are a major source of hydel power. This is because the Himalayan topography makes the rivers to form rapids and waterfalls and provides ideal conditions for the creation of reservoirs. These reservoirs can be utilised for the generation of hydroelectricity by constructing dams across the rivers.

4. Physical Barrier: The Himalayas form a defensive rampart of India against invasion by land. They act as a barrier to the invaders, though small bodies of traders can travel in the Himalayas through difficult routes. The mountains in the north-east are so steep and so densely forest-covered that they are difficult to cross. The Himalayas have made communication with the neighbouring countries a difficult process. Thus, the Indian subcontinent developed a distinct culture of its own.

5. Tourist Potential: The Himalayan scenery is among the most spectacular in the world. It attracts thousands of tourists from India and abroad. Most of the summer resorts, known as hill stations are located in the Himalayas. These include Shimla, Mussoorie, Nainital, Darjeeling, Srinagar, Ranikhet, Almora, Chail, *etc.* A number of sacred shrines are also located in the Himalayas. The most popular of these are the shrines of Badrinath, Kedarnath, Amarnath, Vaishno Devi, Kailash-Mansarovar, *etc.* The Himalayas are a great attraction for adventure seekers as they provide ample opportunities for hiking, climbing, river-rafting, skiing, *etc.*

6. Forests: The Himalayas are rich in forest

Western Himalayas	Eastern Himalayas
1. They are located between the Indus and Kali rivers west of 86° E longitude.	1. They are located between the Tista and Brahmaputra rivers to the east of 88° E longitude.
2. They receive an average rainfall of 100cm.	2. They receive an average rainfall of more than 200cm.
3. They consist of three distinct ranges – the Himadri, Himachal and Shiwalik.	3. The last two ranges— Himachal and Shiwalik merge into one another.
4. They are covered with coniferous forests.	4. They are covered with thick evergreen forests.

resources. On the lower reaches of the Himalayas are found tropical and sub-tropical forests, yielding good quality timber. On the middle and upper reaches are found the coniferous and deciduous soft and hard woods, providing wood for match-sticks, paper pulp, resins, turpentine oil, various medicinal plants, *etc.* The Himalayas are home to a wide variety of wild animals like yaks, snow leopards, bears, red pandas, tigers, elephants, *etc.*

7. Minerals: The Himalayas have rich reserves of important minerals. Copper, lead, zinc, bismuth, antimony, nickel, cobalt and tungsten are found in the eastern and western Himalayas. Coal of good quality is found in the Kashmir valley. The Himalayas also have gold, silver, and precious stones like sapphires and beryl. The adverse geographical conditions prevailing in the mountains hinder easy extraction of such minerals.

8. Fertile Soil of the Northern Plains: The rivers that flow through the Northern Plains carry alluvium as they flow down the Himalayas. They deposit the alluvium in their flood plains making them fertile. These soils have made the fertile northern plains to be amongst the most intensely cultivated agricultural tracts.

THE PLAINS OF NORTHERN INDIA

The plains of Northern India include the lowlands of the three major rivers — the Indus, the Ganga and the Brahmaputra together with their tributaries. They occupy one-fifth of the area, but support half the population of South Asia. These plains are the core area of its political, economic and cultural activities.

The river Indus has its source in the Kailas Range, about 100 km north of Mansarova lake. It has five tributaries, namely, Jhelum Chenab, Ravi, Sutlej and Beas. The Gang rises in the Gangotri glacier in the Himalaya Cutting through the Shivalik range, it ente the plains at Haridwar (Uttarakhand). The mai tributaries of Ganga are Yamuna (which join Ganga on its right bank at Allahabad), Son Ramganga, Ghaghra, Gomti, Gandak, Kosi an Mahananda. The Brahmaputra river rises i Tibet near lake Mansarovar and flows eastwar as *Tsangpo*. In Assam, the river Brahmaputr is joined by numerous streams, namely, th *Dihang*, *Dibang* and *Lohit*. Its other tributarie are *Tista*, *Dhansun* and *Manas*.

The Indo-Gangetie plains extend for 3,20 kilometres between the mouths of the Gang and the Indus, along the mountains. The plain have a width of about 150 to 300 kilometres The longitudinal extent from the banks of th Ravi and the Sutlej to the Ganga delta alone i of 2,400 kilometres. The plain is 280 kilometres wide near Allahabad and 160 kilometres wide near the Rajmahal Hills. It is narrowest in Assam varying between 90 and 100 kilometres.

It is believed that the plains were once an area of the Tethys sea and were formed by the gradual filling of an initial marine depression by the sediments brought down by the Indus, the Ganga, the Brahmaputra and their tributaries. However, the infilling has not been homogenous

as there are differences in depth of the a... vi... between their basins. There are differen... in local relief over the entire plains from Sind to Assam. Thus, each segment of the plain has its own distinctive features.

Sub-Division of Plains

On the basis of regional characteristics, the Great Plains can be sub-divided into the following areas:

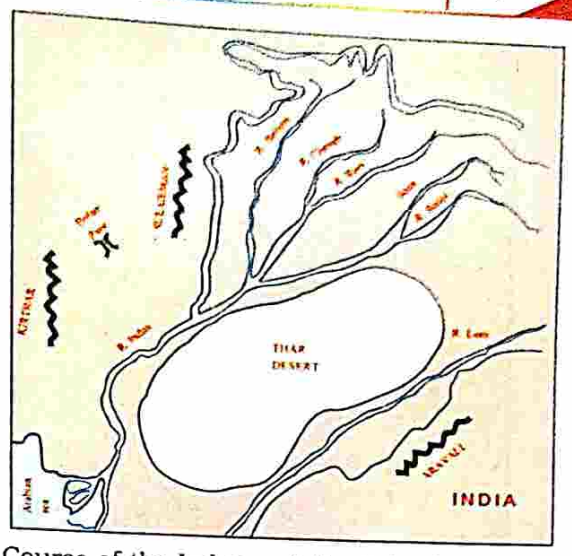
The Punjab Plains: In India, these plains lie in Punjab, Haryana and Himachal Pradesh. A significant feature of these plains is the *doabs* of the five tributaries of the Indus—Jhelum, Chenab, Ravi, Sutlej and Beas. In fact, Punjab derives its name from these, *i.e.*, the land of five rivers.

The watershed of the Aravali Hills separate these plains from the Ganga Basin.

The Rajasthan Plains: These include the *Marusthali* or the *Great Indian Desert*. It is a sandy desert and is surrounded by the Sutlej in the north-west, the Aravali range in the east, the Indus Valley in the west and the Rann of Kutch in the south. These plains extend over the north-west India (Rajasthan desert) and eastern Pakistan. They include the Rajasthan Bagar, which is a semi-arid plain in the eastern side of the desert. Cultivation is done in small patches in this area with the water provided by small streams which originate from the Aravali during the rainy season. These fertile tracts are known as *Rohi.*

The only significant river is Luni. The area north of Luni is a sandy plain. There exists an area of inland drainage on the north of the Luni basin. This is because the rivers of the area do not have sufficient water to reach the sea and dryup or disappear into the sand. These plains are dotted with a number of salt lakes on the eastern edge of the desert, such as the Sambhar, Kuchaman and Didwana. The Sambhar lake is the largest lake which lies on the outskirts of Jaipur.

The Ganga Plains: These plains extend from the Yamuna river in the west to the western borders

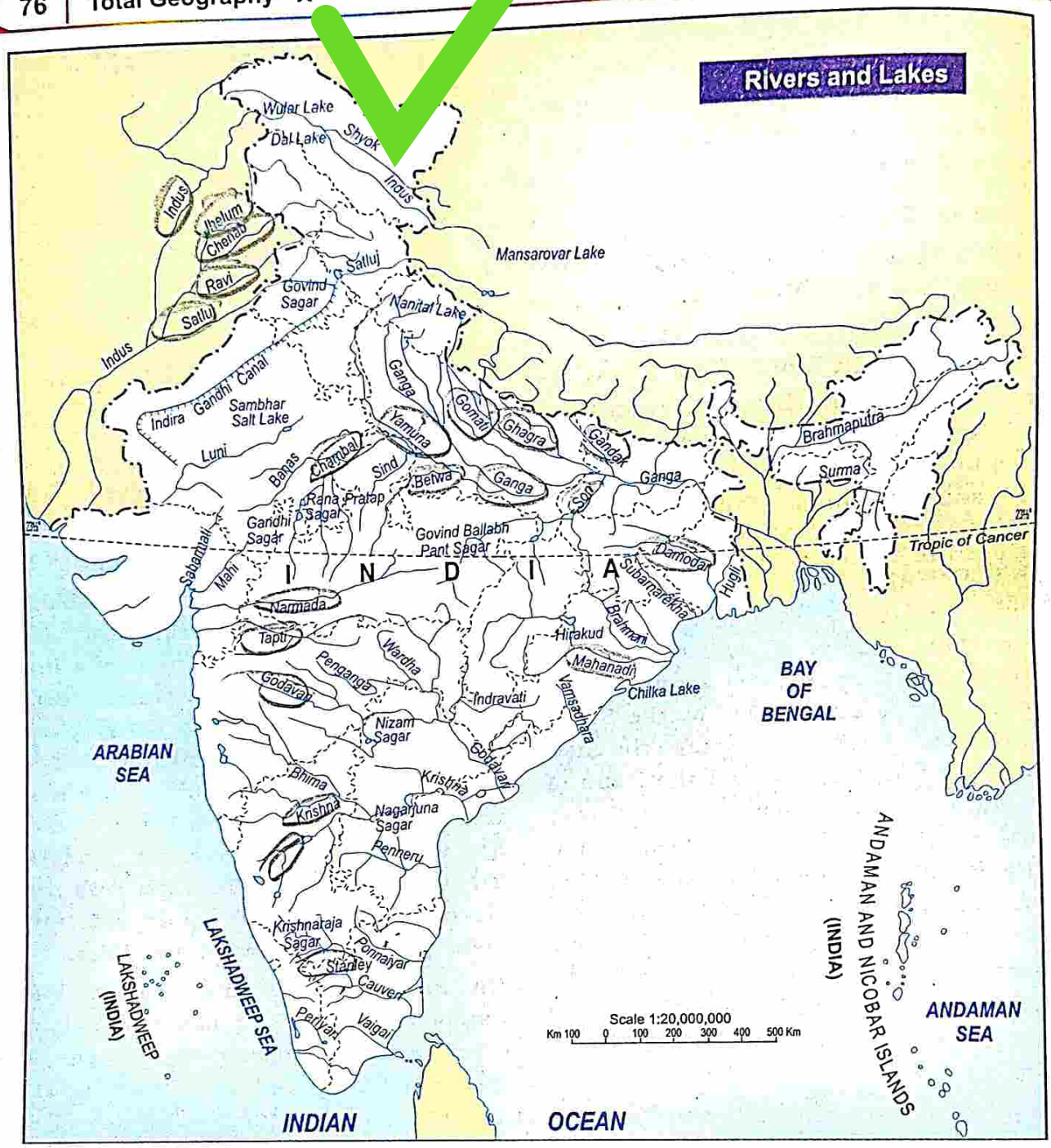


Course of the Indus and the Rajasthan Plains

of Bangladesh, covering a distance of about 1,400 km in the States of Uttarakhand, Uttar Pradesh, Bihar, Haryana, Delhi, partly Jharkhand and West Bengal. They consist of a number of regions, *i.e.*, the Ganga-Yamuna doab, Awadh Plains and Mithila Plains. These plains have been formed by the sediments brought down by the rivers Ganga, Yamuna, Ghagra and their tributaries. Both the *bhabar* and *tarai* belts are well formed in the Uttar Pradesh plain. The Ganga Plain of UP merges with the deltaic plain in West Bengal through a transitional zone lying in Jharkhand and Bihar.

The Brahmaputra Plains: These low-level plains extend in Assam for about 640 kilometres. They have been formed by deposits from the Brahmaputra river and its tributaries and are bordered by high mountains. The small, meandering streams of the north form marshy areas. In some places on the plain, many steeply-rising hillocks are found. Besides, there are a number of riverine islands including *Majuli*, which is the largest river island in the world.

The Brahmaputra Basin is sometimes said to be the continuation of the northern plains towards the east. It is clearly demarcated by the Eastern Himalayas of Arunachal Pradesh in the north, the Garo-Khasi-Jaintia and Mikir Hills in the south, Patkai and Naga Hills in the east and the lower Ganga Plain in the west.



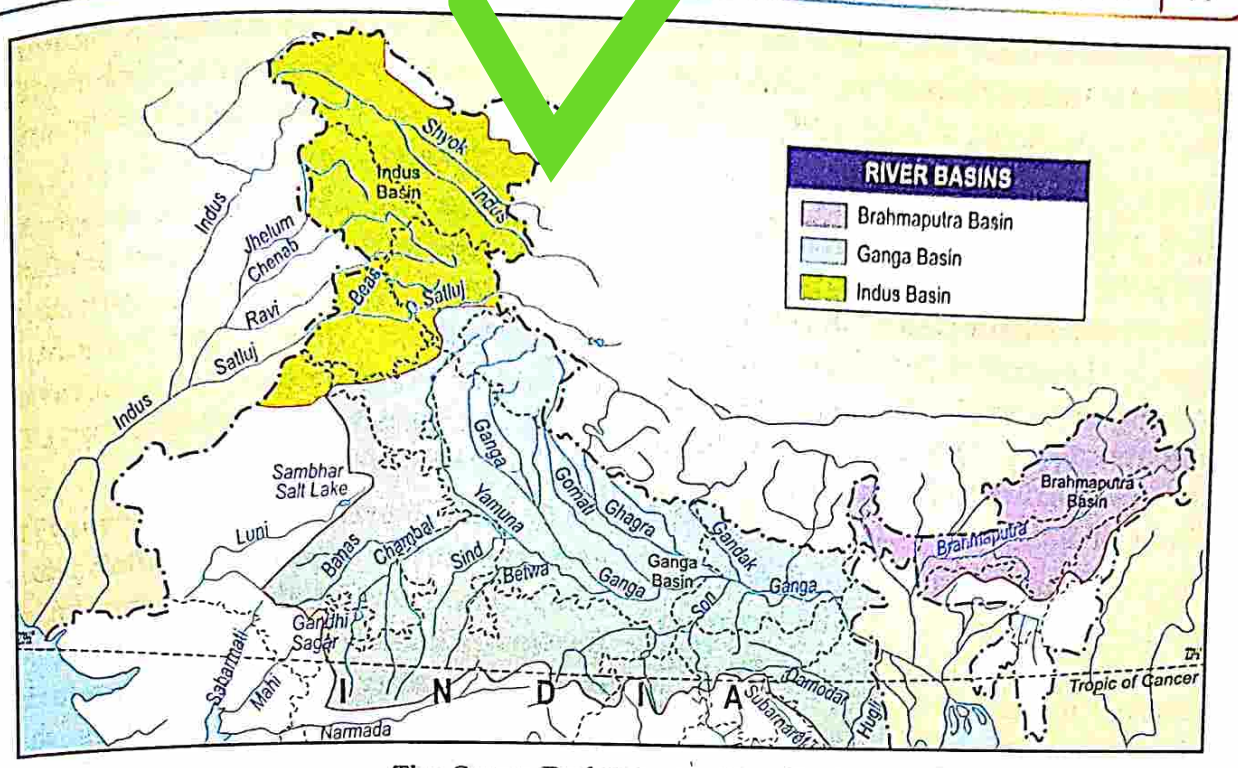
Rivers of the Indian Subcontinent

SIGNIFICANCE OF THE NORTHERN PLAINS

The Northern plains are among the most level and extensive plains in the world. They are of immense significance due to the following reasons:

(i) Favourable for Human Settlement: The northern plains are the most favourable for human settlement as they are endowed with fertile soil, numerous rivers and favourable climate. That is why these plains support one of the most densely populated regions of the world. This plain has a population greater than that of the whole of the USA, which has about ten times more area than the northern plains.

(ii) Rich Agricultural Land: The fertile soils, perennial water resources and favourable climate have made the northern plains rich agricultural land. Many multi-purpose dams have been constructed across some of the rivers to provide water for irrigation and to generate electricity. In fact, the use of irrigation and



The Ganga-Brahmaputra River Basin

modern facilities has made Punjab, Haryana and western UP the granaries of India.

(iii) Socio-Religious Significance: The Northern plains have been socially and religiously quite significant due to their vast literature, art and architecture and sacred rivers. The Ganga has been the sacred river par excellence. Many religious and historical cities such as Haridwar, Ayodhya, Varanasi, Allahabad, Mathura and Patna are situated along the rivers of the northern plains. The religions of Buddha (Buddhism) and Mahavira (Jainism) flourished in these plains.

(iv) Transport and Communication Facilities: These plains are almost level and their even surface allows for construction of roadways and railways. The rivers in the plains are navigable which allow easy transportation and thus, promote trade and commerce. The flatness of the land also allows easy access for communication facilities.

THE PENINSULAR PLATEAU

The Peninsular Plateau is the largest and the oldest of all the physiographic divisions. Its north-west limit is marked by the Aravali range and its northern extreme has the raised Bundelkhand Plateau. At its western and eastern ends are the Western Ghats and Eastern Ghats respectively. The plateau is largely a stable terrain though volcanic eruptions have occurred in some areas of north-west Deccan.

The plateau land can be divided as follows:

1. The Central Plateaus: The upland of Central India with the Ganga to its north has the Kaimur-Maikal range to its east, the Aravalis and Kutch to its west, and the Vindhya and Satpura ranges to its south. The Central Plateaus comprise:

(a) *The Mewar upland* composed of shales, limestones and sandstones.

(b) *The Bundelkhand upland* stretching between the river Yamuna and the Vindhyas. The Northern Plains join this upland.

(c) *The Malwa plateau* in Madhya Pradesh is formed by lava flows. It lies to the north of the Vindhya range. The plateau is flat-topped and has hills covered by forests. The plateau is broken by ravines mainly in the Chambal, Yamuna and Banas valleys.

2. The Eastern Plateaus: These lie to the north-east of the Malwa Plateau. They comprise

(a) *The Baghelkhand Plateau* through which flow the Rihand and Son rivers. It is marked by synclinal valleys and anticlinal hills.

(b) The Chota Nagpur Plateau in Jharkhand lies to the east of Bundhelkhand. Its main rivers are the Damodar and the Subarnarekha. This region is rich in mineral resources and is known as the 'Ruhr of India'.

(c) To the south of the Bundhelkhand is the Bastar or *Dandakaranya upland* – which becomes rugged and forested in its south.

(d) Beyond the Chota Nagpur Plateau is the Meghalaya plateau.

3. The Kathiawar and Kutch: These peninsulas are joined to the peninsular plateaus by Gujarat Plains. Deccan lavas make up the Kathiawar region.

4. The Deccan Plateau: The Deccan Pleateau is triangular in shape and is India's largest plateau. It occupies land between the Western and the Eastern Ghats and the south of the Mahadeo, Maikal and Satpura ranges.

The Deccan Plateau has the following features:

(a) The northern part of the Deccan Plateau has the Maharashtra Plateau composed of lava sheets and displaying flat and steep hills, ridges and shallow broad valleys.

(b) *The Telangana Plateau* has hilly and forest-covered northern parts and a plain land with small hills and minor depressions in its southern portion.

(c) *The Karnataka Plateau* forming the middle parts of the Deccan Plateau rises to the south-west and joins the Nilgiri Hills. Its northern area has the Krishna river flowing through its east. The southern area of the Karnataka Plateau is high with an average elevation of 600 to 900 m. It has the Kaveri river running through its south-east.

(d) The Deccan Plateau displays a sudden narrowing of land below the Karnataka Plateau. Here, it comprises uplands made by the hills of Palni, Nilgiri, Cardamom and Annamalai. It is bordered on its sides by the Tamil Nadu and Kerala plains.

5. The Northeastern Plateau: It is an extension of the main Peninsular plateau and comprises the Meghalaya plateau consisting of the *Garo*, *Khasi* and *Jaintia* hills. These hills have been named after the tribal groups which inhabit this region. This region receives maximum rainfall from the south-west monsoon. The Meghalaya plateau is rich in mineral resources like coal, iron ore, limestone and uranium.

The Peninsular Mountains

The mountains of Peninsular India can be classified as follows:

1. The Western Ghats (The Sahyadris) About 1600 km long and with an average elevation of 900 to 1100 m, they run along the west coast from the south of the Tapti river valley to Kanyakumari.

Important peaks include the Salher peak (1,567 m) and Kalsubai peak (1,646 m) and Doda Betta (2,637 m) in Nilgiris, and the Anai Mudi (2,695 m) in the Annamalai Hills. The Deccan Trap constitutes the northern portion of the Ghats, which, around Mumbai, expose flat-topped ridges. Near Mysore, the Ghats recede from the coast. The meeting point of the Western and Eastern Ghats in the Nilgiri Hills has the highest point at Doda Betta peak.

A break in the Western Ghats is in the form of the Palaghat gap, south of the Nilgiris. Steep hills constitute the Western Ghats south of the Palaghat gap. These hills are (i) the Annamalai the top of which is a forested plateau; (ii) the Palni; and (iii) the Cardamom.

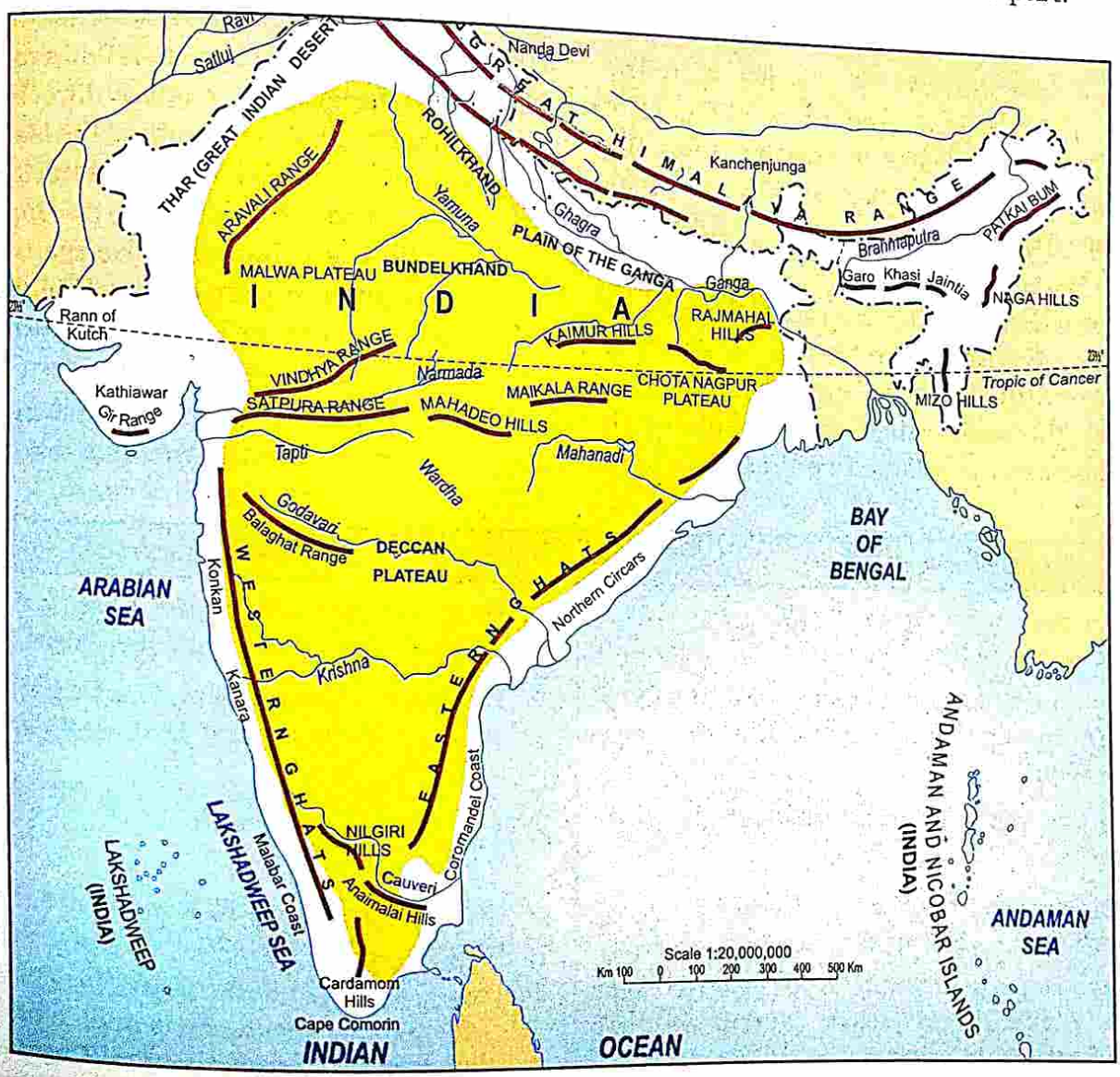
The main rivers of the Western Ghats such as the Godavari, Cauvery and Krishna flow eastwards and fall into the Bay of Bengal.

2. The Eastern Ghats: These irregular hill ranges stretch from northern Odisha to the Nilgiris across coastal Andhra. The highest peak is Mahendragiri in Andhra Pradesh. The ranges are uniform in their northern portion up to Krishna river valley, but are characterised by individual ranges as one goes farther west.

3. The Vindhya Range: Running from Sasaram (Bihar) in the east to Jobat (Gujarat) in the west, the fairly continuous range separates northern India from the southern mainland. Mostly composed of sandstones, quartzites and shales, it is lava-ridden in the west.

4. The Satpura Range: The range extends from the Narmada Valley in the north to the Tapti Valley in the south. In the west it comprises the Rajpipla Hills of Gujarat in the west, and the Pachmarhi, Ranchi Upland, Hazaribagh Hills and the Maikala range in the east. Its northern and southern borders are composed of sandstone. Its eastern section is called the Maikala Plateau.

5. The Aravalis: The 800-km-long range stretching from the north-east to the south-west of India separates the semi-desert regions of Rajasthan from the fertile Udaipur and Jaipur regions. It constitutes one of the oldest fold mountain ranges of the world. The Gurushikhar peak (1,722 m) of the Abu Hills is the highest point of the range. The Delhi Ridge is included as the Aravali's northernmost part.



The Plateau of Peninsular India

DRAINAGE SYSTEMS IN THE PENINSULAR INDIA

There are three directions of drainage in the Indian Plateau.

(i) *Towards the Bay of Bengal*: The rivers Mahanadi, Godavari, Krishna, Cauvery flow southeast into the Bay of Bengal.

(ii) *Towards the Ganga*: The rivers originating from the northern or Vindhyan edge of the plateau fall into the Ganga. These rivers are Chambal, Betwa and Son.

(iii) *Towards the Arabian Sea*: The major river systems which drain into the Arabian Sea are Sabarmati, Narmada, Tapti and rivers of the west coast farther south.

The Major Peninsular Rivers

A. The East Flowing Rivers: These are the rivers that flow east to end up in the Bay of Bengal. They are greater in number than the west-flowing rivers, have wide catchment areas and form large deltas.

(i) The Mahanadi means a big river. It originates in the northern foothills of Dandakaranya in Raipur district of Chhattisgarh. Its upper course lies in the basin called the 'Chhattisgarh Plains'. It is a large river in Odisha and forms many distributaries at Cuttack before entering the sea. Drains a large area mostly in Chhattisgarh and Odisha.

(ii) The Godavari is the largest of the Peninsular rivers and the second largest river in India. It is also known as the 'Vridha Ganga' or 'Dakshin Ganga' because of its extent. It rises from Trimbak in Nasik district in the Western Ghats and on its way receives several important tributaries. It forms a fertile delta before flowing into the sea. The river is shared by Maharashtra, Chhattisgarh, Karnataka, Odisha and Telangana.

(iii) The Krishna is the second largest east flowing river of the peninsula. It has its origin in the Western Ghats just to the north of Mahabaleshwar about 64 km from the Arabian Sea. It flows to the Bay of Bengal in an easterly direction. The Koyna, the Ghataprabha, the Malprabha, the Bhima, the Tungabhadra, the Musi and the Muneru are its important tributaries. Telangana is separated from Andhra Pradesh by the Krishna river, which acts as a geographical divide between the two States.

(iv) The Cauvery (Kaveri) is known as "the Ganga of the South". It rises from the

Western Ghats	Eastern Ghats
1. They rise steeply from the West coast. They originate from the River Tapti to Kanyakumari.	1. They rise gently from the East coast. They originate from Odisha to the Nilgiri Hills.
2. They are higher, with average height 900 to 1,100 m and the highest peak is *Anai Mudi* (2,695m).	2. The hills are lower with average height of about 600 m and the highest peak is *Mahendragiri* (1,500 m).
3. The hills are continuous. The average width is 50 to 80 km.	3. The hills are discontinuous. The average width varies from 100 to 200 km.
4. They are the source of all the important rivers of the Deccan Plateau.	4. No river rises here. In fact rivers cut valleys here.
5. They are perpendicular to the S-W Monsoon winds and cause heavy rainfall on their windward side.	5. They are parallel to the Bay of Bengal Branch of the S-W Monsoon winds and do not cause rainfall in the monsoon season. They, however cause Winter Rainfall on their windward side.

Brahmagiri range of the Western Ghats. It flows for 800 km to join the Bay of Bengal near Kaveripatnam. Its ...ina... area is shared by Karnataka and ...l Nadu. Its upper catchment area rec...ves rainfall during monsoons from the south-west monsoon and the lower catchment area during winter season from the retreating north-east monsoon. It is, therefore, almost a perennial river. It is very useful for irrigation and hydroelectric power production.

B. The West Flowing Rivers: The west flowing rivers of the Peninsular India are smaller and fewer in number. These Peninsular Rivers fall into the Arabian Sea. They do not form deltas but form only estuaries. This is because the west flowing rivers, especially the Narmada and the Tapi flow through hard rocks and are not able to form distributaries before they enter the Arabian Sea.

(i) *The Narmada* rises near Amarkantak in Madhya Pradesh. It flows west-southwards for a distance of 1300 kilometres to finally empty itself in the Arabian Sea. Its drainage basin is confined mostly to Madhya Pradesh. Only one-tenth of the basin area lies in Gujarat. It forms the narrow gorge of Marble Rocks near Jabalpur in Madhya Pradesh and also the famous Kapildhara falls. Another feature of the Narmada basin is that there are hardly any developed tributary streams.

(ii) *The Tapti (Tapi)* rises in the Satpura range in Madhya Pradesh. It flows westwards in a basin more or less parallel to the Narmada. Its basin area lies in Madhya Pradesh, Maharashtra and Gujarat.

(iii) *The Luni* originates from the Aravalis, south-west of Ajmer. Its 450 km course is directed through a semi-arid tract somewhat parallel to the west of the Aravalis. Its tributary Sarsuti, rises from the Pushkar lake at Ajmer.

(iv) *The Sabarmati:* It rises in the Aravali hills and enters the sea at the head of the Gulf of Cambay. Its basin extends lies in Rajasthan and Gujarat. Its major tributaries are the Sabar and the Hathmati.

(v) *The Mahi:* It rises in the east of Udaipur and flows through Dhar, Ratlam and Gujarat and finally into the Gulf of Cambay. The river drains an area lying in Madhya Pradesh, Gujarat and Rajasthan.

Besides the above rivers, the Peninsular plateau has a large number of coastal streams draining the narrow coastal plains. There are as many as 600 tiny streams which drain the western face of the Western Ghats alone. The plains of these streams are narrow and their beds have a generally steep gradient.

SIGNIFICANCE OF THE PENINSULAR PLATEAU

The Peninsular Plateau of India is the oldest landmass of the Indian subcontinent and is said to be a part of the ancient Gondwanaland. The region has been immensely contributing to the

Rivers of Northern India	Rivers of Peninsular India
1. They are perennial as they are snow-fed.	1. They are seasonal as they are rain-fed.
2. These rivers are longer.	2. These rivers are comparatively shorter.
3. They are at their youthful stage and are eroding, transporting and depositing agents.	3. They are in their old stage and are only depositing agents.
4. They have more silt as they erode sedimentary rocks.	4. They have less silt as they erode igneous rocks.
5. These rivers have more tributaries.	5. These rivers have fewer tributaries.

prosperity of the country due to its richness in minerals, fauna, forests, *etc.*

(i) Peninsular India is a deposit of minerals. Jharkhand, Odisha, Madhya Pradesh, Chhattisgarh and southeast Rajasthan—all lying in Peninsular India—are associated with a variety of minerals, such as iron, bauxite, mica, manganese, copper, chromium and coal. Karnataka and Andhra Pradesh have considerable reserves of iron, gold, chromium and porcelain clay. The Telangana region has coal, mica, graphite and corundum.

(ii) The north-western plateau of the Peninsular India is covered with basaltic lava which is rich in iron. Soil formed of basaltic lava, *i.e.* black soil is conducive for the cultivation of cotton. This soil also facilitates the production of tea, rubber, coffee and millets. Tobacco, groundnuts and oilseeds are abundantly grown in the peninsular region.

(iii) The highlands of the plateau are covered with different types of forests. Deciduous and evergreen forests are the characteristics of Peninsular India. Ebony, mahagony, cane, bamboo, eucalyaptus, sal, sisum and sandalwood are prominent commercial timbers of the region, while tall grasses, shrubs and herbs provide fodder.

(iv) The Peninsular rivers are marked by a number of waterfalls which are being harnessed for the production of hydroelectricity. Besides these waterfalls, the rivers of South India can be tapped for power generation because they have less silt as they erode igneous rocks. These peninsular rivers have also been impounded for irrigation and hydroelectric power.

(v) The Western Ghats are among the finest faunal tracts of India. These include the Nilgiri Ibex, the black monkeys and the lion-tailed macaque in the southern reaches (Kerala and Tamil Nadu) of the Western Ghats. Forests in the peninsular region are also home to wild elephants, sambhar, chital, leopards and tigers.

THE COASTAL PLAINS

The Deccan Plateau has a coastal strip in the east and in the west, which are known as coastal plains. They run along the coastline of the peninsula from the Rann of Kutch in the west to the Ganga-Brahmaputra delta in the east. The Western Coastal plains lie on the coastal strip along the Arabian Sea and west of the Western Ghats while the Eastern Coastal plains lie between the Bay of Bengal and the Eastern Ghats. The two plains meet at the tip of the peninsula, *i.e.*, at Cape Comorin.

Western Coastal Plains

Western Coastal Plains include the following:

- ***Gujarat Plains:*** They are located in the southern side of the Thar Desert.
- ***The Kutch Peninsula:*** The westernmost section of the Western Coastal Plains is called the Rann of Kutch. This area is open to marine inundation and is composed of dark silt. Due to the deposition of silt, salt marshes are formed during the dry season.
- ***The Kathiawar Peninsula:*** This peninsula is located in the south of the Kutch peninsula. It is a sandy plain with some hills like the Mt. Girnar. Its southern part has mostly alluvium brought down by the rivers from the Western Ghats.
- ***The Konkan Coast:*** The coastal plains from Daman to Goa are called the Konkan Coast. This 500 km stretch is generally flat and is composed of basaltic trap rocks.
- ***The Kanara Coast:*** It runs from Goa to Cannanore. In this stretch, significant estuaries are formed near Goa.
- ***The Malabar Coast:*** It is the southernmost stretch of the western coastal plains. It runs from Cannanore to Cape Comorin. It is known as the *Malabar coast*. Its characteristic features are the lagoons

or backwaters called *kayals*, such as the Ashtamudi and Vembanad lakes.

Eastern Coastal Plains

The coastal areas along the Bay of Bengal are broad and more level. The area is rocky, except for the delta region and is highly dissected by small but fast flowing rivers. Several depositional features such as spits, lagoons and offshore bars are found along the coast. The prominent deltas are those of the Mahanadi, Godavari, Krishna and Kaveri. These deltas are not suitable for harbours as their mouths are full of silt. There are several lakes on the East Coast. These include the Chilka lake in Odisha, and Kolleru and Pulicat in Andhra Pradesh.

From the mouth of the Ganga to Nellore the plains are called *Northern Circars*. These plains lie between the Mahanadi and the Krishna rivers. The southern part of the Eastern Coastal Plains from Nellore to Kanyakumari are called *Coromandel Coast* in Andhra Pradesh and Tamil Nadu.

SIGNIFICANCE OF THE COASTAL PLAINS

- They are the sources of precious minerals. Gujarat is famous for producing salt. The sands of Kerala coast have a large quantity of Monazite which is used for nuclear power. The sedimentary rocks of these plains are said to contain large deposits of mineral oil.
- The ports along the coasts account for 98 per cent of the international trade.
- Fisheries are set up in these areas.

ISLANDS

Besides the mainland, India has two groups of islands, *i.e.*, the Andaman and Nicobar Islands in the Bay of Bengal and the Lakshadweep Islands in the Arabian Sea.

ANDAMAN AND NICOBAR ISLANDS

The Andaman and Nicobar Islands are a group of more than 300 islands out of which 265 are uninhabited. The two groups of islands are separated by the Ten degree channel. The Andaman Islands lie in the Bay of Bengal 1,255km from Kolkata and 1,190 km from Chennai. The islands are 193 km from Cape Negrais in Myanmar. Five large islands grouped together are called the Great Andamans and to the south is the island of Little Andaman. There are some 204 islets. Andaman and Nicobar Islands are formed by the elevated parts of submarine ridges that are extended southward from the Arakan Yoma Mountains of Myanmar. These Islands are highly dissected and rise to 730 metre in height. There are 550 islands, most of which are too small to be inhabited.

The Nicobar Islands are situated to the south of the Andamans, 121 km from Little Andaman. There are 19 islands, 7 uninhabited. The chief islands are Great Nicobar and Car Nicobar.

These islands are of volcanic origin. The only active volcano of India is found on the Barren Island. Narcondam is another volcanic island in this group. They are surrounded by coral reefs and have narrow coastal plains.

Western Coastal Plains	Eastern Coastal Plains
1. They are a product of submergence of land.	1. They are a product of emergence due to deposits.
2. They are located between the Arabian Sea and the Western Ghats.	2. They are located between the Bay of Bengal and the Eastern Ghats.
3. They are drained by several short and swift streams which do not form deltas.	3. They are drained by a number of large rivers which form deltas.
4. They are indented with many natural ports.	4. They have a linear coastline.
5. They are narrow with an average width of 64 km.	5. They are broader with an average width of 80 to 100 km.
6. They do not exhibit many depositional features.	6. Many depositional features are found near the coast.

THE LAKSHADWEEP ISLAND

Lakshadweep consists of a group of 36 islands, of which only 11 are inhabited and located about 280 to 480 kms off Kerala coast. It was constituted as a Union Territory in 1956 as the Laccadive, Minicoy and Amindivi Islands, and renamed in November 1973 as Lakshadweep. The northern portion is called the Amindivi. The remaining islands are called the Laccadive (including Minicoy Islands).

EXERCISES

I. Answer the following questions:

Q.1 (a) Give two differences between the Eastern Coastal Plains and the Western Coastal Plains.

(b) What kind of mountains are the Himalayas? By what name are the offshoots of the Eastern Himalayas known?

(c) State how the Northern Plains were formed.

(d) Give a geographical reason for each of the following:

(i) The rivers of south India are less suitable for irrigation than the rivers of north India.

(ii) The Peninsular Plateau of India is considered to be a part of Gondwanaland hundreds of millions of years ago.

(iii) The Narmada and Tapi do not form deltas.

Q.2 (a) Give two differences between the Plains of North India and the Coastal Plains.

(b) Name two rivers of the Peninsular Plateau that flow towards the Arabian Sea. Name two rivers that flow into the Bay of Bengal.

(c) (i) Name the four parts of the Peninsular Plateau of India.

(ii) Name the landforms that form the boundaries of the Peninsular Plateau.

(d) Give a geographical reason for each of the following:

(i) Less land is available for agriculture on the West Coast than on the East Coast.

(ii) Access through the Western Ghats is difficult.

(iii) The Peninsular Plateau of India is rich in mineral resources.

Q.3 (a) Give two differences between Eastern Ghats and Western Ghats.

(b) Name the source of the river Ganga. Where does this river enter the plains?

(c) (i) Name any two left bank tributaries of the Ganga.

(ii) Is Ganga a perennial river? Give reason.

(d) Give a geographical reason for each of the following:

(i) The Northern Plains of India are one of the most densely populated regions of the world.

(ii) The Deccan Plateau is an example of a dissected plateau.

(iii) The rivers of South India are easier to tap for power than the rivers of north India.

Q.4 (a) Give two differences between rivers of Northern India and the rivers of Southern (Peninsular) India.

(b) Name the only significant river of the Rajasthan Plains. Name the largest river island in the world.

(c) (i) How is cultivation carried out in the Rajasthan Plains?

(ii) Name the fertile tracts of these plains.

(d) Give a geographical reason for each of the following:

(i) Most of the rivers in South India flow into the Bay of Bengal.

(ii) The Rann of Kutch is not cultivated.

(iii) The Rajasthan Plains are an area of inland drainage.

II. Map Work

On an outline map of India shade and mark the following:

Mountains and Plateaus: Himalayas, Karakoram Range, Aravali Range, Vindhyas, Western and Eastern Ghats, Deccan Plateau, Satpura Range, Garo, Khasi, Jaintia Hills, Chota Nagpur Plateau and Malwa Plateau.

Plains: Gangetic Plains, Coastal Plains.

Rivers: Indus, Ravi, Beas, Chenab, Jhelum, Sutlej, Ganga, Yamuna, Ghaghra, Gomti, Gandak, Kosi, Chambal, Betwa, Son, Damodar, Brahmaputra, Tapti, Mahanadi, Narmada, Godavari, Krishna, Kaveri and Tunghbhadra.

Cities: Delhi, Mumbai, Kolkata, Chennai, Hyderabad, Bengaluru, Kochi, Chandigarh, Srinagar, Vishakhapatnam, Allahabad.

Chapter 8 Climate

Syllabus

Climate

Distribution of Temperature, Rainfall, winds in Summer and Winter and factors affecting the climate of the area. Monsoon and its mechanism.

Seasons: March to May — Summer; June to September — Monsoon; October to November — Retreating Monsoon. December to February — Winter.

India has a *tropical monsoon* type of climate. This is because India lies in the tropical belt and its climate is influenced by the monsoon winds which are largely confined to the Tropics, *i.e.*, between 20°N and 20°S. The main characteristics of this type of climate are relatively high temperatures and dry winters. However, the Himalayas in the north and the Indian Ocean in the south provide distinctive climatic conditions to India. The Himalayan ranges protect northern India from the cold winds of Central Asia and Siberia and give it a continental climate, the characteristics of which are the prevalence of land winds, dryness of air and large diurnal range of temperature. The Indian Ocean in the south gives it a hot monsoon climate more typical of the tropical than of the temperate zone.

REGIONAL VARIATIONS

Despite the broad unity of the monsoon type of climate, variations in climate occur in different regions of the country. For example, the climatic conditions of Bihar and Uttar Pradesh in the north differ from that of Kerala and Tamil Nadu in the south; yet all of these States have a similar monsoon type of climate. These variations are expressed in the pattern of winds, temperature and rainfall, rhythm of seasons and the degree of wetness or dryness. These regional diversities are known as the sub-types of monsoon climate.

TEMPERATURE

Seasonal variations in temperature occur from place to place and from region to region. Variations in temperature are found also at a single place and in a single day. Examples of these variations are:

1. Barmer in Rajasthan may record a temperature of 48°C or 50°C on a June day, while it hardly reaches 22°C at Pahalgam or Gulmarg in Kashmir on the same day. However, in Dras near Kargil, the temperatures may go down to –40°C during winter.
2. Kerala has tropical climate with warm and moist air, whereas Punjab has continental climate with severe heat alternating with severe cold.
3. The temperature touches – 40°C in Kargil in the month of December whereas Kerala records 20°C or 22°C in the same month.
4. The annual range of temperature is 3°C along the Malabar Coast and more than 20°C in the interiors.
5. The difference between day and night temperatures in the Andaman Islands and Kerala is hardly seven or eight degree celsius, whereas in the Thar desert it is between 25 to 30°C.

PRECIPITATION

Variations occur not only in the type of precipitation but also in its amount and the seasonal distribution. Snowfall occurs in the Himalayas, whereas it only rains over the rest of the country.

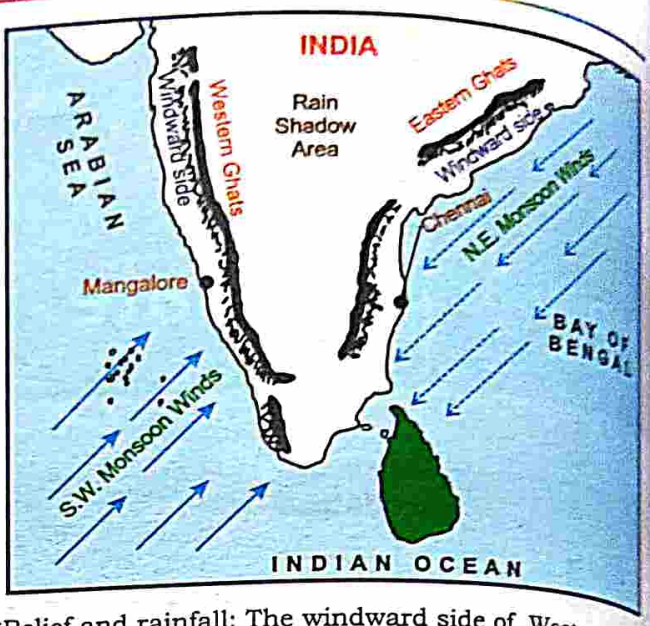
1. Cherrapunji and Mawsynram in Meghalaya get about 1100 cm rains in the year, whereas Jaisalmer in Rajasthan hardly receives 9 cm of rainfall in a year.
2. Tura in Meghalaya gets an amount of rainfall in a single day which is equal to 10 years of rainfall at Jaisalmer in Rajasthan.
3. The Coromandel Coast remains dry in the months of July and August, whereas the Ganga delta and the coastal plains of Odisha are hit by strong storms almost every third or fifth day during these months.
4. Most parts of India receive rainfall during June-September, but the coastal areas of Tamil Nadu get rains in the beginning of the winter season.

FACTORS AFFECTING THE CLIMATE OF INDIA

Climate refers to a generalised and composite picture of the average weather conditions spread over a long period, for a given large area. The factors which influence the climate of India are the following:

1. The Himalayas: The Himalayas form a climatic barrier separating the Indian sub-continent from the rest of Asia. They not only prevent the cold Siberian winds from entering the Indian region and from India becoming a cold desert but they also force the moisture laden South West Monsoon winds to shed rainfall in India or else India would be a dry region.

2. The Monsoon Winds: The monsoon winds have almost a universal effect in bringing summer rains over the whole of South Asia. During summers, winds move quickly into peninsular India towards the low-pressure system of northwest India from the Arabian Sea and Bay of Bengal. The moisture carried by these south-westerly winds from the Arabian Sea and Bay of Bengal bring rain to the entire subcontinent, leaving Tibet dry in the 'rainshadow' of the Himalayas. The south-west monsoon start retreating by the end of September from Punjab and Uttar Pradesh, by October from Central India and by the end of November from South India. Retreating monsoon brings rain in eastern coastal region. During winter, dry offshore, North-East Monsoon winds blow from high pressure to low pressure region which is centred at the head of Bay of Bengal. These winds originate in Mongolia and northwest China. As they blow over a vast landmass, they are cold and dry. These cold dry winds join the Trade Winds to pass over the Bay of Bengal. They pick moisture from the Bay of Bengal to bring rain to Tamil Nadu in winters.



*Relief and rainfall: The windward side of Western Ghats receive rainfall from the S-W Monsoon and the windward side of Eastern Ghats receive rainfall from N–E Monsoon.

3. Latitude: The Indian subcontinent is divided into two parts by the Tropic of Cancer. The northern portion lies in the temperate zone and the southern portion lies in the tropical zone. The warm temperate or sub-tropical climate of the northern zone gives it cold winter season and hot summer season. The southern tropical climatic zone of India is warmer than the north and does not have a clear-cut winter season. Similarly, the northern zone does not have the

*Sketch (not to scale) to aid in understanding concepts.

mid-day Sun almost vertically overhead during any part of the year, while the southern zone has the mid-day Sun almost vertically overhead at least twice every year.

4. Varied Relief: Relief plays an important role in the climatic conditions of India. The Western Ghats get heavy rainfall on western side because they stand in the way of South West Monsoon winds which come from the Arabian Sea. On the other hand, the Deccan Plateau gets less rainfall as it lies in the rain shadow area of the Western Ghats. In Rajasthan, the Aravali Range is parallel to the direction of the South West Monsoon winds. So it is unable to stop the moisture laden winds. This makes Rajasthan a dry area. The southern hills of Assam get heavy rainfall but the northern ones do not. This is because the southern hills force the moisture laden winds to shed their moisture before they proceed northwards.

5. Altitude: There is a decrease of 1°C for every 166 m rise in height, because temperature decreases as you move to higher altitudes. So, the mountains are cooler than the plains. For example, Ooty has much lower temperature, than Kochi, because of the altitude.

6. Influence of the Surrounding Seas: India is flanked by three water bodies, namely, the Indian Ocean, the Bay of Bengal and the Arabian Sea which have a profound impact on the climate, especially in areas lying close to the sea. These water bodies act as the major source of moisture to the summer monsoons and bring heavy rainfall to the whole area. In fact, it is because of the nearness to the sea that these areas have a moderate climate.

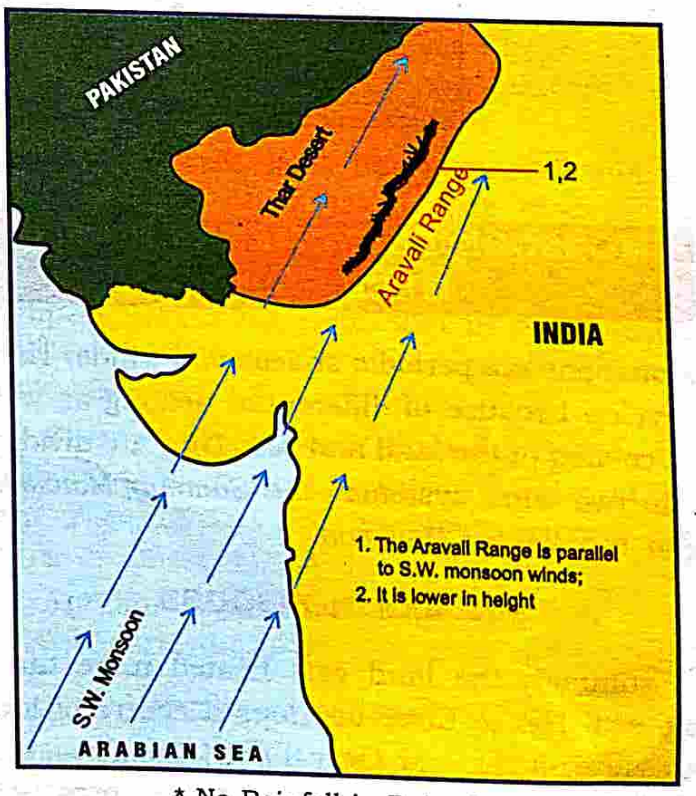
7. Western Disturbances: The weather conditions during winter are generally influenced by the distribution pattern of pressure in Central and West Asia. In the winter season due to the shifting of the pressure belts, the westerlies blow from 20° N to 50° N Latitude and the Northern India comes under the influence of the winds and cyclones rising from the Mediterranean Sea. These cyclones bring rain to Northern Plains and snow in Jammu and Kashmir in India.

8. Jet Streams: Jet streams are cold fast blowing winds that develop in the upper layers of the atmosphere. They influence the climate of India. The westerly jet stream prevails over the North Indian Plains during the winter months, while the easterly jet stream steers the tropical depression over India. These depressions play a very significant role in the distribution pattern of the monsoon rainfall in the subcontinent. The highest rainfall occurs along the track of these depressions.

9. Distance from the Sea: Areas in the interiors of India have extreme type of climate or *continental climate* whereas coastal areas have equable or *maritime climate.* The effect of land breeze and sea breeze caused by differential rate of heating and cooling of land and sea are responsible for moderate climate in coastal areas.

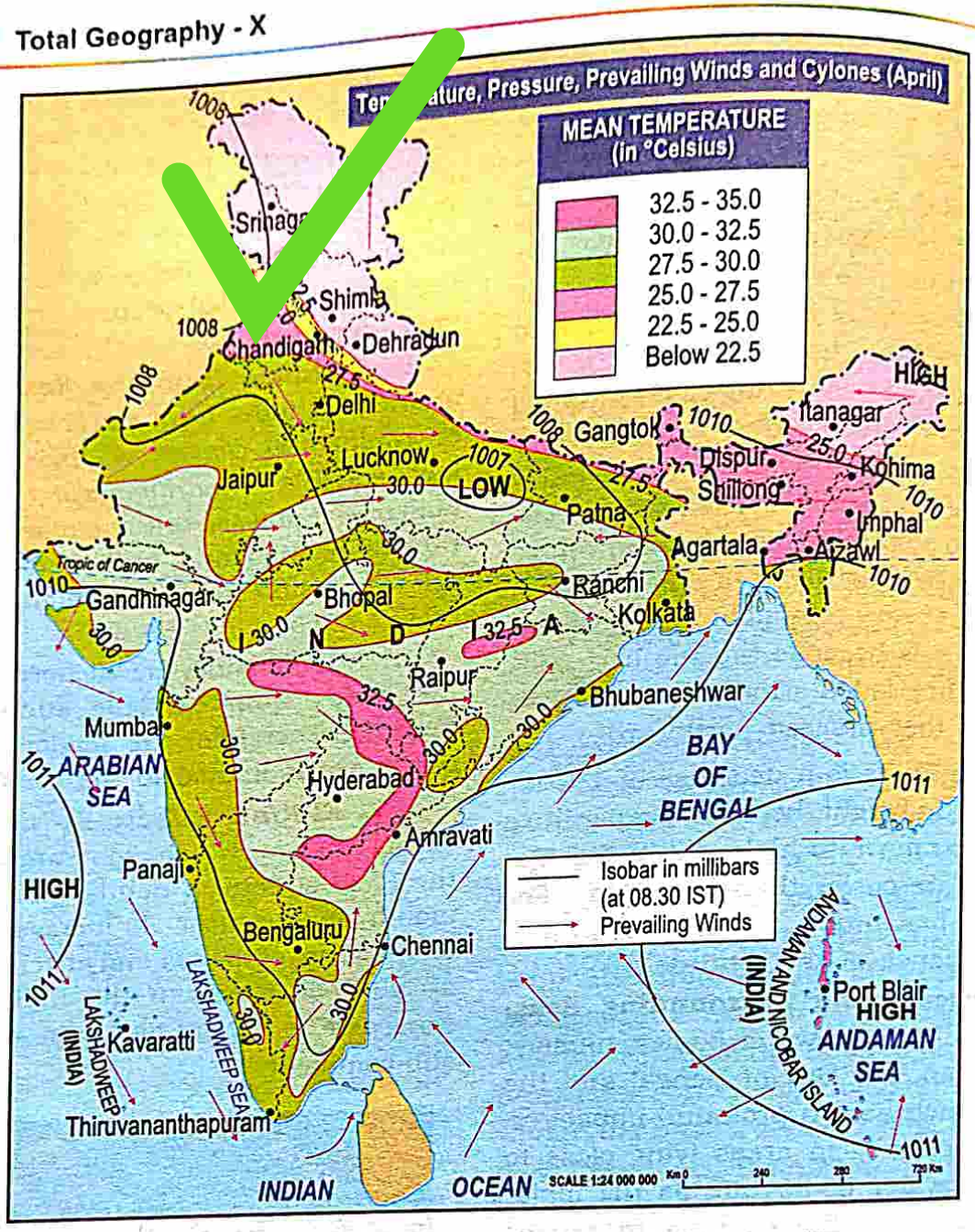
In the Peninsula, the Western Ghats prevent the winds from carrying such benefits far inwards. Therefore, the moderating influence of the sea is limited to the coastal areas.

10. El-Nino Effect: El-Nino is a warm ocean current which sometimes appears off the coast of Peru in South America during the month of December. It increases the surface temperature of the sea and affects the movement of monsoon winds in the Indian Ocean and causes weak drought-like situation in the Indian sub-continent.



* No Rainfall in Rajasthan

*Sketch (not to scale) to aid in understanding concepts.



India–Pressure, Prevailing Winds and Cyclones in (April)

MONSOON PHENOMENA AND ITS MECHANISM

Monsoons are periodic or seasonal winds. They develop because of differential heating as well as cooling of the land and sea. They are divided into two wind systems—the *Summer Monsoon* and the *Winter Monsoon.*

SUMMER MONSOONS

In summer, the land gets heated more than the sea. Hence there develops a centre of low pressure on the land. Over the adjoining sea, the air is comparatively cool, and a high pressure develops there. This causes the winds to blow from the sea to the land. It is the *'Summer Monsoon.'*

In May, June and July, the plains of the Indian subcontinent are heated by the vertical rays of the sun. The intense heat develops a low pressure. During these months, over the Indian Ocean, a high pressure area develops. So, the winds blow from the Indian Ocean northward and north-westward into Asia. As they blow from the sea to the land, they bring heavy rainfall in some parts of the Indian subcontinent. The summer monsoon winds blow south-west; so they are known as the *'South-West Summer Monsoon.'*

WINTER MONSOONS

During winter season, the conditions are just reverse of those in summers. A high pressure develops over a big landmass stretching from Central Asia upto north-west Indian plains. At the same time a low pressure zone develops in the Indian Ocean. As the winds blow from the land to the sea, they bring cold dry weather. They are incapable of producing rain.

When these winds blow over seas and pass over the adjoining land, they bring some rainfall. The Southern Coromandel Coast (Tamil Nadu and southern tip of Andhra Pradesh) in India get rain from winter monsoons. The winter monsoon winds blow north-east; so the monsoon is known as the *'North-East Winter Monsoon.'*

Mechanisms of Monsoon are further explained in this Chapter.

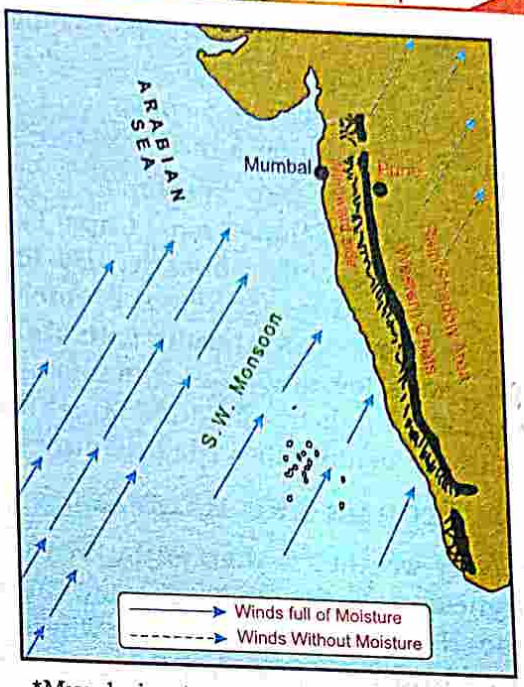
FOUR SEASONS

The Monsoon type of climate has distinct seasonal pattern marked by significant change from one season to the other. These changes are clearly visible in the interior parts of the country. The coastal areas, due to the influence of the seas do not experience much variation in temperature though there occurs variation in the pattern of rainfall. Thus, the year may be divided into four principal seasons on the basis of monsoon variations:

1. The Hot and Dry summer (March to May).
2. The Hot and Wet or Rainy Season or the South-West Monsoon (June to September).
3. The Retreating South-West Monsoon (October-November).
4. The Cold and Dry Winter Season or North-East Monsoon (December-February).

1. THE HOT DRY SUMMER

In India, the hot season begins in March and lasts until June. The vertical rays of the Sun fall directly over the Tropic of Cancer during this period.



*Mumbai gets more rainfall than Pune

TEMPERATURE

From March to May, due to the northward movement of the path of the Sun's vertical rays, the length of the day increases. It results in the increase in solar radiation which moves northward over the tropical areas of South Asia and the temperature starts rising. In most parts of India, temperature ranges between 30° and 32°C. The highest day temperatures increase as the heat belt moves further north. In north-western part of India, temperatures around 48°C are not uncommon.

In south India, the hot weather is not as intense as in north India. The moderating influence of the oceans together with the Peninsular situation of south India keeps the temperatures lower than that in north India. The temperatures, therefore, remain between 26°C and 32°C in south India.

There is some respite from the heat in the coastal regions due to the influence of the sea. Plateaus and hills are also relatively cool because of the elevation.

The diurnal variation is large, especially in the interior part lying on the west of the subcontinent.

PRESSURE CONDITIONS

The warmest area slowly shifts from the Deccan to northwest India. The high temperature

*Sketch (not to scale) to aid in understanding concepts.

in the subcontinent causes a low pressure between Thar Desert and Chota Nagpur Plateau. The surrounding seas are cooler and develop high pressure conditions in the Indian Ocean.

By the end of May a comparatively high pressure area develops near Cape Comorin extending towards the Arabian Sea. By June, the inland low pressure system becomes more intense and moves northward with its centre over the Indus lowlands and Baluchistan. The influx of these winds by mid-June brings about a change in the weather towards the rainy season.

STORMS AND RAINFALL

The hot-dry weather is marked by weak winds and dryness over the area. The low pressure over the Northern plains draws winds from the surrounding areas and gives rise to thunderstorms with strong dusty winds. These winds cause a shower of rain mostly in Punjab, Haryana and Uttar Pradesh.

LOCAL WINDS

(a) A striking feature of the hot weather season is the strong and dusty winds, called *loo*, which blow during day time over northern and north-western India. These winds have temperature range between 45°C and 50°C which is hot enough to cause heatstrokes.

(b) There are occasional tornado-like dust storms in Punjab and Haryana and Uttar Pradesh.

(c) The thunderstorms accompanied with strong winds and heavy rainfall occur in Assam and West Bengal. These local winds are known as *Kalbaisakhi* which means 'the calamity of the month of Baisakh'. In Assam, these storms are known as *Bardoli Chheerha*. They originate over the Chotanagpur Plateau and are carried eastward by westerly winds. They bring rainfall in Assam, West Bengal and Odisha. This rainfall is quite beneficial for growing jute and rice in West Bengal and tea in Assam.

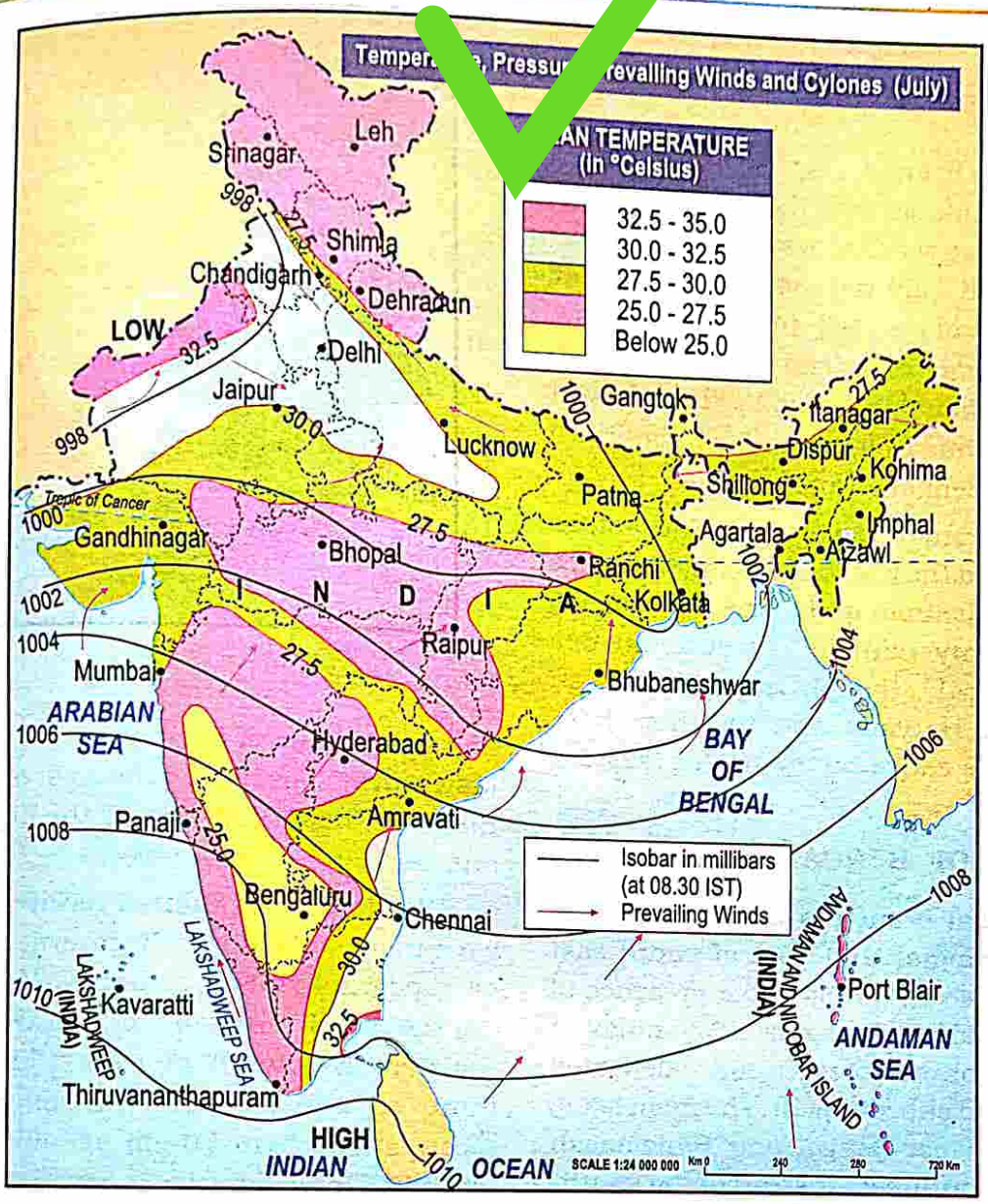
(d) Thunderstorms cause rainfall along the Kerala and Karnataka coasts. The little rainfall that they bring is important for mango, tea and coffee plants. Such rains are called *mango showers* as they help in the early ripening of the mango crop. They are also called *cherry blossoms* in Karnataka.

2. THE SOUTH-WEST MONSOON SEASON

The South-West monsoon season is the season of general rainfall. This season lasts from June to September. The differential heating of land and sea during the summer months causes the monsoon winds to drift towards the subcontinent. The large landmass to the north of the Indian Ocean gets intensely heated during April and May. This causes the formation of an intense low pressure in the north-western part of the Indian subcontinent. Since the pressure in the ocean to the south of the landmass is high, it attracts the South East (S.E.) Trade winds which prevail in the southern hemisphere. These S.E. Trade winds after crossing the Equator are deflected towards the right because of the Coriolis force and reach the west coast as *South-West Monsoon*. These winds bring heavy rainfall accompanied by violent thunder and lightning. This sudden violent onset of rainfall in the first week of June is termed as the *Burst of the Monsoon*. However, when the South-West Monsoon fails to bring rainfall for two or more weeks and there is a dry period in the rainy season it is

Sources of Rainfall

1. For Punjab and Haryana — the three sources of rainfall are:
   - Western disturbances
   - South West monsoon wind—Arabian Sea branch
   - South West monsoon wind—Bay of Bengal branch
2. For Tamil Nadu Coast—the three sources of rainfall are:
   - South West monsoon winds
   - North East monsoon winds
   - Retreating monsoon winds



India Mean Temperatures (July)

called the *Break of Monsoon*. The first State to receive the monsoon showers is Kerala and also the last to see its withdrawal.

As a result of the tapering topography of peninsular India the South-West Monsoon winds divides into two branches:

(a) The Arabian Sea Branch; and

(b) The Bay of Bengal Branch

The rains bring down the temperature and hence, some respite from the heat. However, there is relief only as long as it rains, because the relative humidity is quite high during July-August. In Mumbai the temperature drops by 10°C after a week's rain. Nagpur sees a maximum of 45°C in May which drops to 31°C in July.

THE ARABIAN SEA BRANCH

The monsoon winds originating over the Arabian Sea further split into three branches:

(a) Its one branch is obstructed by the Western Ghats. These winds go up the slopes of the Western Ghats, become cool and bring heavy rains in the windward side of the Sahyadris and the Western Coastal Plains. After crossing the Ghats these winds descend, get heated up and thereby, the humidity in the winds is reduced. Consequently,

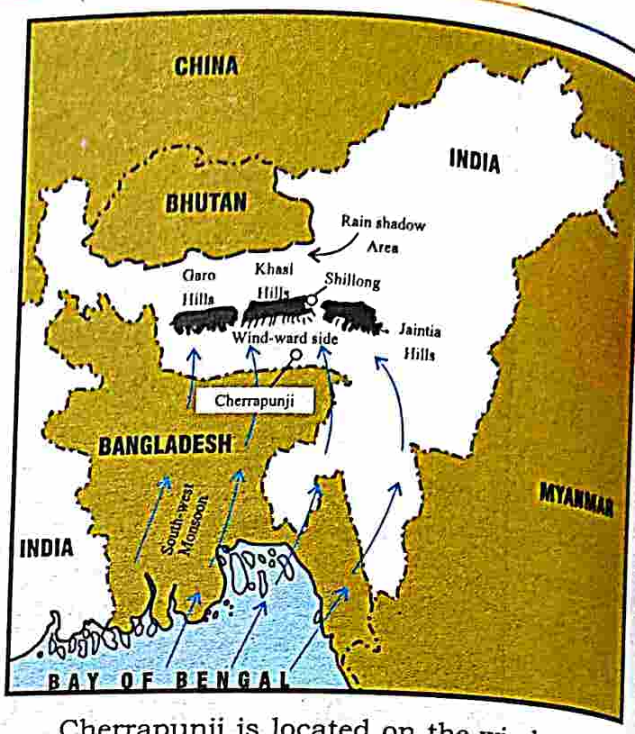
these winds cause little rainfall east of the Western Ghats, *i.e.*, in the rain shadow area.

(b) The second branch of the Arabian Sea monsoon winds strikes the coast north of Mumbai. These winds move further along the Narmada and Tapi river valleys and cause fair amount of rainfall in Central India. The Chotanagpur Plateau receives 15 cm of rainfall from this branch. After that, it enters the Ganga plains and mingles with the Bay of Bengal Branch.

(c) The third branch strikes the Saurashtra Peninsula and the Kutch. After that it passes over west Rajasthan and along the Aravalis causing scanty rainfall. The Arabian Sea Branch joins the Bay of Bengal Branch in Punjab and Haryana and together these two branches cause rainfall in the western Himalayas.

THE BAY OF BENGAL BRANCH

The Bay of Bengal branch is directed towards the coast of Myanmar and part of south-east Bangladesh. However, owing to the presence of the Arakan Hills along the coast of Myanmar, a large part of this branch of monsoon is deflected towards the Indian subcontinent. The monsoons, therefore, enter West Bengal and Bangladesh from south and south-east instead of the south-westerly direction. Now this branch bifurcates into two branches: one along the Ganga plains and the other along the Brahmaputra valley. These branches cause wide spread rain in the Ganga plains, Brahmaputra valley and Garo and Khasi Hills of Meghalaya. Cherrapunji and Mawsynram, located on the crest of the southern range of Khasi Hills, receive the highest average annual rainfall in the world.



Cherrapunji is located on the windward side of hills

Distribution of rainfall received from south-west monsoons is largely governed by the relief or topography. For example, Mahabaleshwar on the windward side of the Western Ghats registers a rainfall of over 250 cm. whereas Pune on the leeward side of these Ghats, receives less than 70 cm of rainfall. Likewise, the heavy precipitation in north-eastern states is due to the occurrence of hilly ranges in these states. There is a decrease in rainfall as one goes from east to west. During this particular season Kolkata receives about 120 cm, Patna 102 cm, Allahabad 91 cm and Delhi 56 cm.

South-West Monsoon Winds

Arabian Sea Branch	Bay of Bengal Branch
1. It enters Indian landmass after blowing over a vast open sea. During this period it collects lot of moisture.	1. It travels a shorter distance (a bay) and carries less moisture.
2. The Arabian Sea Branch blows over India.	2. The Bay of Bengal Branch partly enters India, its major part blows over Myanmar and Thailand.
3. It hits against the Western Ghats as soon as it blows over the land.	3. It has to travel a long distance over land before it hits against the mountains.

*Sketch (not to scale) to aid in understanding concepts.

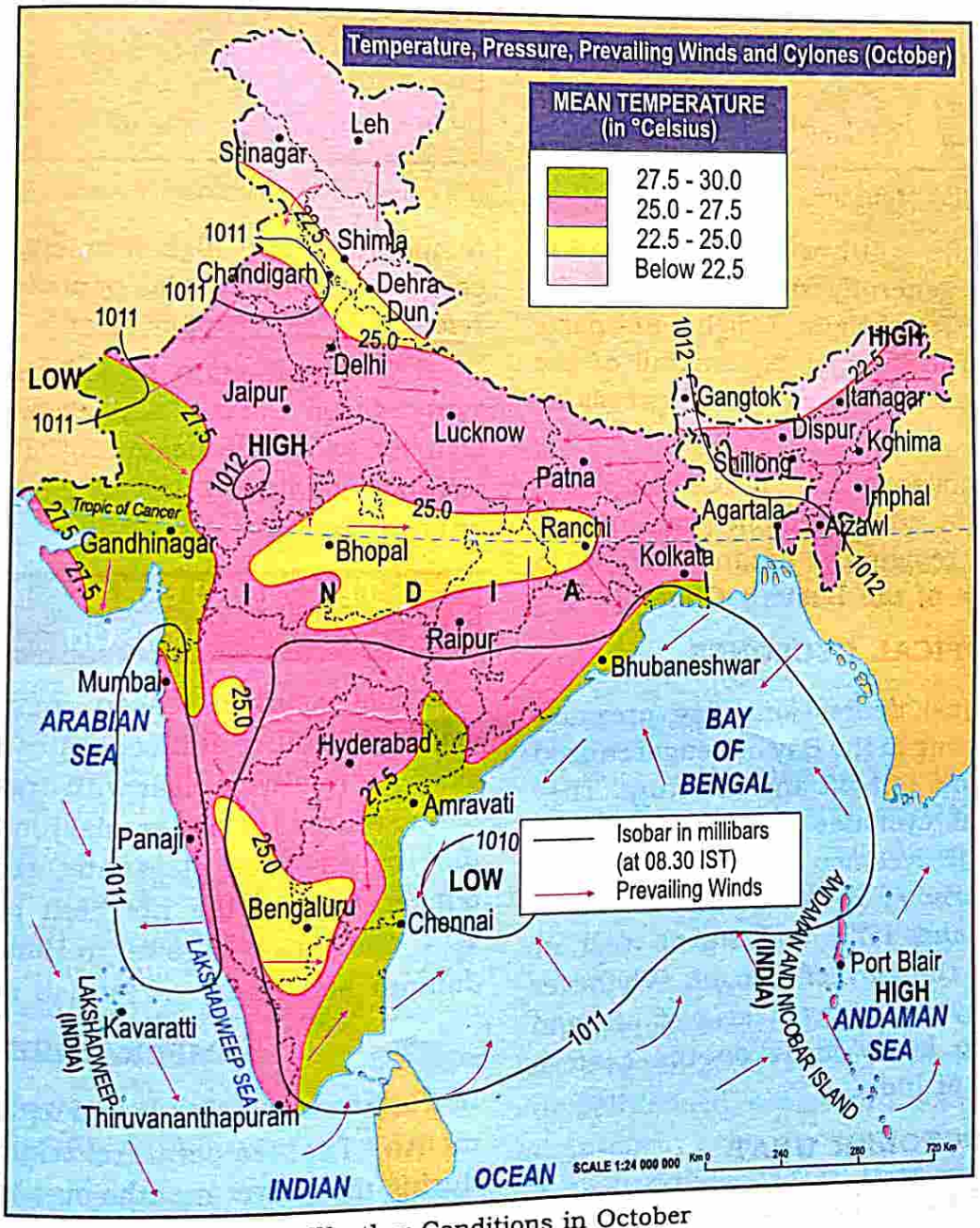
The Tamil Nadu coast remains dry during this season. This is because the Tamil Nadu coast is located parallel to the Bay of Bengal branch of the south-west monsoon. Further it lies in the rain shadow area of the Arabian Sea branch of the south-west monsoon.

3. RETREATING MONSOON

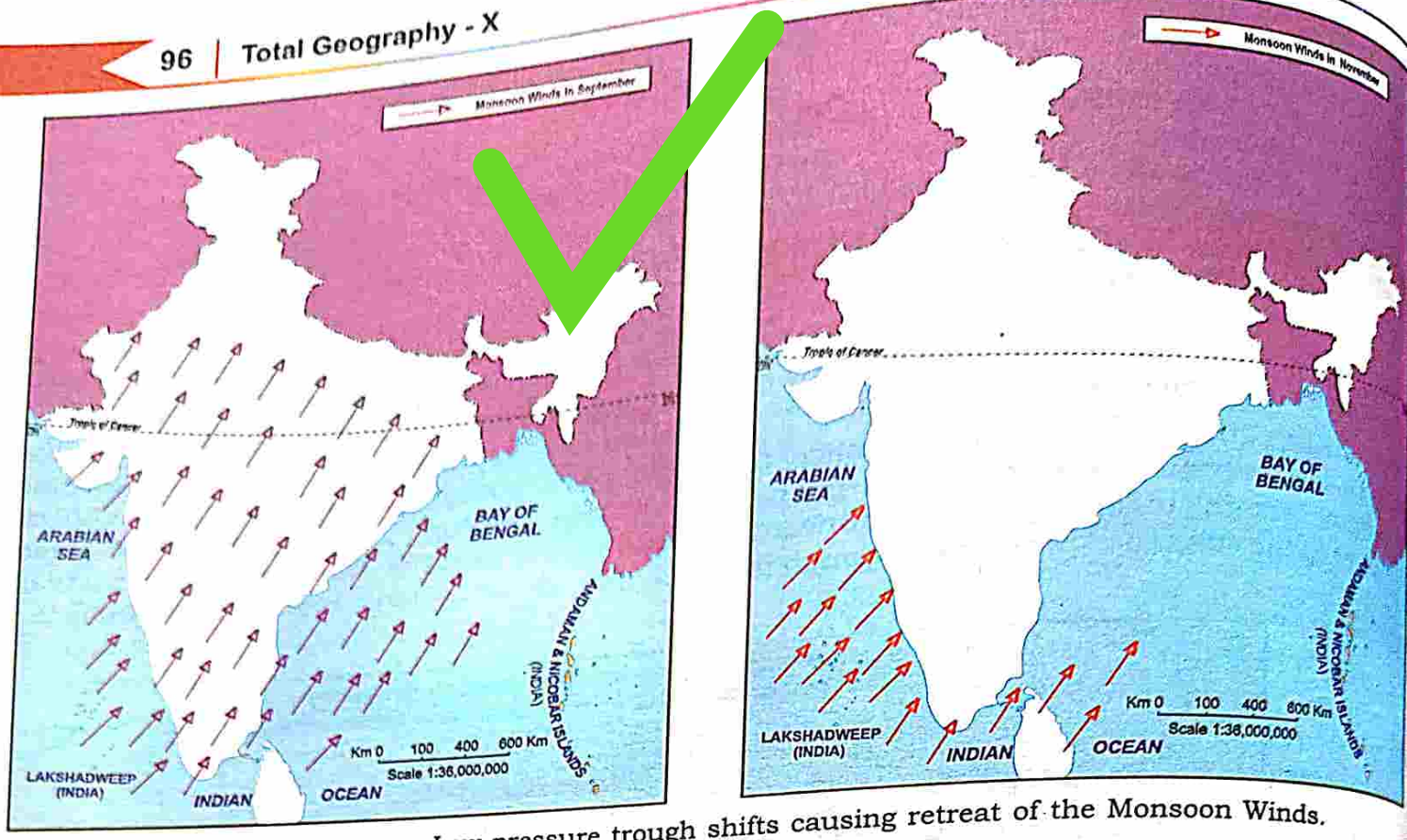
The South-West Monsoon starts retreating from northern India in early October. Hence, the months of October and November are known for the *retreating monsoon*.

The reason of this retreat is that the monsoon trough of low pressure over the Ganga plains becomes weaker due to the apparent Southward movement of the sun. The low pressure trough is gradually replaced by high pressure. The retreat of the monsoon is marked by clear skies and drop in night temperature. The land remains moist. The combination of high temperature and humidity gives rise to an oppressive weather. This is commonly known as 'October heat'. Day temperature rises due to clear skies.

The low pressure conditions are transferred to the centre of Bay of Bengal by early November. This shift of the low pressure area is marked by cyclonic depressions which originate over the Andaman Sea. Some of the cyclonic depressions manage to cross the eastern coasts of southern peninsula resulting in heavy and widespread rains on the coast of Tamil Nadu and parts of Odisha. These cyclonic storms move from the



Weather Conditions in October



Receeding Monsoons - Low pressure trough shifts causing retreat of the Monsoon Winds.

north-east to the south-west. The retreating monsoons are generally dry except on the coastal areas of Tamil Nadu, Odisha and parts of Karnataka. The bulk of the rainfall of the Coromandel Coast is derived from depressions and cyclones.

Retreating Monsoon rainfall in some places is as heavy as the summer monsoons. Interior parts of Deccan remain dry because they lie in the rain shadow of the Eastern Ghats.

TROPICAL CYCLONES

There are tropical depressions (low-pressure systems) originating in the Bay of Bengal caused by local variations of heat and moisture. They lead to tropical cyclones in November and December. Such cyclones generally originate in the neighbourhood of the Andaman Islands between 12°N and 17°N and travel west or northwest over the Bay of Bengal. Whenever they occur, they cause great loss of life and property due to heavy rains on the eastern coastal regions of India.

OCTOBER HEAT

October is marked by clear cloudless sky, high temperature and high humidity. As explained earlier, this sultry and oppressive weather is referred to as 'October Heat.'

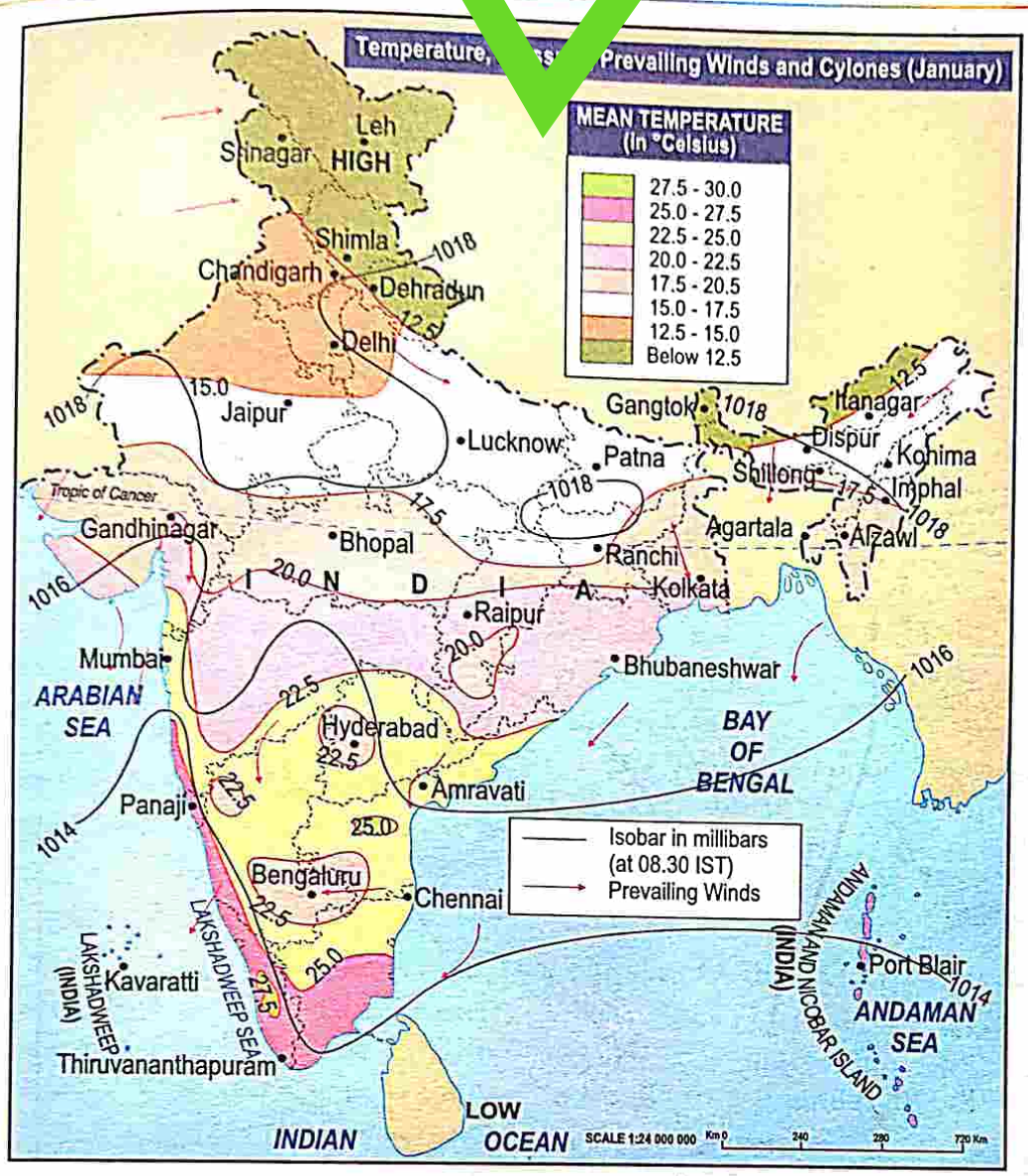
It is a transition period between the hot rainy season and cold dry season. By the end of October or by the beginning of November fine weather conditions prevail over the rest of the subcontinent.

4. THE NORTH-EAST MONSOON SEASON

The cold weather season commences at the end of November and continues till March. The skies are relatively clear with dry weather. Night temperatures are low, specially in northern India, but the days are pleasantly warm. The mean temperature in the northern plains is below 20°C and gets even lower in Himachal Pradesh, Jammu and Kashmir, Punjab and Haryana.

TEMPERATURE

In winter season, January is usually the coldest month. The temperature remains quite low during the winter months over the Indian sub-continent. The temperatures decrease from south



Weather Conditions in January

o north. The mean maximum temperature for he month of January at Trivandrum is as high as 31°C, at Calicut 26°C, at Chennai 24°C, at Varanasi about 16°C and at Jammu only 10°C.

The night temperature in the Gangetic Plains varies from 2.5°C to 17.5°C. Temperatures fall below freezing point in the higher reaches of the Himalayas. Dras Valley in Kashmir near Kargil records minimum temperature of –45°C. It is the coldest place in India.

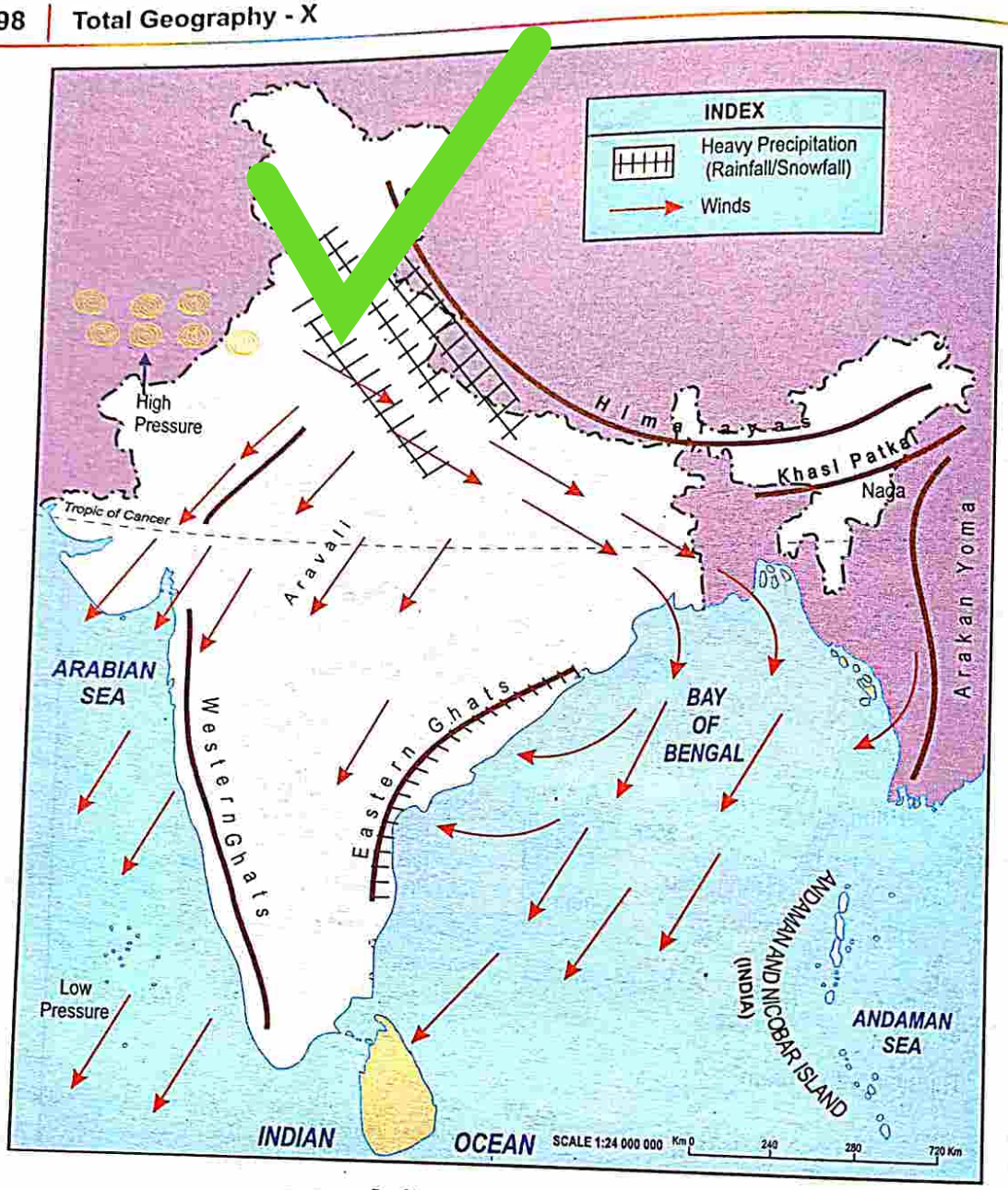
The excessive cold in north India during this season is due to the following reasons:

(a) In the month of February, the cold winds from the Caspian Sea and Turkmenistan bring cold wave over the northwestern parts of India;

(b) Punjab, Haryana and Rajasthan experience continental type of climates as they are located far away from the sea to experience its moderating influence; and

(c) The snowfall in the nearby Himalayan ranges creates cold wave situation.

In Peninsular India, the average temperature lies between 20°C to 25°C and it does not have any well defined cold weather season. The coastal areas hardly experience any seasonal change in the distribution pattern of temperature due to the moderating influence of the sea and proximity



India—Winter Rainfall

to the Equator. For example, the mean maximum temperature for June at Thiruvananthapuram is 29.5°C and it is 31°C for January.

Pressure

The weather in this season is characterised by feeble high pressure conditions over the north-western part of the plain. This is because of the oblique rays of the Sun which reach the subcontinent as the Sun moves to the Southern hemisphere.

During this season, the north east trade winds prevail over the country. These winds blow from land to sea and hence, for most parts of the country it is dry season. However, when these winds pass over Bay of Benga they pick up some moisture and cause some amount of rainfall on the Coromandel Coast. As these winds blow from north-east to south-west, they are called the *North-East Monsoon*.

TEMPERATE CYCLONES (Western Disturbances)

A characteristic feature of the cold weather season is the inflow of depressions from the west and the north-west. These low-pressure systems, called the *western disturbances*, originate in West Asia and the regions near the

Tropical Cyclones	Temperate Cyclones
• Tropical cyclones are largely a summer phenomenon.	• Temperate cyclones are most intense in the winter season.
• They are generally smaller in size and their shape is more or less circular.	• They are bigger in size than the tropical cyclones and are oval in shape.
• Tropical cyclones develop over the seas.	• Temperate cyclones develop over continents.
• They develop in the tropical region of Bay of Bengal and influence Indian coastal climate.	• They develop in the temperate region of Mediterranean sea.
• They bring heavy rainfall with strong winds over the Coromandel coast of India.	• They bring light to moderate rainfall in the North western part of India under the influence of westerly jet streams.

Mediterranean Sea. They travel eastwards across Iran and Pakistan and reach India during the winter season. They bring the much-needed winter rains over the plains and snowfall in the mountains. On an average, four or five such depressions affect India in each of the winter months. They are generally active between December and February. Though the amount of winter rainfall is small, it is of considerable importance for the cultivation of rabi crops.

RAINFALL

Most parts of India do not receive rainfall in the winter season. This is because the winter monsoons have little humidity and due to anti-cyclonic circulation on land, the possibility of rain from them decreases. However, there are some areas which do receive rainfall in the winter season. They are as follows:

1. Central parts of India and northern parts of Peninsula get occasional rainfall in winter.
2. Some weak temperate cyclones from the Mediterranean Sea cause rainfall in Delhi, Haryana, Punjab and western Uttar Pradesh. Though the amount of this rainfall is meagre, it is quite beneficial for the rabi crops.
3. The north-eastern part of India also gets rainfall during the winter months. Arunachal Pradesh and Assam get rains between 25 mm and 50 mm during winters.
4. In the months of October and November, the north-east monsoon while crossing over the Bay of Bengal, picks up moisture and brings torrential rainfall over Tamil Nadu coast and southern tip of Andhra Pradesh.

DISTRIBUTION OF RAINFALL

The distribution of rainfall is determined by the following:

1. the pressure conditions and the direction of the relief features;
2. the direction of the winds bearing moisture;
3. cyclonic depression determined by pressure gradient.

India can be divided into four rainfall regions:

(1) Heavy Rainfall Region: This region experiences more than 200 cm of rainfall annually and includes the following areas.

(i) The windward side of the Western Ghats like the Western Coastal Plains and the slopes of the Western Ghats.

(ii) Meghalaya Hills (Garo, Khasi and Jaintia), the southern slopes of Eastern Himalayas, Assam, Arunachal Pradesh and West Bengal.

(2) Moderate Rainfall Region: This region receives rainfall ranging from 100 cm to 200 cm a year. The following areas are included in this region:

(i) The northern part of Andhra Pradesh, the southern part of Tamil Nadu.

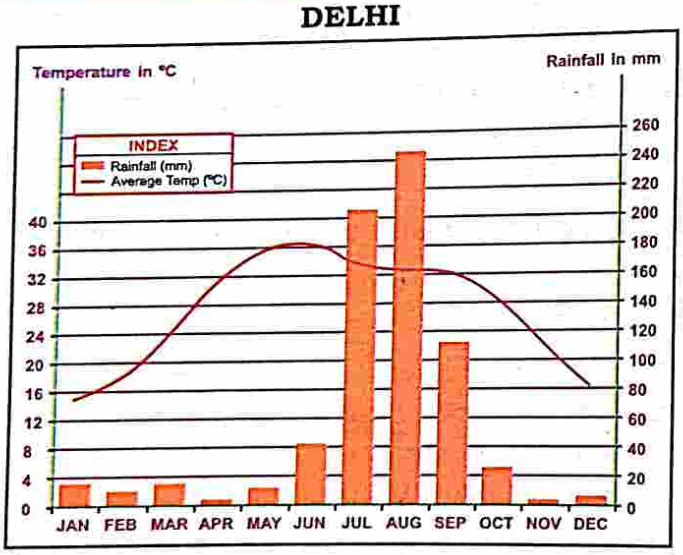
(ii) Middle Ganga Valley, some portions of Western Ghats, Eastern Maharashtra, Madhya Pradesh, Odisha.

(3) Low Rainfall Region: The rainfall in this

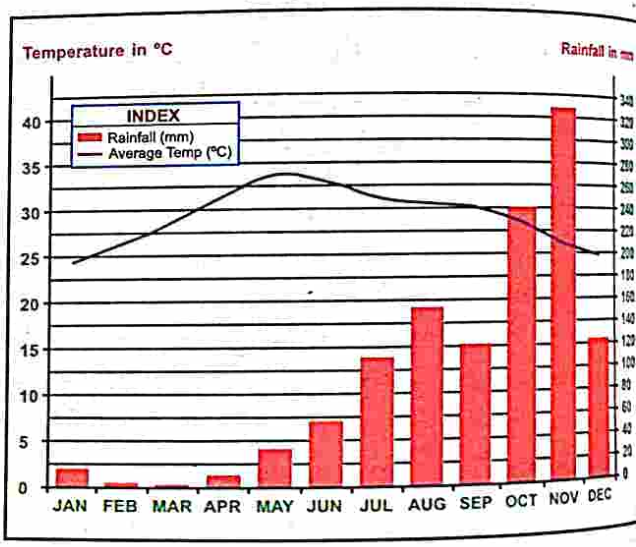
South-West Monsoon	Retreating Monsoon	North East Monsoon
• These winds blow from June to September.	• These winds blow during October and November.	• These winds blow fro December to February.
• The direction of these winds is from South West.	• The direction of these winds is from North East.	• The direction of these wind is from North East.
• They blow from sea to land and are moisture laden winds.	• These winds blow from land to sea.	• These winds blow from lan to sea.
• They bring heavy rainfall. This is a high temperature and high humidity season. The pressure is low on the land area and high over surrounding water bodies.	• The temperature changes and the humidity remains high but rainfall decreases. It is a transition from rainy season to cold dry winter season.	• Clear skies, pleasant weathe with low temperature and lo humidity prevails over th Indian region.
• During these months there is rainfall in the whole subcontinent.	• The coastal areas of Tamil Nadu receive maximum rainfall from these retreating winds.	• When they move over th Bay of Bengal they pick u moisture to bring rainfall onl to the Coromandel coast.

CLIMATE GRAPHS

DELHI



CHENNAI



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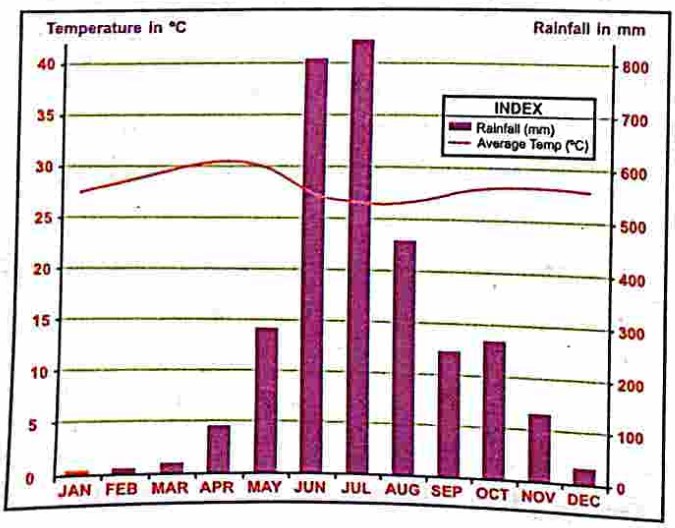

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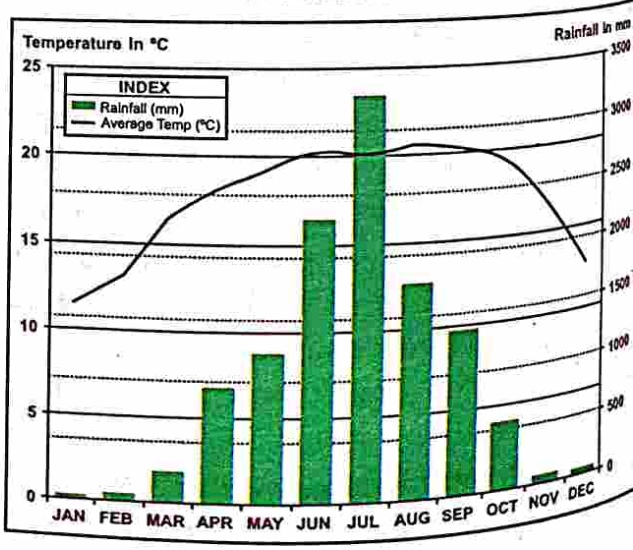
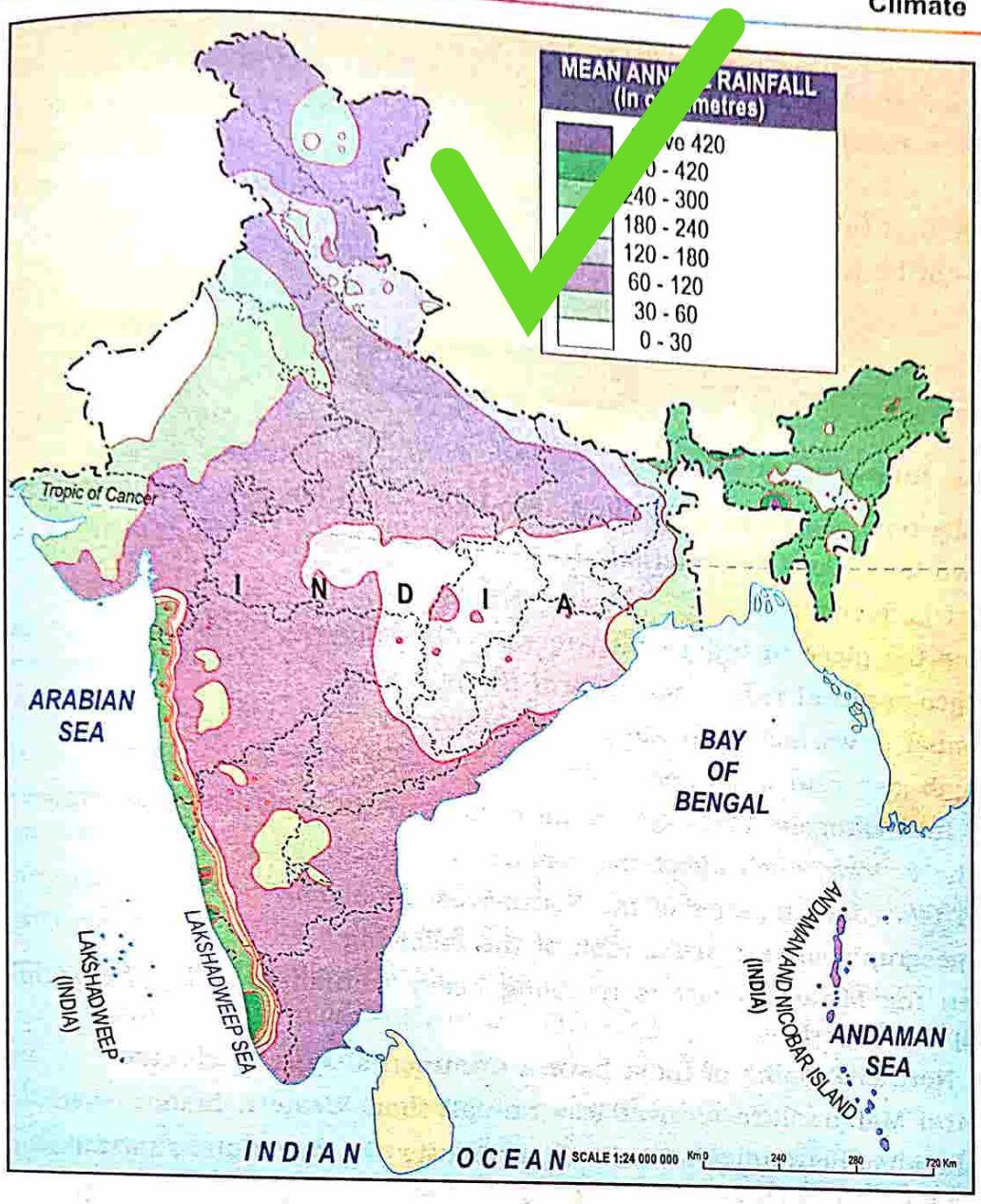




India – Annual Rainfall

region is scarce, varying from 50 to 100 cm. The areas of scanty rainfall are:

(i) Parts of the Deccan Plateau comprising the regions of Karnataka, Andhra Pradesh and Tamil Nadu.

(ii) Eastern Rajasthan, Punjab, Haryana and Kashmir.

(4) Scanty Rainfall Region: These areas get the least rainfall, *i.e.*, less than 50 cm annually. Desert and semi Desert areas are included in this.

The following areas come in this region:

(i) Southern Punjab, Western Rajasthan and parts of Ladakh.

(ii) The rain shadow regions of the Western Ghats lying in the Deccan Plateau.

Features of the Rainfall

Main features of the rainfall in India are:

1. There is rainfall over three months and the rest of the year is mostly dry. Seventy per cent of annual rainfall occurs in the rainy season.
2. The rains are mainly of relief type. The windward slopes of the mountains get more rainfall than the leeward side.

3. Only a small portion of the r[illegible]fall is r[illegible]ived from sources other than [illegible]nsoon, like cyclonic rainfall and [illegible]ectional rainfall.
4. The quantity and the time of occurrence of rainfall cannot be predicted as the rainfall is erratic. It is because of this uncertainty that sometimes there are floods; and sometimes droughts.
5. India has an agrarian economy dependent on rainfall. As such rainfall affects the economy of the country.

EXERCISES

1. Answer the following questions:

Q.1 (a) Name the type of climate prevailing over India. Mention any two factors responsible for it.

(b) State two important characteristic features of the Monsoon rainfall in India.

(c) (i) What is 'Monsoon'?

(ii) Name the place in India which receives the heaviest rainfall.

(d) Give a geographical reason for each of the following:

(i) Mumbai is warmer than Kanpur in December.

(ii) Punjab gets rain in winter.

(iii) The Indo-Gangetic Plain gets some rainfall in the months of December and January.

Q. 2 (a) Name the factors which affect the climate of a place.

(b) Mention two characteristics of the South-West Monsoon.

(c) Give a geographical reason for each of the following:

(i) When the Malabar coast is receiving heavy rainfall in July, the Tamil Nadu coast is comparatively dry.

(ii) The Northern Plains of India have a Continental type of climate.

(iii) Central Maharashtra receives less rainfall than Western Maharashtra.

(d) Study the climatic data given below and answer the questions that follow:

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Temperature °C	23.1	24.8	26.5	29.3	32	32.8	33.1	32.1	30.5	29.3	28.7	26.1
Rainfall cm	15.3	10.1	0.3	0.1	1.3	4.5	6.1	10.2	10.5	20.1	16.8	19.0

(i) Calculate the annual rainfall experienced by the station.

(ii) Suggest a name of this station, giving a reason for your answer.

(iii) Name the season during which the rainfall is heaviest.

Q. 3 (a) Distinguish between 'Burst of Monsoon' and 'Break of Monsoon'.

(b) Define: (i) Western Disturbances (ii) Mango Showers.

(c) (i) Name two regions which get very little rain from the Summer Monsoon.

(ii) Name any two local winds which blow in India during the summer season.

(d) Give a geographical reason for each of the following:

(i) The monsoon rain is unevenly distributed over India.

(ii) Excessive cold in north India during winter season.

(iii) Most of the India remains dry during North-East Monsoon.

Q. 4 (a) What is meant by the season of 'Re...ati... Monsoon'?
(b) Name the months in which Retreating ...nsoon rain is experienced.
(c) (i) Name the seasons during which the North-East Trade Winds dominate.
(ii) How do these winds affect the climate of India?
(d) Give a geographical reason for each of the following:
(i) The northern plains of India do not freeze in winter.
(ii) In spite of Aravali Range, Rajasthan receives very less rain.
(iii) Patna receives heavier rain than Delhi.

Q. 5 (a) Mention the different sources of rain in Punjab and Tamil Nadu during the winter season.
(b) What is meant by 'rain shadow area'? Give an example and state the mountains which are responsible for the rain shadow area.
(c) State the benefits that are derived from the local winds that blow in summer in the following areas:
(i) Kerala (ii) West Bengal
(d) Give a geographical reason for each of the following:
(i) Western Rajasthan receives no rain from the Arabian Sea branch of the South West Monsoon winds.
(ii) Mangalore is not cold even in the month of December.
(iii) Even in summer Shimla is cooler than Delhi.

Q. 6 (a) Give two points of difference between the Arabian Sea branch and the Bay of Bengal branch of South-West Monsoon Winds.
(b) Name any two states that receive rain in January-February from North-East Monsoons.
(c) (i) What causes the winter rain along Coromandel coast?
(ii) Name a state which gets sufficient rainfall from the winter monsoon.
(d) Give a geographical reason for each of the following:
(i) Western part of Rajasthan is a desert region.
(ii) Kochi has a lesser annual range of temperature than Agra.
(iii) The Northern plains and Punjab receive winter cyclonic rain in winter.

Q. 7 (a) Give two points of difference between Tropical Cyclones and Temperate Cyclones.
(b) An Inter-School Football Match at Vishakhapatnam from November 1 to 3 had to be cancelled because of bad weather. Give an explanation for this happening. Your explanation should provide the technical name of this season in India, as well as the pressure conditions over the Bay of Bengal.
(c) (i) Name one region which gets rainfall from the Retreating Monsoon.
(ii) Name two areas which get more than 200 cm of rainfall in India.
(d) Give a geographical reason for each of the following:
(i) Kanyakumari experiences an equable climate.
(ii) Chennai has a lower annual range of temperature than Lucknow.
(iii) Jaipur has a higher annual range of temperature than Mumbai.

Q. 8 (a) From where does the winter showers in Western Uttar Pradesh and Punjab originate?
(b) State the economic importance of Kalbaisakhis in West Bengal and Assam.
(c) Briefly explain the role of the Himalayas in determining the climate of India during:
(i) the hot weather season; (ii) the southwest monsoon season;

(d) Give a geographical reason for each of the following:

(i) Chennai receives less rain than Thiruvananthapuram although it has more rainy days.

(ii) Shillong gets less than 200 cm of rainfall in a year while Cherrapunji receives more than 1250 cm of rainfall.

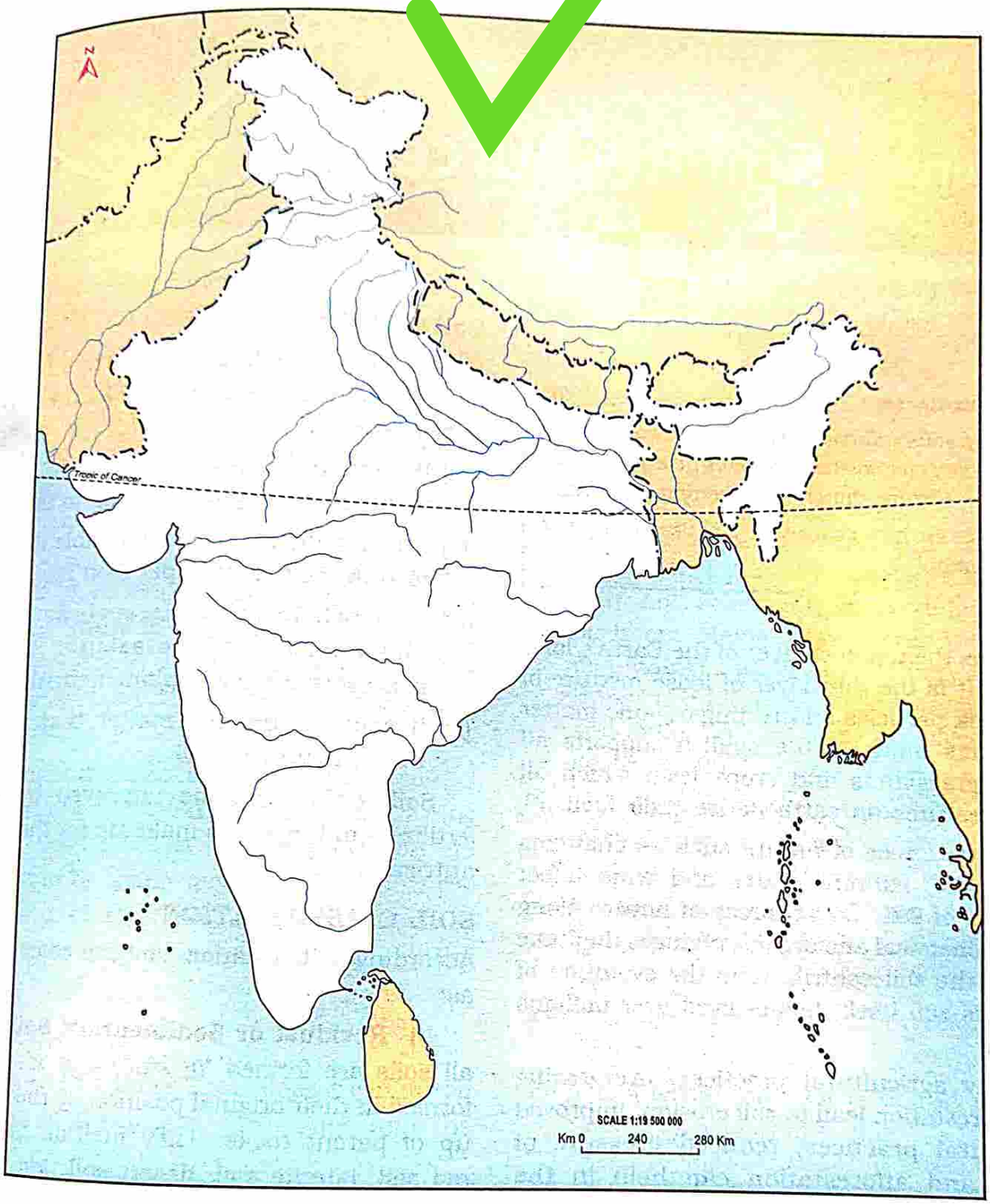
(iii) Mangalore experiences more rainfall than Mysore.

II. Map Work

On the outline map of India mark the following:

1. Colour the areas which receive less than 30 cm rainfall in a year.
2. Write L over the region which is the last to receive the South-West Monsoon.
3. Show by arrows, the direction of the rain bearing winds during winter and summer.
4. Mark the wind direction in Ganga basin and Tamil Nadu coast in the month of January.
5. Write E over the region which is the first to receive the South-West Monsoon.
6. Shade an area which receives rain in January and February.
7. Shade and name the regions of India which experience cyclonic rain and convectional rain.
8. Mark dots on the areas which are affected by Loo.
9. Write HAR in an area having high annual range of temperature and LAR in an area having low annual range of temperature.
10. Shade and mark the Thar Desert.

❖❖❖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Chapter 9 Soil Resources

Syllabus

Soil Resources

Types of soils (alluvial, black, red and laterite), distribution, composition and characteristics such as colour, texture, minerals and crops associated.

Soil Erosion — causes, prevention and conservation.

Soil forms the topmost layer of the Earth's land surface. It is the thin layer of loose mixture of small rock particles and rotting organic matter that covers much of the land. It supports all forests, grasslands and crops from which all living creatures on earth derive their food.

Various forces of nature such as changing temperature, running water and wind affect formation of soil. These forces of nature along with the chemical and organic changes that take place in the soil contribute to the evolution of soil. Thus soil itself, has evolved over millions of years.

Faulty agricultural practices, overgrazing and deforestation lead to soil erosion. Improved agricultural practices, reduced pressure of grazing and afforestation can help in the conservation of soils.

Constituents of Soil

Soils are derived from parent rock material through a process of breakup or wear and tear. Decomposed vegetal and animal remains, referred to as humus is an important constituent of soil and adds to the fertility of the soil. Besides humus, silica, clay and sand are the other constituents of soil.

Soil Fertility

Soil fertility refers to the strength of the soil to support plant life. Fertile soil has the following characteristics:

(i) It contains adequate amount of moisture to supply essential nutrients to the plants.

(ii) It has sufficient depth to enable the plants to grow their roots as per their requirement.

(iii) It is rich in nutrients such as nitrogen, phosphorus and potassium, that are necessary for basic plant nourishment.

(iv) It contains organic matter that improves the structure of soil.

Soil fertility can be improved by adding fertilizers to the soil to make up for the missing nutrients.

SOIL CLASSIFICATION

According to its location, soil can be categorised as:

(i) Residual or Sedimentary Soil: Almost all soils are formed *'in situ'*, that is, they are formed in their original position by the breaking up of parent rocks. They include black soil, red soil, laterite soil, desert soil, *etc.*

(ii) Transported Soil: These soils are *'ex situ'*, that is, transported by various agents of erosion and consist of sediments carried and deposited by rivers and winds. Hence they do not have a well defined soil profile.

India is a vast region with varied natural environment. We find several physiographic regions and different types of climate. Therefore, a number of soil types have developed here.

The soils of India are classified on the basis of their origin and formation as follows:

1. ALLUVIAL SOILS

These soils are formed by the sediments brought down by rivers. They are also rich in chemical ingredients. The rivers deposit very fine particles of soil called *alluvium* in their plains during the course of their long journey. Alluvial soil is also known as *riverine soil* because it is mainly found in the river basins. It is a mixture of sand, clay and silt, called *loam*. These have been deposited by three important river systems — the Indus, the Ganga and the Brahmaputra. These soils occupy 40 per cent of the land area. The entire Northern Plains are made up of these soils. These soils are also predominant in coastal plains and deltas particularly in the deltas of the Mahanadi, the Godavari, the Krishna and the Kaveri rivers.

On the basis of its age, the alluvial soil is of two types— *bhangar* and *khadar*. The *bhangar* or the older alluvium is composed of lime nodules or *kanker* and has a clayey composition. The *khadar* is light in colour and is composed of newer deposits.

Khadar is more fertile than bhangar soil as new layers are deposited year after year during monsoon floods. Crops can be grown on old alluvial soils by using manure. They form the largest and most important group as they contribute the largest share to the agricultural wealth of India.

Distribution

I. *Inland Alluvium:* These soils are found on the plains of the Indus, the Ganga and the Brahmaputra rivers, extending from Punjab and Sindh (Pakistan) to Bangladesh and Assam (India). Punjab, Haryana, Uttarakhand, Uttar Pradesh, Bihar, West Bengal have alluvial soils. This soil type also covers a part of Gujarat and a few patches in Rajasthan.

II. *Deltaic Alluvium:* The Deltaic alluvium is found in the deltas of the Ganga-Brahmaputra, Mahanadi, Godavari, Krishna and Kaveri rivers.

III. *Coastal Alluvium:* It is of tidal origin. It is found in the coastal strips of Peninsular India. It is also found in the plains of Gujarat.

Characteristics of Alluvial Soil

(i) It is formed by the deposition of the river load as it flows from its upper to its lower course.

(ii) In the upper reaches of the river valleys (near the place of their origin) the soil is coarse. Soil particles are large and non-uniform. Such soil is predominant in piedmont plains (plains near the foot of mountains). As we move further down a river valley, the soil particles become smaller and more uniform. They are found upto a depth of 500 metres.

(iii) The alluvial soil of the Upper Ganga Valley is dry, porous, sandy, faint yellow and consists of clay and organic matter, while the soil of lower Ganga Valley, *i.e.*, of West Bengal and Bangladesh is more compact, less coarse and more moist.

(iv) It is light and porous, therefore easily tillable.

(v) It is a fertile soil as it is rich in minerals, especially potash and lime.

Bhangar Soil	Khadar Soil
• Old alluvium soils, known as Bhangar, occupy the largest part of northern plains.	• The area in northern plains that lies below flood levels is made up of Khadar.
• Bhangar is above the flood levels of rivers and presents a terrace like structure.	• Khadar is younger alluvium as flood waters deposit new layers every year.
• Bhangar is full of kankars (lime nodules).	• It is formed of fine silt and clay.
• Bhangar is not very fertile.	• Khadar is very fertile and ideal for intensive cultivation.

(vi) It is deficient in nitrogen and humus, except the alluvium of the Ganga deltaic region which is rich in humus.

(vii) It is suitable for the growth of a large variety of rabi and kharif crops.

(viii) Soil in the drier areas is more alkaline.

Crops

Alluvial soil is fertile and suitable for cultivation of rice, wheat, sugarcane, cotton, tobacco, gram and oilseeds. In the lower Ganga-Brahmaputra Valley it is useful for jute cultivation.

2. BLACK SOIL

This soil is black in colour and is also known as the *Regur soil* or *Black Cotton Soil*. It is dark in colour and is suitable for cotton cultivation. This soil is the residual soil, *i.e.*, it is formed at the place of its origin over the underlying rocks. Since it is formed by the denudation of volcanic rocks, it is also known as *lava soil*.

Distribution

The Regur soils are concentrated over the Deccan lava tract which include parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Uttar Pradesh and some parts of Tamil Nadu.

Characteristics of Regur (Black) Soil

(i) It is fine textured and clayey in nature.

(ii) It has high quantities of lime, iron, magnesium and generally poor percentage of phosphorous, nitrogen and organic matter.

(iii) It is black in colour as it is formed from weathered lava rocks.

(iv) It is very clayey (up to 50% clay content) and, therefore, highly retentive of water. Because of high clay content, this soil expands when wet and become difficult to plough. During the dry season, black soil shrinks and develops big cracks which help in air circulation.

(v) The soil is very fertile in most of the places.

(vi) It is suitable for cultivation of cotton, jowar, wheat, sugarcane, linseed and gram.

(vii) In any season it has moisture stored in its subsoil.

Crops

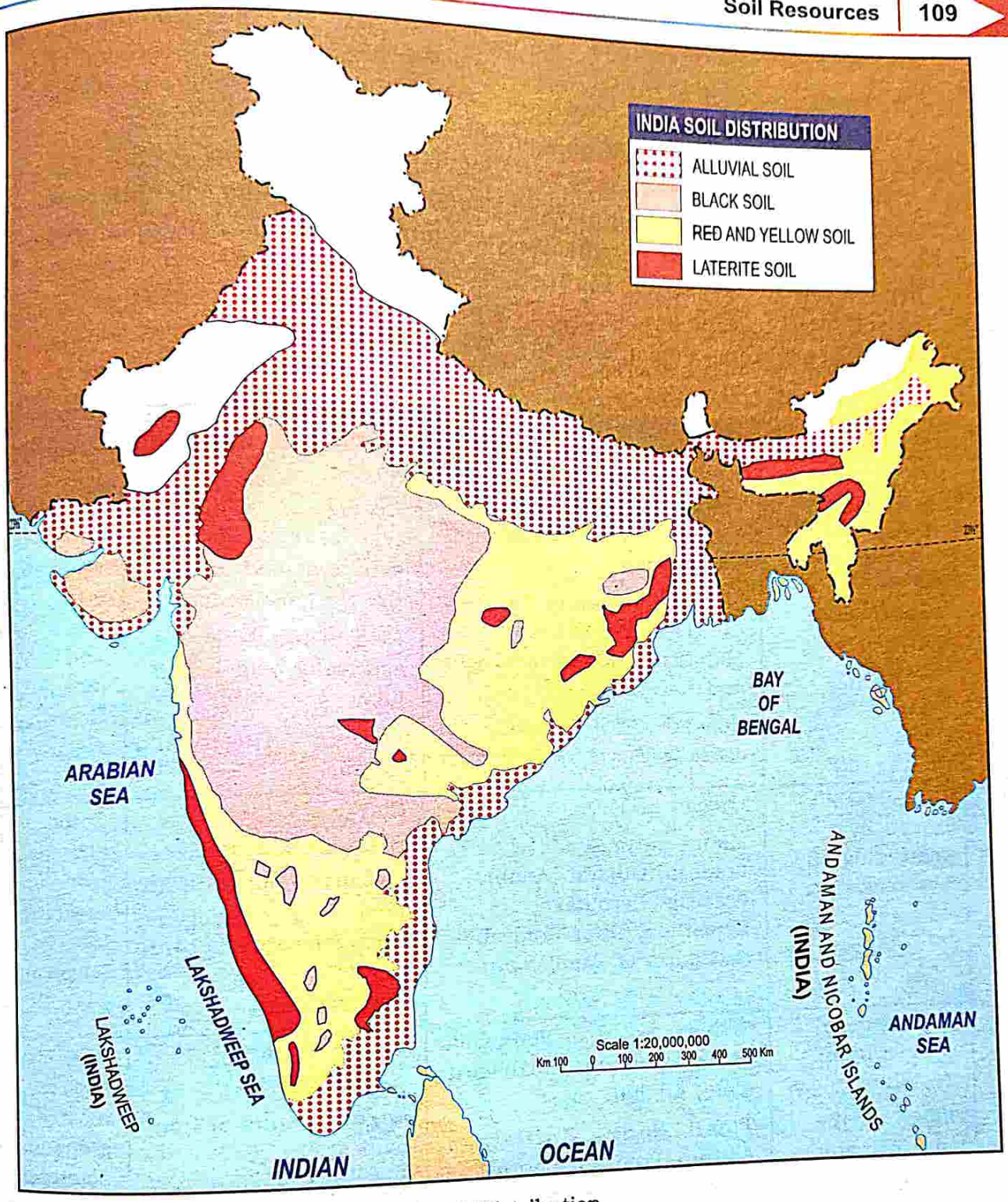
Besides cotton cultivation, this soil type is suitable for growing cereals, oilseeds, citrus fruits and vegetables, tobacco and sugarcane. The moisture retentiveness of black soil makes it suitable for dry farming.

3. RED SOIL

It is a category of soil which develops on old crystalline rocks. Under prolonged weathering by rainfall, ancient crystalline and metamorphic rocks of the Peninsular plateau break up to form this soil. This soil differs from place to place on the basis of the parental rock material and climatic conditions. It is red in colour as it contains large amounts of iron oxide. At several places, its colour slightly changes and it appears brown or grey. It looks yellow when it occurs in a hydrated form.

Distribution

Red soil forms the second largest soil group in India and is found mainly on the plateau region of peninsular India from Tamil Nadu in the south to Bundelkhand in the north and Rajmahal Hills in the east to Kutch in the west. Red soil covers almost the whole of Tamil Nadu, Karnataka, Andhra Pradesh, south-eastern Maharashtra, parts of Odisha, Chhattisgarh, Jharkhand, Bundelkhand, Meghalaya, Mizoram, Manipur, Telangana and Nagaland. Scattered patches of red soil are also found in Birbhum (West Bengal), Mirzapur, Jhansi, Banda, Hamirpur (Uttar Pradesh), Udaipur, Chittorgarh, Dungarpur, Banswara and Bhilwara districts (Rajasthan). It practically encircles the entire black soil region on all sides. It extends northwards in the west along the Konkan Coast of Maharashtra.



Soil Distribution

Characteristics of Red Soil

(i) Red soil has got its name from its colour.
(ii) It is porous and has high percentage of iron oxide.
(iii) It is generally shallow and its pH value ranges from 6.6 to 8.0.
(iv) It is loose and aerated.
(v) It is poor in nitrogen, phosphorus, potassium and organic matter.
(vi) It is ideal for dry farming as it is formed in poor rainfall areas.
(vii) It is not fertile but responds to fertilizers.
(viii) It needs irrigation support for cultivation.
(ix) It contains soluble salts in small quantities.

Crops

Though red soil is suitable for cultivating almost all crop types, it is most suitable for growing vegetables, rice, ragi and tobacco. Groundnut and potatoes can be grown on coarse soils at higher levels and sugarcane on heavy clays at lower levels.

4. LATERITE SOIL

This soil type is formed as a result of atmospheric weathering of rocks under conditions of high rainfall and temperature with alternate wet and dry periods. It is the residual soil formed by leaching due to tropical rains. Leaching is the process in which the nutrients get percolated down below the soil due to heavy rainfall; thus leaving the top soil infertile. This is also called *desilication*. Due to heavy rains, lime and silica are leached away and aluminium compounds are left behind. Humus content of the soil is removed by bacteria that survives well in high temperature.

There are two types of laterite soils: *Upland Laterites* and *Lowland Laterites*. Upland laterites are formed over hills and uplands. From there they are transported by streams towards lowlands. Such transported soils are known as *Lowland Laterites*.

Soil	Formation	Areas	Characteristics	Crops
Alluvial Soil	Deposition of sediments by rivers.	Inland alluvium in Punjab, Haryana, U.P., Bihar, West Bengal, parts of Gujarat and Rajasthan. Deltaic alluvium in the deltas of Ganga-Brahmaputra, Mahanadi, Godavari, Krishna and Kaveri. Coastal alluvium along the coastal strips of the Peninsula.	Loamy. Coarse and dry in upper reaches of the river and gets finer and moist as the river flows down. Rich in minerals especially potash and lime. Poor in nitrogen and humus.	Large variety of Rabi and Kharif crops: rice, wheat, sugarcane, cotton, gram and oilseeds; jute in Ganga-Brahmaputra delta.
Black Soil	Residual soils formed by weathering of lava rocks.	Deccan lava tract. Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, Rajasthan, Uttar Pradesh and parts of Tamil Nadu.	Clayey. Black in colour. Rich in lime, Magnesium. Poor in phosphorous, nitrogen and organic matter. Very fertile.	Cotton, cereals, oilseeds, citrus fruits and vegetables, tobacco, and sugarcane.
Red Soil	Prolonged weathering of crystalline rocks. Differs on the basis of parent rock material and climatic conditions.	Plateau region of Peninsular India extending northwards along Konkan coast. Tamil Nadu, Karnataka, Andhra Pradesh, South-East Maharashtra, Chhattisgarh, parts of Odisha, Jharkhand, Bundelkhand, Meghalaya, Mizoram, Manipur, Telangana and Nagaland.	Loamy or Sandy. Red in colour due to large amounts of iron-oxides Deep and fertile in lowland; thin and poor in highlands. Poor in nitrogen, phosphorus, potassium and organic matter.	Vegetables, rice, ragi, tobacco, groundnut and potatoes.
Laterite Soil	Due to leaching in areas of heavy rain.	Highland areas of Peninsular plateau. Patches in Madhya Pradesh, Odisha, Maharashtra, West Bengal, Andhra Pradesh, Telangana, Karnataka, Kerala, and Tamil Nadu.	Coarse and porous. Red due to Iron Oxide. Poor in lime, nitrogen and magnesium. High acidity and low moisture retention.	Tapioca, cashewnuts. With manure ragi, rice, sugarcane, tea, rubber and coffee.

Distribution

Laterite soil mainly occurs in the highland areas of the Peninsular Plateau, especially on the summits of the Sahyadris, Eastern Ghats, Rajmahal Hills and many other hills in the eastern parts of the peninsula. Patches of laterite soil are found in Madhya Pradesh, Odisha, Maharashtra, West Bengal, Andhra Pradesh, Telangana, Karnataka, Kerala, Tamil Nadu and along the top slopes of the peninsular mountains, the Western and Eastern Ghats.

Characteristics of Laterite Soil

(i) It is of a coarse texture, soft and friable.

(ii) It is red due to the presence of iron oxide which is formed by leaching. The soluble plant foods like potash are removed from the top soil leaving alumina and iron oxide.

(iii) It is a porous soil; silica is removed from it by chemical action. It is poor in lime and magnesium and deficient in nitrogen.

(iv) It does not retain moisture and hence is not fertile. It suits only special crops like tapioca, cashewnuts, tea, coffee, *etc.*

(v) It is acidic in nature as alkalis are leached.

(vi) It is considered suitable for building purposes.

Crops

As the laterite soil has low fertility because of high acidity and low moisture retention, manuring and other activities are required to make it suitable for growing crops such as ragi, rice and sugarcane. Paddy is grown on lower elevations, whereas tea, cinchona, rubber and coffee are grown on higher elevations.

SOIL EROSION

The removal of the top soil cover by water, wind and human activities is called *soil erosion*. Man is responsible for soil conditioning either through agriculture or through pollution like dumping of chemical wastes in water bodies as well as underground. Besides human activity, soils are degraded by nature during drought or floods.

1. SOIL EROSION BY WATER

(i) Sheet Erosion: It occurs on gentle slopes and is the slow removal of a thin layer of soil when vegetation is destroyed. Rainwater washes away the thin layer of bare soils.

(ii) Rill Erosion: When sheet erosion continues for long, the silt-laden run-off forms many finger-shaped rills or grooves over a large area. This is called rill erosion. It is the intermediate stage between sheet erosion and gully erosion.

(iii) Gully Erosion: During heavy downpour, deep gullies are made on bare soils on account of water run-off. Gully erosion removes nutrients and heavy load of loose soils, making the soil unproductive. It makes water very muddy. This is seen in the Chambal Valley region.

(iv) Leaching: After harvesting, farmers leave the soils bare for some time. During rainfall the nutrients in the soil are leached or percolated below the top layer.

(v) Sea or Shore Erosion: The tidal waters of the sea cause considerable damage to the soil along the coast. The powerful waves dash against the coast and break hanging cliff rocks. The broken material is then removed by the retreating sea waves. This type of sea erosion is seen throughout the eastern and western coasts of India.

(vi) Stream Bank Erosion: Streams and rivers change their courses by cutting one bank and depositing the silt loads on the other. During flash floods, the damage is accelerated.

Stream Bank Erosion is prevalent in the flood plains of Ganga, Yamuna and other rivers. As a result of Stream Bank Erosion, large areas of agricultural land in the States of Uttar Pradesh, Madhya Pradesh, Rajasthan, have been transformed into ravines.

2. SOIL EROSION DUE TO HUMAN ACTION

(i) The loss of vegetation cover leads to Sheet Erosion on hilly slopes because water instead of sinking into the ground washes the soil down. In the second stage, in the

absence of vegetation cover and washing off of the absorbent top soil, rills begin to appear on the landscape. In the third stage, the water run off during heavy rains may develop deep grooves causing Gully Erosion.

(ii) The Outer Himalayas (the Shiwaliks), the Western and Eastern Ghats are subjected to deforestation by man. These areas also receive heavy monsoon rains. The removal of vegetation cover for different land use like railway lines, roads, buildings or even agriculture has caused Sheet, Rill and Gully erosion. In these areas, local population practise shifting cultivation. The heavy rains then wash away the bare soil from the slopes to the valleys below.

(iii) Another important cause of Sheet, Rill and Gully Erosion is uncontrolled grazing of domestic animals in the valleys and the upper slopes.

3. EROSION BY WIND

Wind Erosion refers to the movement and deposition of soil particles by wind. It occurs when soil devoid of vegetation is exposed to high-velocity wind. Wind moves soil particles 0.1–0.5 mm in size in bouncing or hopping fashion and those greater than 0.5 mm by rolling. The former is known as *saltation* and the latter as *soil creep*. The particles less than 0.1 mm or the finest particles detach into suspension. In fact, wind erosion is most visible in the suspension stage, as dust storms, or subsequently as deposition along fence lines and across roads.

Wind erosion reduces the productive capacity of soil, as most of the nutrients required by the plants are carried away by the wind.

SOIL EROSION IN INDIA

CAUSES OF SOIL EROSION

(i) Heavy Population Pressure on Land: India's forest cover continues to be very low, just *21.54 per cent of the total area. On the other hand, the population continues to rise at a rapid rate and has already crossed the one billion mark in the year 2000. More forests are being destroyed to house and feed the increasing population. The heavy pressure on land is the main cause of soil erosion.

(ii) Nature of Rainfall: India receives 80 to 90 per cent of rainfall in the monsoon season. Heavy downpour during monsoon months causes floods. In the remaining months droughts are frequent. This affects the soils.

(iii) Overgrazing: The number of domestic animals particularly the cattle in India is the highest in the world. The cattle freely graze in open lands making them bare of vegetation. Winds carry away dry soil particles from the bare landscape. Thus, soil erosion takes place. In many parts of Rajasthan, excessive grazing by cattle has resulted in the exposure of the top soil to elements of denudation.

(iv) Bad Farming Techniques: The poor farmers plough fields in traditional ways. The farming techniques and small size of holdings lead to soil erosion on a large scale. The absence of terracing, contour cultivation, crop rotation and the improper use of manure *etc.*, have caused serious problems of soil erosion.

(v) Topography: Northeastern parts of India, Shiwaliks and hilly regions in South India are affected by soil erosion because of steep slopes and heavy rainfall. During heavy rainfall, soils are washed away by running water down the slope.

(vi) Deforestation: Forests are destroyed so that more land can be used for cultivation. Cutting of trees exposes the soil to water and wind, which leads to soil erosion.

REGIONS OF SOIL EROSION

In India, soil erosion is one of the great enemies of Indian agriculture responsible for low agricultural productivity. According to an estimate every year rainwater alone washes out 1/8 cm thick fertile topsoil. Among the States, Rajasthan comes on the top of the soil eroded regions, followed by Madhya Pradesh, Maharashtra, Uttar Pradesh, Gujarat, Andhra Pradesh and Karnataka. The worst affected areas include:

(i) the badlands of the Chambal and Yamuna rivers;

(ii) the piedmont zone of the western Himalayas;

*Source: Forest Survey of India Report 2017.

(iii) the Chotanagpur plateau region;
(iv) the Tapi-Sabarmati valley region in Gujarat;
(v) the regur soil area of Maharashtra; and
(vi) the dry areas of Rajasthan, Gujarat and Haryana.

PREVENTION

1. **Terrace Farming:** On hilly slopes, terraces act as bunds and prevent the soil from being washed away by running water. Terrace farming is practised with successful results in Japan, South-East Asia and the USA.

2. **Shelter Belts:** Farmers plant trees in several rows to check wind erosion. They are known as *wind breaks*.

3. **Contour Ploughing:** Ploughing along contours on a slope prevents soil being washed away by rainwater or by surface run off. Contours act like bunds. Terraces are levelled into step-like small fields with even slope. Contour ploughing is common in Japan, China and some South-East Asian countries.

4. **Strip Cropping:** Crops are grown in alternate strips of land to check the impact of the winds.

5. **Construction of Dams:** Rivers cause soil erosion. Dams are built in the upper course of rivers to control erosion of soil.

6. **Plugging Gullies:** The gullies made in the soil are plugged with deposition of silt during heavy rains.

7. **Planting Trees:** The trees, like in the case of Shelter Belts, are planted along the edges of the fields, the waste land and on steep slopes to prevent soil erosion as well as to enhance the capacity of the soil to retain water.

SOIL CONSERVATION

Soil conservation means prevention of soil loss from erosion or prevention of reduced fertility of soil caused by over usage, acidification, salinisation or other types of soil contamination.

There is an acute need to prevent soil erosion, because of its adverse effects which include the following:

(i) Loss of fertile top soil together with its mineral nutrients, from the upper surface lead to gradual loss of soil fertility and agricultural productivity.

(ii) Lowering of the underground water table and decreasing soil moisture.

(iii) Drying of vegetation and extension of arid lands; Increase in the frequency of droughts and floods.

(iv) Silting of river and canal beds; Recurrence of landslides; Adverse effect on economic prosperity and cultural development.

SOIL CONSERVATION SCHEMES

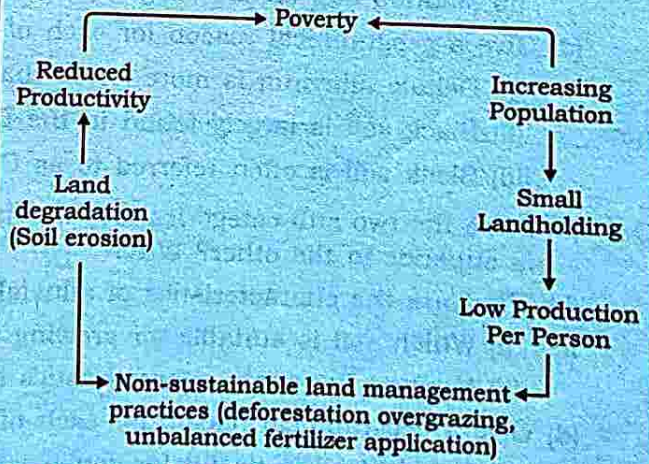
In India, from the very first Five Year Plan, soil conservation measures were launched.

The programmes under the State Plan aim at conservation of soil mainly on agricultural lands with some components of land reclamation, soil and land use survey, raising of utility trees on private and common lands.

(i) The centrally sponsored scheme of *Integrated Watershed Management* in the catchments of flood-prone rivers aims at enhancing the ability of the catchment, reducing erosion and consequent silt load.

(ii) A scheme for *reclamation and development of ravine areas* was launched in Madhya Pradesh, Uttar Pradesh and Rajasthan. The components of this scheme included

Cycle of Poverty and Soil Erosion



To counter this vicious cycle of poverty and soil erosion government agencies need to encourage:

(i) use of technology for soil conservation;
(ii) use of high yielding crop varieties;
(iii) alternative avenues of livelihood;
(iv) limit increase in population.

peripheral bunding to halt further ingress of ravines, afforestation of ravines for fuel, fodder and reclamation of shallow ravines.

(iii) The scheme for control of shifting cultivation is being implemented in the north eastern States. It encourages farmers to practise terraced cultivation and afforestation to support fuel and fodder requirements.

(iv) National Project on Development and Use of Bio-Fertilizers and National Project on Quality Control encourage the use of bio-fertilizers as well as balanced and integrated use of fertilizers.

(v) In urban areas, rainwater harvesting is a means of checking soil erosion, besides recharging ground water.

EXERCISES

I. Answer the following questions:

Q.1 (a) How are alluvial soils formed?

(b) Mention any two advantages of alluvial soil.

(c) (i) Why is soil a valuable resource for India?

(ii) Why is black soil considered a productive soil?

(d) Give a geographical reason for each of the following:

(i) Different regions in India have different kinds of soil for agriculture.

(ii) Alluvial soils vary in texture.

(iii) Nearly all types of crops grow well in riverine soils.

Q.2 (a) Give two characteristic features of the soil found most suitable for growing cotton or sugarcane in Maharashtra.

(b) Name one soil of volcanic origin commonly found in India. Name one crop widely grown in this soil.

(c) (i) Name the process by which Laterite soil is formed.

(ii) Mention one disadvantage of Laterite soil.

(d) Give a geographical reason for each of the following:

(i) Deltaic alluvium is more fertile than the coastal alluvium.

(ii) Black soil is largely found in the Deccan Trap region.

(iii) Black soil is often referred to as Cotton soil or Regur soil.

Q.3 (a) State the two sub-categories into which alluvial soil is generally divided. Which one of these is superior to the other? Why?

(b) What are the characteristics of alluvial soil?

(c) (i) Which soil is suitable for growing coffee in Karnataka?

(ii) Mention two main characteristics of this soil.

(d) Give a geographical reason for each of the following:

(i) Laterite soil is useful for construction purpose.

(ii) Soils of the Western Ghats are affected by wind erosion.

(iii) The foothills of the Himalayas are prone to excessive soil erosion.

Q.4 (a) Name two States in India where Regur soil is found.

(b) Give two points of difference between Regur and Alluvial soil.

(c) (i) Besides cotton, name the crops which grow well in Regur soil.

(ii) In what way does Regur soil help agricul[illegible]e?

(d) Give a geographical reason for [illegible] of the [illegible]owing:

(i) Jowar is grown in Maharasht[illegible].

(ii) Bajra is grown in Rajasthan.

(iii) Sugarcane is grown in Uttar Prade[illegible]h.

Q.5 (a) Name two states where Red soil is found. Mention two important crops grown in this soil.

(b) State two advantages of this type of soil.

(c) (i) How is Red soil formed?

(ii) How is this soil suitable for dry farming?

(d) Give a geographical reason for each of the following:

(i) Black soil is also called lava soil.

(ii) Red soil is red in colour and its colour varies from yellow to brown.

(iii) Jute is cultivated in West Bengal.

Q.6 (a) What is soil erosion? Name the areas of soil erosion in India: (i) for wind erosion. (ii) for running water erosion.

(b) Give two methods used to prevent soil erosion.

(c) (i) What is meant by soil conservation?

(ii) State two measures to conserve soil in hilly areas.

(d) Give a geographical reason for each of the following:

(i) Shelter belts reduce soil erosion in arid areas.

(ii) Rural development will influence soil conservation.

(iii) Water harvesting aids in soil conservation.

Q.7 (a) How does deforestation lead to soil erosion?

(b) State two methods of controlling erosion of soil caused by running water.

(c) Name two important agents of erosion. For each, state one method of controlling the erosion caused.

(d) Explain briefly the need for conservation of soil as a natural resource.

II. Practical Work

With the help of a suitable sketch show the action of running water that causes Sheet, Rill and Gully erosion.

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Chapter 10 Natural Vegetation

Syllabus

Natural Vegetation

Importance of Forests

Types of vegetation (tropical evergreen, tropical deciduous, tropical desert, littoral and mountain), distribution and correlation with their environment.

Forest Conservation.

Natural Vegetation refers to the plant cover that has not been disturbed over a long time, so as to allow its individual species to adjust themselves fully to the climate and soil conditions. Thus, grasses, shrubs and trees, which grow on their own without any human interference, constitute the natural vegetation of an area.

There is a difference between flora, vegetation and forest. *Flora* refers to plants of a particular region or period, listed as species and considered as a group. For example, the Eastern Himalayas have about 4000 species of plants which vary with increasing altitude from tropical to temperate and alpine.

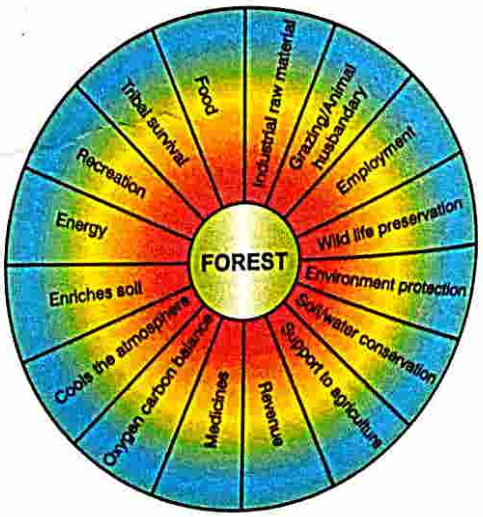
Vegetation, on the other hand, refers to the assemblage of plant species living in association with each other in a given environmental set-up. For example, the redwood forests, coastal mangroves, roadside weed patches, cultivated gardens and lawns, *etc.*, all are encompassed by the term vegetation. The major vegetation types of the world are grouped as forests, grasslands, scrubs and tundra.

Forest refers to a large tract of land covered with trees and accompanying undergrowth of shrubs, herbs and sustaining thousands of life forms, which include both plants and animals. In legal terminology, a forest is any land with its vegetative cover, that has been so declared under a legal provision.

Importance of Forests

(i) Productive Functions: Various trees provide us with products such as fruits, leaves, roots and tubers of plants. Wood is used for making furniture in houses as well as industrial units. Wood and bamboo pulp are used for manufacturing paper and paper boards. Wood is used indiscriminately as a source of energy for cooking and for providing warmth.

Forest products, other than timber and firewood, include fibres, essential oils, oil seeds and edible plants. Bamboos provide a means of livelihood for the tribals who make mats, baskets, ropes, etc., using bamboo. It is also used in the manufacture of rayon (yarns and artificial silk fibres).



Importance of Forests

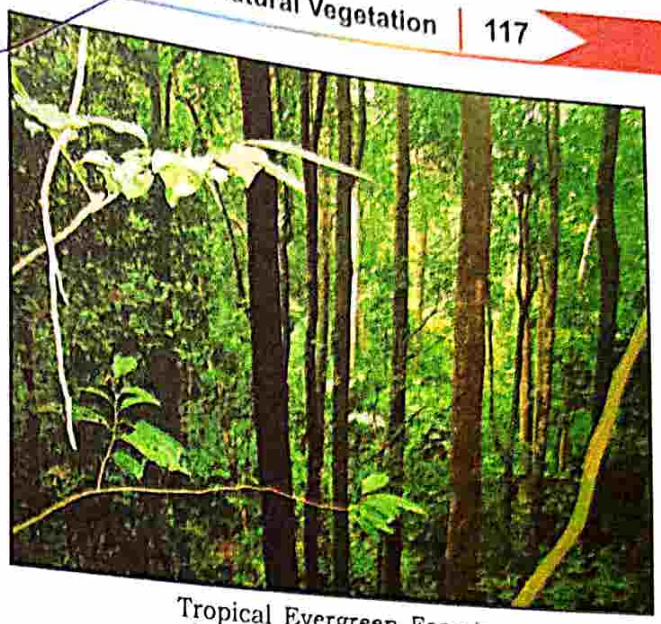
(ii) Protective Functions: Forests control the water flow. The thick layer of humus in the forests prevents evaporation of water. The humus acts as a natural sponge and helps to soak the rain water in the soil. The forest with its complex root system binds the soil thereby preventing soil erosion and loss of nutrients. The thick humus over the years is formed by the decay of forest litter, which increases the fertility of the soil.

(iii) Regulatory Functions: The trees utilise carbon dioxide and release oxygen during photosynthesis. The oxygen released by the trees is used by the animal world. Thus, the trees perpetuate the cycles of oxygen and carbon dioxide in the biosphere. They also regulate the water cycle. The trees absorb water from the ground, release water (during transpiration) into the atmosphere which helps to form clouds and precipitation, which brings water again into the soil, thus completing the Water Cycle.

(iv) Accessory Functions: Accessory functions of the trees means that the forests provide habitat for the wildlife. Forests also provide aesthetics and recreation to human beings through National Parks, Wildlife Sanctuaries and Biosphere Reserves.

TYPES OF VEGETATION

India has a variety of forests and natural vegetation due to variations in climatic conditions, soil types and relief features. The Western Ghats and the Andaman and Nicobar Islands are marked with tropical rain forests; the Himalayas have temperate vegetation; the desert and semi-desert regions of Rajasthan have a wide variety of bushes and thorny vegetation; and the Delta regions have tropical forests and mangroves. The country can be divided into five major vegetation regions, which are: (i) Tropical Evergreen; (ii) Tropical Deciduous; (iii) Tropical Desert; (iv) Littoral; and (v) Mountain.



Tropical Evergreen Forests

1. Tropical Evergreen or Rain Forests

(a) **Climatic Conditions:** These forests are found in the areas where the annual rainfall is more than 200 cm, average annual temperature is between 25°C and 27°C and average annual humidity exceeds 77 per cent.

(b) **Distribution:** These forests are chiefly distributed in the heavy rainfall areas of the western slopes of the Western Ghats, hills of north-eastern region and the island groups of Lakshadweep, the Andaman and Nicobar and Tamil Nadu coast.

(c) **Characteristic Features:**

(i) Since this region remains warm and wet throughout the year, it has a luxuriant vegetation of all kinds — trees, shrubs and creepers giving it a multi-layered structure.

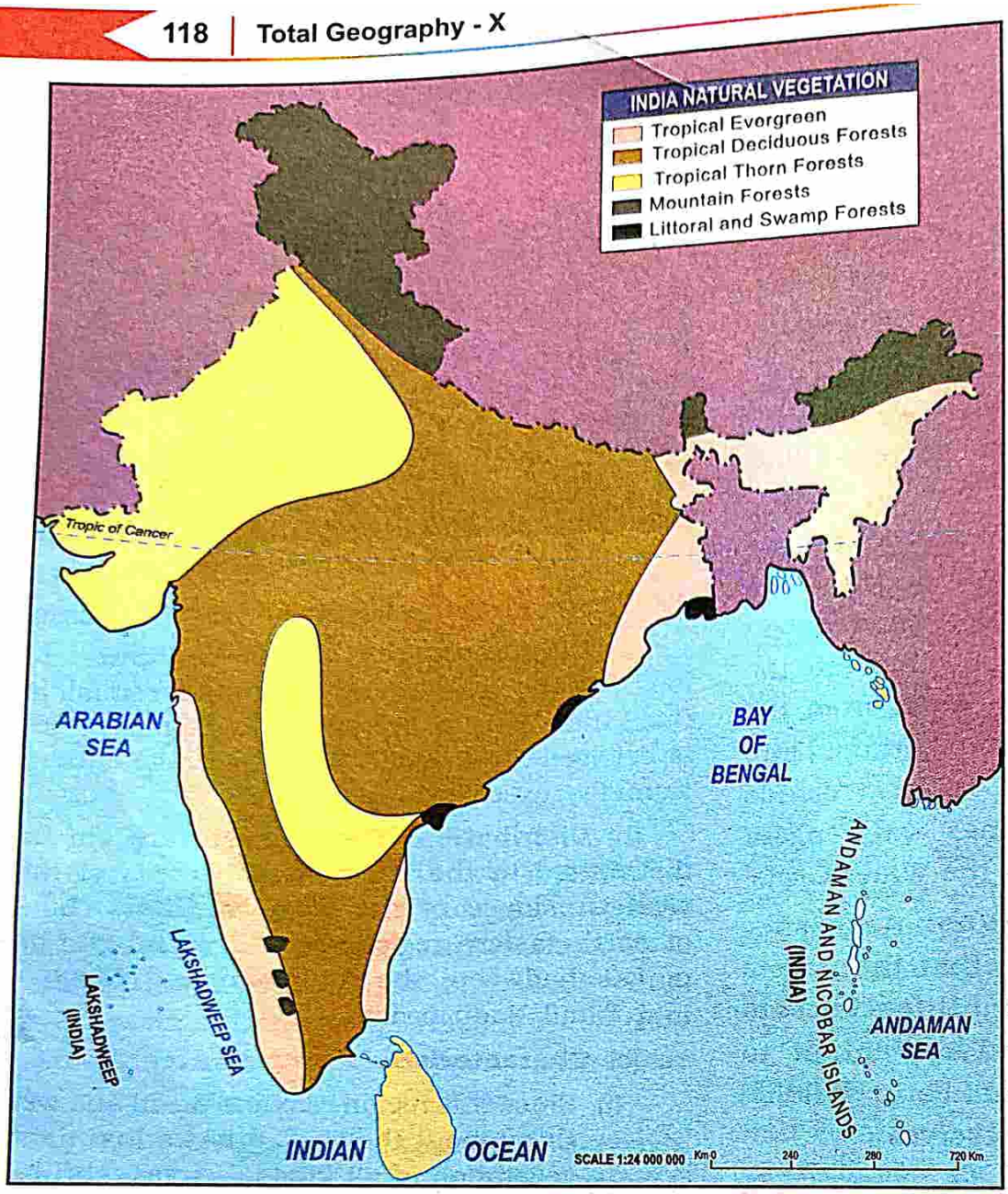
(ii) Trees reach great heights of more than 60 m.

(iii) The carpet layer of herbs and grasses cannot grow because of the dense canopy of trees which do not allow enough sunlight to reach the ground.

(iv) The trees in these forests do not have a fixed time to shed their leaves, to flower or for fruition. That is why these forests appear green all the year round.

The main variety of trees found in these forests include *rosewood, ebony, mahogany, toon, chaplas, sissoo, gurjan, telsur, etc.*

(d) **Economical Value:** Tropical Evergreen forests produce various plant species of high



Natural Vegetation of India

economic value. The timber produced is hard, durable and fine-grained. However, due to tangled mass of canes, palms, bamboos, ferns and climbers along with the lack of means of transport, these forests have not been fully exploited.

2. Tropical Deciduous Forests

These forests are also known as the *monsoon forests*. They are the most widespread forests in India. Based on the availability of water, these forests are further categorised into two types: (i) the moist deciduous forests; and (ii) the dry deciduous forests.

(i) The Moist Deciduous Forests

(a) **Climatic Conditions:** Such forests are found in areas with moderate or low annual rainfall of 100 cm to 200 cm and the mean annual temperature of 24°C and 27°C and humidity percentage of 50 to 80.

(b) **Distribution:** These forests occur in the north-eastern part of the Peninsula, along the foothills of Himalayas and eastern slopes of the Western Ghats. They occupy a sizeable area in Uttar Pradesh, Maharashtra, Karnataka and Tamil Nadu and have an area bigger than the Evergreen forests.

(c) **Characteristic Features:**

(i) The trees in these forests shed their leaves from six to eight weeks during spring and early summer when the storage of water is acute. Further, the sub-soil water is not enough for the trees to keep their leaves all the year around.

(ii) A particular species can be found over a large area.

(iii) They are commercially most exploited forests of India.

The common trees of such forests are sal, teak, arjun, shisham, mahua, mulberry, palas, semul and sandalwood.

(d) **Economical Value:** Tropical Deciduous Forests are commercially the most exploited. Besides providing valuable timber, they provide various other products. Sandalwood found in these forests is in great demand in India and abroad.

(ii) Dry Deciduous Forests

(a) **Climatic Conditions:** These forests are found in areas having a mean annual temperature of 23°C to 27°C, annual rainfall between 70 cm to 100 cm and humidity between 51 to 58 per cent.

(b) **Distribution:** These forests are found in the rainier parts of the Pennisular Plateau and the plains of Bihar and Uttar Pradesh.

(c) **Characteristic Features:** These forests thrive between moist deciduous forests (in the east) and tropical thorn forests (in the west). On the wetter margins, these forests have a transition into moist deciduous, while on the drier margins they degrade into thorn forests. In the northern Indian plains and in the areas of higher rainfall in the Peninsular Plateau, these forests have open stretches in which teak and other trees are interspersed with patches of grass. During the dry season, the trees in these forests shed their leaves completely and give the forests a look of a vast grassland with naked trees.

The common trees of these forests are *teak, tendu, sal, rosewood, amaltas, bel, khair, axlewood, etc.*

(d) **Economical Value:** The trees of these forests provide timber, fruits and other useful products. Large tracts of these forests have been cleared for agricultural activities.

3. Tropical Desert Forests

These are also known as Tropical Thorn Forests.

(a) **Climatic Conditions:** These forests are found in the areas which receive rainfall less than 50 cm, the mean annual temperature ranges between 25°C to 27°C and has humidity below 47 per cent.

(b) **Distribution:** These forests are chiefly distributed in south-western Punjab, Haryana, Uttar Pradesh, central and eastern Rajasthan, Madhya Pradesh, Chhattisgarh, Gujarat, parts of Maharashtra, Karnataka and Andhra Pradesh.

(c) **Characteristic Features:**

(i) These forests have Xerophytic vegetation. Due to paucity of rainfall, the trees are stunted with large patches of coarse grasses.

(ii) These forests have trees which have adapted themselves to survive in drought like conditions and are called *xerophytes*. For example, the *acacia* or *babool* trees have developed long tap roots that can reach deep, ground water resources and therefore, can survive drought like conditions. Further, the acacia trees have long thorns and a symbiotic relationship with stinging ants. These ants live in the thorns, feed on the nectare produced by the trees and when an animal takes a bite of leaves, the insects attact the animal.

(iii) In these forests, plants remain leafless for most part of the year and look like scrub vegetation.

The important trees found here include *babool* or *acacia, date palm, ber, khair, neem, khejri, kanju, cactii, kokko, etc.*

(d) **Economical Value:** *Ber* fruit is eaten raw or made into pickle or beverages. Its timber is hard, strong, tough and durable. It is used to make legs for bedsteads, boat ribs, agricultural implements, charcoal, *etc. Babool* bark and gum have medicinal value. *Date Palm* is eaten raw and also used as an astringent, as a decoction, syrup or paste for sore throat, cold, fever, *etc. Neem* bark and roots have medicinal properties. Neem oil, leaves and neem extracts are used to manufacture health and beauty products. It is also used as an insecticide.

4. Littoral or Tidal Forests

(a) **Climatic Conditions:** These forests are found in wet marshy areas, in river deltas, in tidal or other swampy areas and along the sea coasts.

(b) **Distribution:** These forests are chiefly distributed in the deltas of large rivers on the eastern coast and in pockets on the western coast in saline swamps of Sunderbans in West Bengal and coastal areas of Andhra Pradesh and Odisha.

Tropical Thorn Forests

Exposed Stilt Roots During Low Tide

(c) **Characteristic Features:**

(i) They have mainly evergreen species of varying density and height, usually associated with wetness.

(ii) The tree trunks are supported by a number of stilt like roots which remain submerged under water during high tide and can be seen during low tide.

(iii) They have profuse growth with tangle of climbers, which is an adaptation for survival in soft and shifting mud.

(iv) These forests have breathing roots called pneumatophores. Because of waterlogged conditions, the roots are deprived of oxygen during high tides. So, some mangrove roots extend vertically above the ground. These vertical roots have pores which enable the trees to breathe when other roots remain sub merged under water during high tide.

The important trees include *keora, amur, bhara, rhizophora, screw pines, canes* and *palms, sundari, agar, etc.* Mangrove forests grow along the coasts in the salt marshes, tidal creeks, mud flats and estuaries. They are found in the Andaman and Nicobar Islands and West Bengal. Other areas of significance include the Mahanadi, the Godavari and the Krishna deltas.

These forests have *Sundari trees*, after the name of which these forests are known as *'Sunderbans'* in the Ganga Delta.

(d) **Economical Value:** Mangrove trees are utilised for fuel whereas sundari trees provide hard durable timber.

Important Trees and their Uses

- ***Rosewood*** is used for making furniture, floor boards, wagon parts, *etc.* It is used as decorative wood for carving and for making ornamental ply-boards and veneers.
- ***Ebony*** is used for ornamental carving and for decoration. It is used for inlaying, for making musical instruments, sports goods, piano keys and caskets.
- ***Teak*** wood is moderately hard, durable and easy to work. It is used for construction purposes, shipbuilding and making furniture, railway carriages, sleepers and bridges.
- ***Sandalwood*** is used for making statues and ornamental objects. It is also used in making aromatic substances and for extracting sandalwood oil.
- ***Sal*** wood is very hard, heavy and tough. It is used for making beams, planking and railing of bridges, doors, window posts of houses, railway sleepers, *etc.*
- ***Palas*** leaves are used for rearing shellac worms.
- ***Ber*** is a fruit which is eaten raw or made pickle or beverages. Its timber is hard, strong, tough and durable. It is used to make legs for bedsteads, boat ribs, agricultural implements, charcoal, *etc.*
- ***Babool's*** bark and gum have medicinal value.
- ***Neem*** bark and roots have medicinal properties. It is effective in treating diabetes, allergies, ulcers and several other diseases. Neem oil, leaves and neem extracts are used to manufacture health and beauty products. Neem is also used as an insecticide.
- ***Deodar*** is a medium weight durable wood. It is used for construction work and for making railway sleepers. It is also suitable for beams, floor boards, ports, window frames and light furniture.
- ***Sundari*** trees provide hard durable timber for construction purposes and boat making.

5. Mountain Forests

In the mountain regions temperature decreases with altitude. This has a corresponding effect on the natural vegetation of the mountain regions.

(a) **Climatic Conditions:** These forests are found in areas where annual temperature

is 12°C to 13°C, rainfall is between 100 and 300 cms and annual humidity is between 56 and 65 per cent.

(b) **Relief:** These forests occur at an altitude between 1000m to 4000m.

(c) **Distribution:** These forests cover the entire Himalayan zone. In the Peninsular region they are found in the Vindhyas, Nilgiris and the Western Ghats.

(d) **Characteristics Features:**

(i) These forests contain mixed species of broad leafed evergreen trees and conifers. They also contain scrubs, creepers and ferns.

(ii) At the foothills of the Himalayas deciduous forests are found.

(iii) At an altitude of 1000m to 2000m they are the moist temperate forests.

(iv) In the hilly areas of West Bengal and Uttarakhand, evergreen broad leaf trees like chestnut and oak are found.

(v) Between the altitude of 1500m and 1750m, coniferous trees like Chir pine is an important tree. At an altitude of 2250m and 3000m blue pine and spruce are found.

(vi) At higher altitudes, alpine forests and alpine grass upto the snowline are found followed by mosses and lichens. Beyond the snowline no vegetation is found.

(vii) In the Peninsular regions, the area is only about 1500 m in height and vegetation varies from tropical to temperate forests.

This is because of their closeness to the tropics and height of only 1500 m above sea level. So the vegetation is temperate in the higher regions, and sub tropical on the lower regions of the Western Ghats, especially in Kerala, Tamil Nadu and Karnataka. These temperate forests are called *Sholas* in the Nilgiris, Anaimalai and Palani hills.

The important trees found in these forests include *magnolia, laurel, cinchona, wattle, jamun, plum, etc.*

CORRELATION OF THE FORESTS WITH ENVIRONMENT

Forests have an intricate interrelationship with the environment. Forests play a vital role in protecting the environment by performing the following functions:

- Forests are the moderators of climate.

Natural Vegetation of India

Vegetation Type	Climatic conditions	Distribution	Important Trees
Tropical Evergreen	Temp: 25°C–27°C Rainfall: More than 250 cm	Western slopes of the Western Ghats, hills of north-eastern region, and the Andaman and Nicobar Islands.	Rosewood, ebony, mahagony, toon chaplas, sissoo, gurjan, telsur, etc.
Tropical Deciduous	Temp: 24°C–27°C Rainfall: 100–200 cm	Northern states along the foothills of the Himalayas, eastern slopes of the Western Ghats.	Sal, teak, arjun, palas, shisham, mahua, mulberry, semul, sandalwood, etc.
Tropical Desert	Temp: 25°C–27°C Rainfall: Less than 50 cm	South-western Punjab, Haryana, Uttar Pradesh, Central and eastern Rajasthan, Madhya Pradesh and Gujarat.	Ber, babool, date palm, khair, neem.
Littoral	Temp: 26°C–29°C Rainfall: More than 200 cm	Deltas of large rivers on the eastern coast, in pockets on the western coast, in saline swamps of the Sunderbans in West Bengal and coastal areas of Andhra Pradesh and Odisha.	Keora, amur, bhara, rhizophora, screw pines, canes and palms, sundari, agar, etc.
Mountain	Temp: 12°C–13°C Rainfall: 100–300 cm	The Himalayan zone.	Spruce, deodar, walnut, cypress, jamun, chestnut, cedar, kail, birch.

They play an effective role in controlling humidity, temperature and precipitation.

- Forests play dominant role in carbon cycle. They absorb atmospheric Carbon dioxide and help in maintaining the purity of air and controlling atmospheric pollution.
- Forests help in controlling soil erosion, soil degradation and floods. That is why they are very helpful in land reclamation and flood control.
- Forests help in water percolation and thereby maintain underground water table.
- Decay of plant leaves provides humus to the soils and increases their fertility.

FOREST CONSERVATION

Man has been overexploiting the forests to satisfy not only his needs but also his greed. This has led to a decline in the forest cover.

- Due to rapid population growth and the demand for more food, forests have been cleared to convert them into agricultural land.
- Forests have been converted into pasture land for expanding dairy farming and cattle ranching.
- Overgrazing in the forests by animals in the tropical and sub-tropical regions has resulted into large-scale degradation of natural vegetation.
- Ever increasing demand for timber for various purposes due to industrial expansion and urbanisation has added to the problem of deforestation.
- Construction of multi-purpose river valley projects has led to submergence of land and destruction of forested riversides.

All these factors have led to the decline in forests, which have the following effects:

(i) Decline in the forests have led to the decline in forest productivity.

(ii) Forests influence human environment by moderating climate, regulating water supply, maintaining fertility of soil and purifying air. Absence of forest cover leads to soil erosion which increases load of the rivers. The increased surface load reduces water in the rivers for human use. Siltation causes floods which destroy property, crops and living beings.

(iii) Lack of forest cover reduces precipitation, thus causing droughts.

(iv) Forests act as a sink for carbon dioxide that the trees use during photosynthesis. The absence of forests increases the concentration of carbon dioxide in the atmosphere. Thus, increasing greenhouse effect in the atmosphere. This raises the temperature of the earth's surface and of the atmosphere leading to global warming and its harmful consequences.

Hence, conservation of forest is of vital importance for the survival and prosperity of human kind.

CONSERVATION MEASURES

To arrest deforestation and stop the diversion of forest lands for non-forest uses, the following conservation practices must be undertaken:

(i) Increasing the Area Under Forests: Loss of forests can be remedied by a massive programme of tree plantation. Planting trees on degraded lands and land that is unfit for agriculture will not only help in improving the environment but will also relieve harvesting pressure on these forests.

(ii) Afforestation around Industrial Units: The level of pollution is much higher in areas where industries are located. For example, in the cities having Iron and Steel Plants, pollutants generated are more than other cities. This is because during the manufacture of steel, air emissions from the manufacturing plants emit particulate matter, sulphur oxides, nitrogen oxides, hydrocarbons and hydrogen fluoride which pollute the air. Besides, these steel plants emit significant dust levels of about 20 kilograms per metric ton of steel. To prevent pollution, trees are planted around the cities having Iron and Steel Plants. The trees act as a barrier for the dust and purify the air.

(iii) Stopping Indiscriminate Felling of Trees: There should be a strict ban on felling of naturally growing trees. If a tree has to be cut, necessary permission has to be obtained. Besides, proper replacement of trees by planting

saplings at least in the ratio of 1:10 (1 tree to 10 saplings) should be undertaken.

(iv) Establishing Corridors between Different Reserved Forests: Wide corridors should be established in different reserved forests to allow the migration of wild animals. This will also help numerous species of animals to use these corridors for their dispersal and migration.

(v) Using Alternative Sources of Energy: In many parts of the world including India, trees are felled for providing firewood. So, in order to conserve forests, we must use non-conventional or renewable sources of energy, like solar energy, tidal energy, hydel energy, *etc.*

(vi) Proper Legislation and its Implementation: Strict laws should be made to check deforestation. Proper care should be taken to see that these laws are strictly implemented.

(vii) People's Participation: Participation of the local community is of utmost significance if any plan has to be enforced since the local inhabitants are the ultimate users. Most programmes now involve local communities in planning, decision-making and implementation.

Useful Terms

Afforestation: Planting trees on lands which are not previously covered with forest vegetation.

Agro-forestry: The sustainable system of managing a piece of land through combined production of agricultural crops and forest crops and animal rearing, to ensure the most efficient land use in accordance with socio-cultural practices of the local people.

Deforestation: The clearing or thinning of forests by humans for wood, crop lands and grazing land.

Farm forestry: The practice of growing trees on farm land to produce saleable products like timber, tannin, charcoal, etc. and to provide shade and shelter for stock and crops.

Reforestation: Re-establishing a forest by planting trees in an area from which forest vegetation has been removed.

Social Forestry: The management and protection of forests and afforestation on barren lands with the purpose of helping in the environmental, social and rural development.

(viii) Developing badlands and barren lands into vegetation belts.

Draft National Forest Policy 2018

Draft National Policy 2018 aims at sustainable forest management by incorporating elements of ecosystem security, climate change, forest hydrology, robust framework to monitor and develop forest cover and strengthening the overall environmental balance.

- The overall objective and goal of the policy is to safeguard the ecological balance and livelihood of people, of the present and future generations, based on sustainable management of the forests.
- The country should have a minimum of one-third of the total land area under forest and tree cover and two-thirds in the hills and mountainous regions. This will help to prevent soil erosion and land degradation and ensure the stability of the fragile eco-systems.
- Reverse the degradation of forest by taking up rehabilitation without compromising its natural profile.
- Checking denudation and soil erosion in the catchments of rivers and the wetlands through integrated watershed management techniques and practices.
- Maintenance of the health of forest vegetation and forest soils for enhancing water supplies through recharge of underground aquifers and regulation of surface water flows.
- Safeguard forest land by exercising strict restraint on diversion for non-forestry purposes, and strict oversight on compliance of the conditions.
- Manage protected areas and other wildlife rich areas with the primary objective of biodiversity conservation and for enriching other ecosystem services.
- Increase substantially the tree cover outside forests by promoting agro-forestry and farm forestry.
- Integrate climate change mitigation and adaptation measures in forest management

through the mechanism of REDD+(Reducing Emissions from Deforestation and Forest Degradation plus) so that the impacts of the climate change is minimised.

- Managing and expanding green spaces in urban and peri-urban areas (outskirts or hinter land) to enhance citizens' wellbeing.

Based on this Conservation Policy, the Government has initiated the following measures:

Social Forestry: It refers to the management and protection of forests and afforestation on barren lands with the purpose of helping in the environmental, social and rural development.

Social forestry is people-oriented, value based joint management of forests with the major objective of satisfying the needs, wants and aspirations of both the people and the government. It embraces almost a limitless range of activities on uncultivated land and thus, reduces the pressure on the nation's forest resources. Social Forestry is also known as extension forestry, mined forestry, urban forestry, tree farming, *Vanamahotsava*, recreation forestry, livestock forestry, *etc.* Most of these names indicate utility of the forest features of Social Forestry.

Social forestry is forestry for community development. It consists of:

- restoration, reallocation, reorganisation of existing forest lands for the total development of the land and the people living on it;
- joint management of the forest and its production processes; and
- developing the socio-economic structure that makes the above two possible.

Objectives of Social Forestry

The main objectives of Social Forestry, as recommended by the National Commission on Agriculture, include the following:

(i) Providing fuel wood, fodder for cattle, timber and minor forest products to rural people.

(ii) Utilising the available land according to its productive capacity.

(iii) Developing local cottage industries by providing raw materials.

(iv) Providing efficient conservation of soil and water.

(v) Providing employment opportunities to the rural people.

(vi) Increasing agricultural production by using cow dung as manure.

(vii) Fulfilling the recreational needs of the people.

(viii) Improving the aesthetic scene of the area.

(ix) Achieving all-round rural development as a part of integrated rural development programme.

Agro-Forestry: Agro-forestry is a part of social forestry and represents the intermediate stage between forestry and agriculture. Agro-forestry refers to "the sustainable system of managing a piece of land through combined production of agricultural crops and forest crops and animal rearing, to ensure the most efficient land use under a management system in accordance with socio-cultural practices of the local people." Agro-forestry aims to provide conservation of the land and its improvement in order to achieve a combined produce of forest and agricultural crops.

Objectives of Agro-Forestry

(i) To reduce pressure on natural forests for obtaining timber as well as non-timber forest produce.

(ii) To check soil erosion and to maintain the natural fertility of the soil.

(iii) To maintain ecological balance along with proper utilisation of farm resources.

(iv) To make the best use of all the available resources like land, manpower, livestock, ecological factors, *etc.*, to obtain a variety of forest products such as food, fuel, fodder, livestock, recreation and a variety of forest products sustainably from the same land.

Agro-Forestry is different from the traditional forestry in the sense that it is not vulnerable to population stresses. It is created in accordance with the socio-cultural practices of the population. In fact, agro-forestry co-ordinates with local population and reduces the pressure of population on traditional forestry.

EXERCISES

I. Answer the following questions:

Q.1 (a) What is meant by natural vegetation?

(b) Give two points of difference between vegetation and forests.

(c) (i) Name the area where tropical rain forests are found.

(ii) Mention two main characteristics of tropical rain forests.

(d) Give a geographical reason for each of the following:

(i) The Western Ghats are covered with thick evergreen forests while the Eastern Ghats are covered by deciduous forests.

(ii) Tropical evergreen forests have tall trees and appear green all the year round.

(iii) Deciduous forests are commercially most exploited.

Q.2 (a) Give two points of difference between Tropical Evergreen and Tropical Deciduous Forests.

(b) What are the climatic conditions under which Tropical Evergreen Forests develop?

(c) (i) What are the characteristic features of deciduous forests?

(ii) Name the two types of deciduous forests.

(d) Give a geographical reason for each of the following:

(i) Tropical Evergreen Forests are difficult to exploit for commercial purposes.

(ii) Delta area of river Ganga is called *Sunderbans*.

(iii) Forests are grown in and around the cities having Iron and Steel Industries, and Thermal Power Plants.

Q.3 (a) Mention the areas where Tropical Desert Vegetation thrives.

(b) Under what climatic conditions do Littoral forests develop?

(c) (i) State two characteristic features of tropical desert vegetation. Name two typical trees found here.

(ii) Why tropical deserts have stunted trees.

(d) Give a geographical reason for each of the following:

(i) The forest area has greatly depleted in India.

(ii) The Tropical Evergreen forests are found on the western slope of the Western Ghats.

(iii) Acacia has long roots.

Q.4 (a) What are 'Tidal forests'? Name two typical trees found there.

(b) Name the type of forests found in the western part of the Western Ghats. Give two reasons why these forests are so named.

(c) Describe the methods of protecting forests under the following heads:

(i) Afforestation.

(ii) Using alternative sources of energy.

(d) Give a geographical reason for each of the following:

(i) Forests constitute an important natural resource.

(ii) Agro forestry is not vulnerable to population stress.

(iii) Tidal forests have profuse growth with tangle of climbers.

Q.5 (a) What is social forestry?

(b) Give two points of difference between agro-forestry and traditional forestry.

(c) Mention any three methods for the conservation and development of forests in India.

(d) State three objectives of agro-forestry.

Q.6 (a) Why does the vegetation in Himalayas vary with altitude?

(b) Why does Tropical Evergreen forests appear dark inside the forests.

(c) Explain how is man responsible for the reduction of forest cover in India.

(d) Give a geographical reason for each of the following:

(i) Nilgiri region has variety of vegetation type.

(ii) Sundari trees are used for boat making and construction purposes.

(iii) Littoral forest is also called tidal forest.

Q.7 (a) Name two areas where Tropical deciduous vegetation is found.

(b) Why do the Coniferous trees of mountain forests have conical shape?

(c) What is meant by 'farm forestry'? State two of its advantages for farmers.

(d) Give a geographical reason for each of the following:

(i) Littoral forest vegetation has breathing roots.

(ii) Forests are often compared to human lungs.

(iii) Van Mahotsav is celebrated in our country every year.

II. Map Work

1. On an outline map of India mark the areas having:

(i) Tropical Evergreen. (ii) Tropical Deciduous Forests.,

(iii) Tropical Desert Vegetation. (iv) Montane Forests.

(v) Littoral Vegetation.

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Chapter 11 Water Resources

Syllabus

Water Resources

Sources (Surface water and groundwater).

Need for conservation and conservation practices (Rainwater harvesting and its importance).

Irrigation: Importance and methods.

SOURCES OF WATER

The term 'water resource' refers to any of the entire range of natural waters that occur on the earth and are of potential use to living beings. Of these resources the ones which are most available for use are the waters of oceans, rivers and lakes. Other available water resources comprise groundwater and deep sub-surface waters and glaciers and permanent snowfields.

About 97 per cent of the earth's water supply is in the ocean which is unfit for human consumption and other uses due to high salt content. Of the remaining 3 per cent, 2.3 per cent is locked in the polar ice caps. The balance 0.7 per cent is available as freshwater but 0.66 per cent, is groundwater and the rest 0.03 per cent is available to us as freshwater in rivers, lakes and streams.

(a) **Surface Water:** Water on land is the result of precipitation or seepage from underground which forms streams and rivers flowing on land and finally joining the sea.

(b) **Groundwater:** The water from precipitation, that is from rain or snow flows on the surface. Some of the water evaporates and the rest sinks into the soil. The water which gets collected under the surface of the land is known as *groundwater* which remains in the soil, sub-soil or bedrock. Most of the water ultimately reaches the sea. An undergroundwater stream that is saturated with water and transmits water readily is known as an aquifer. Groundwater constitutes 0.66 per cent of usable water on the earth.

Nature has endowed India with plentiful water resources. These resources account for four per cent of the world's water resources. Besides *surface water, i.e.,* from rivers, lakes, ponds and tanks and *groundwater resources,* India has a vast coastline with indented coasts in some states. Odisha, Kerala and West Bengal have vast surface water resources in the form of lagoons and lakes. Though water is brackish in these water bodies, it is utilised for fishing and irrigation of certain crops like paddy, coconut, *etc.*

NEED TO CONSERVE WATER

Water is a natural resource which satisfies the basic human need. Due to increase in population, irrigation and industrialisation, the demand for water has risen. This has led to a decline in groundwater levels in various parts of the country. According to a report by Central Ground Water Board (CGWB), Delhi, Haryana, Chandigarh, Himachal Pradesh and Uttarakhand recorded a sharp fall in the groundwater levels, ranging from 70 to 80 per cent. We need to conserve water for the following reasons:

(i) The overexploitation of undergroundwater often results in the lowering of water table.

(ii) The loss of vegetation causes drought and reduction of rainfall and lowering of the water table.

(iii) Irrigation utilises more than 90 per cent of the total freshwater.

(iv) The increase in population results in water scarcity.

(v) Our water resources like the underground water, rivers, lakes *etc.* are polluted and their water can hardly be used without adequate treatment.

CONSERVATION PRACTICES

Due to declining availability of freshwater and increasing demand, we need to conserve water and manage our water resources. We need to take quick steps to make proper policies and laws and adopt effective measures for its conservation. This can be done by rainwater harvesting, adopting water saving technologies, encouraging watershed development, water recycling and preventing the pollution of water.

Rainwater Harvesting

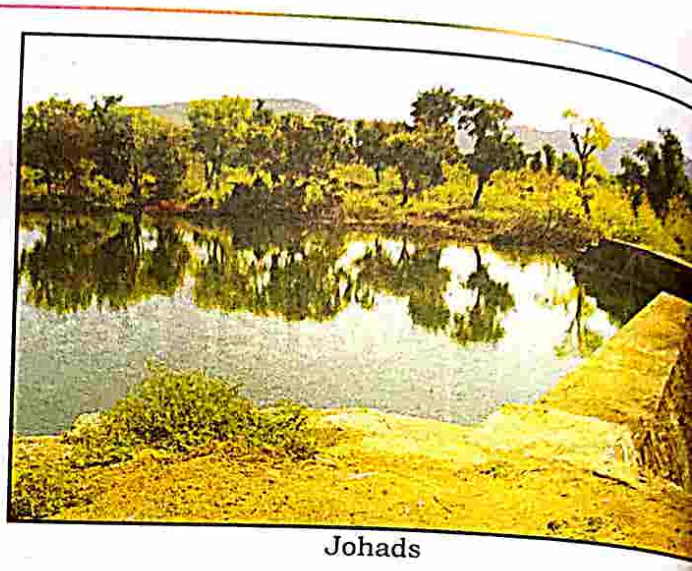
Rainwater harvesting is collecting and storing rainwater, which includes activities aimed at—

(i) harvesting surface and groundwater,

(ii) prevention of losses through evaporation and seepage, and

(iii) all other hydrological studies and engineering interventions, aimed at conservation and efficient utilisation of the limited water endowment of an area such as a watershed.

Rain is the primary source of water according to the hydrological cycle. Rivers, lakes and groundwater are all secondary sources of water. We depend entirely on such secondary sources of water, and most of the time forget the value of the rainwater. Water harvesting means understanding the value of rain and making optimum use of rainwater at the place where it falls. Water harvesting is the activity of direct collection of rainwater that can be stored for direct use or can be used to recharge groundwater.



Johads

Water has been harvested in India from ancient times. Our ancestors had perfected the art of water management. Many water harvesting structures and water conserving mechanisms were followed in each region of the country.

- People harvested rainwater by collecting water from the rooftops and storing it in tanks built in their courtyards. From open community lands, they collected the rainwater and stored it in artificial wells.
- They harvested rainwater runoff by capturing water from swollen streams during the monsoon season and storing it in water bodies.
- They harvested water from flooded rivers.

The storing mechanisms or the water receptacle was known by different names in different areas. They were called *Khatri* or *Kuhl* in Western Himalayas, *Baolis* or *Dighis* in the Gangetic plains, *Johads* in Central India, *Bhandaras* or *Kere* in the Deccan Plateau, *Surangam* in Western Ghats, *Korambu* in Eastern Ghats and *Zing* in Ladakh.

Need of Water Harvesting

In India, we have acute shortage of water during the year. This is because we have not

WATERSHED MANAGEMENT

Watershed management refers to the efficient management and conservation of both the surface and groundwater resources. It includes prevention of runoff as well as storage and recharge of groundwater by various methods like percolation pits, recharge wells, borewells, dugwells, *etc.*

The Central Government has started a watershed development project, called '*Haryali*'. It aims at enabling the rural people to conserve water for irrigation, drinking, fisheries and afforestation.

cared to conserve water or rationalised its use. The annual rainfall in India is 1,170 mm (46 inches). This is higher compared to the world average of 800 mm (32 inches). Ironically, even Cherrapunji, which receives about 11,000 mm of rainfall annually, suffers from acute shortage of drinking water. This is because rainfall in India occurs in short spells of high intensity. Due to such intensities and short duration of heavy rain, most of the rain falling on the surface tends to flow away rapidly, leaving very little for the recharge of groundwater. This makes most parts of India experience lack of water even for domestic uses.

Water Harvesting Mechanism

The elements of water harvesting are given below:

1. Catchments: The catchment of a water harvesting is the surface which receives rainfall directly. It can be a paved area like a terrace or courtyard of a building or an unpaved area like a lawn or open ground. Temporary structures like sloping sheds can also act as catchments.

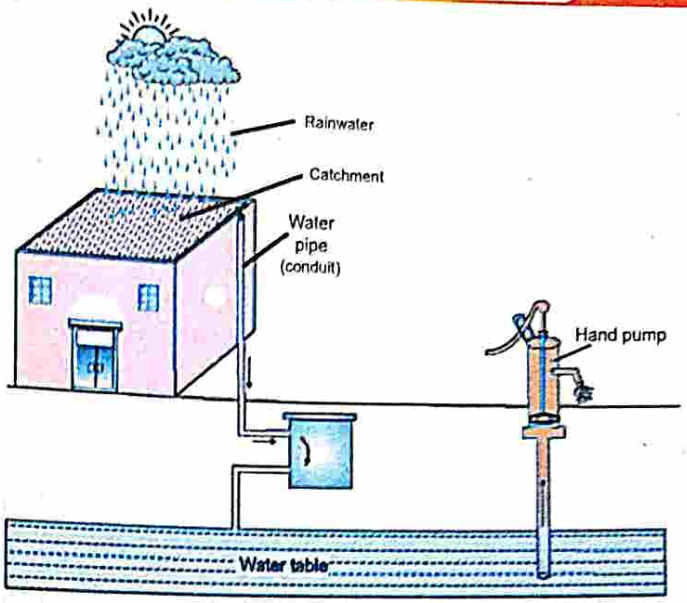
2. Conduits: Conduits are the pipelines or drains that carry rainwater from the catchment or rooftop to the harvesting system. Conduits may be of any material like Polyvinylchloride (PVC), asbestos or Galvanised Iron (GI), or materials that are commonly available.

3. Storage facility: Rainwater can be stored in any commonly used storage containers like RCC, masonry or plastic water tanks.

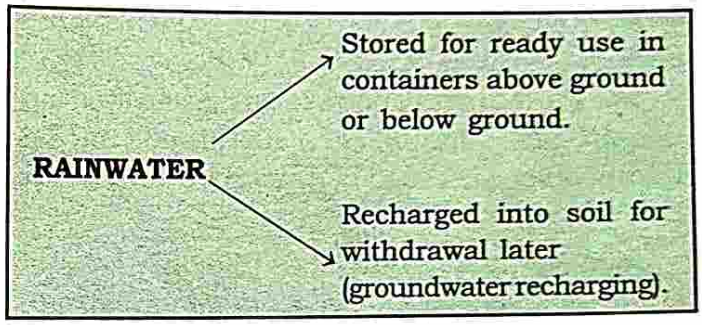
4. Recharge facility: Alternative to storing, rainwater can be used to recharge groundwater aquifers. This can be done through any suitable structures like dugwells, borewells, recharge trenches and recharge pits.

Storing Water for Direct Use

An underground RCC (Reinforced cement concrete) or masonry tank can be used for storage of the rainwater. The tank can be installed inside the basement of a building or outside the building. Prefabricated tanks such as PVC can be installed above the ground. Each tank must have an overflow system for situations when excess water enters the tank. The overflow can be connected to the drainage system.



Modern Water Harvesting



Generally, runoff from only paved surfaces is used for storing, since it is relatively free of bacteriological contamination. *Rooftop rainwater harvesting is the process of water harvesting in which rainwater falling on a roof is diverted through drain-pipes to the storage container.* To prevent leaves and debris from entering the system, mesh filters are provided at the mouth of the drain-pipe. Further, a first-flush device is provided in the conduit before it connects to the storage container. If the stored water is to be used for drinking purposes, a sand filter is provided.

Water quality improves over time during storage in the tank because impurities settle down in the tank if the water is not disturbed. Even pathogenic (harmful) organisms gradually die out due to storage. Biological contamination can be further removed by disinfecting the water. Many simple methods of disinfection are available which can be carried out at the domestic level.

IRRIGATION

Irrigation refers to the process of watering of agricultural plants through artificial means

RECHARGING GROUNDWATER AQUIFERS

Various kinds of recharge structures are possible which can ensure that rainwater percolates in the ground instead of draining away from the surface. Some of these are:

1. **Borewells and Dugwells** are used to raise the undergroundwater table by collecting rainwater on the rooftop of the building which is then diverted by drainpipes to a filtration tank. From there it flows into the borewell or dugwell.

2. **Recharge Pit** excavated into the ground, lined with a brick or stone wall with openings at regular intervals.

3. **Percolation Pits (Soakaway)** is a bored hole of up to 30 cm diameter drilled in the ground to a depth of 3 to 10 m.

4. **Recharge Trenches** are excavated on the ground and refilled with porous media like pebbles, boulder or brickbats to harvest the surface runoff.

5. **Permeable Surfaces** like a patch of grass is used to retain a large proportion of the rainwater falling on it, yielding only 10-15 per cent as runoff.

6. **Porous tiles** on pavements and footpaths.

from wells, tanks, tubewells, canals, *etc.* From the point of view of sustained agricultural production and all-round development, water is the most precious resource. Presently about 92 per cent of water is used for agriculture, 2 per cent for industries and 6 per cent for drinking and domestic purposes. For farmers rainfall is still the most important source of water. About 55 per cent of the net sown area in the country depends on rainfall to sustain crop production. Success in dry farming depends on moisture conservation practices and judicious use of available water for irrigation.

Under this situation, it is imperative to utilise artificial means to raise crops. In India, irrigation has been practised from ancient times. A number of artificial lakes and canals that dot the country are centuries old and some of them have served for more than a thousand years. The notable examples are the two big tanks in Chingleput district of Tamil Nadu constructed in 8th and 9th centuries AD and the Grand Anicut built across the Cauvery river during the second century AD. The irrigation canals built by various rulers from time to time, testify the importance of irrigation in the development of agriculture in India.

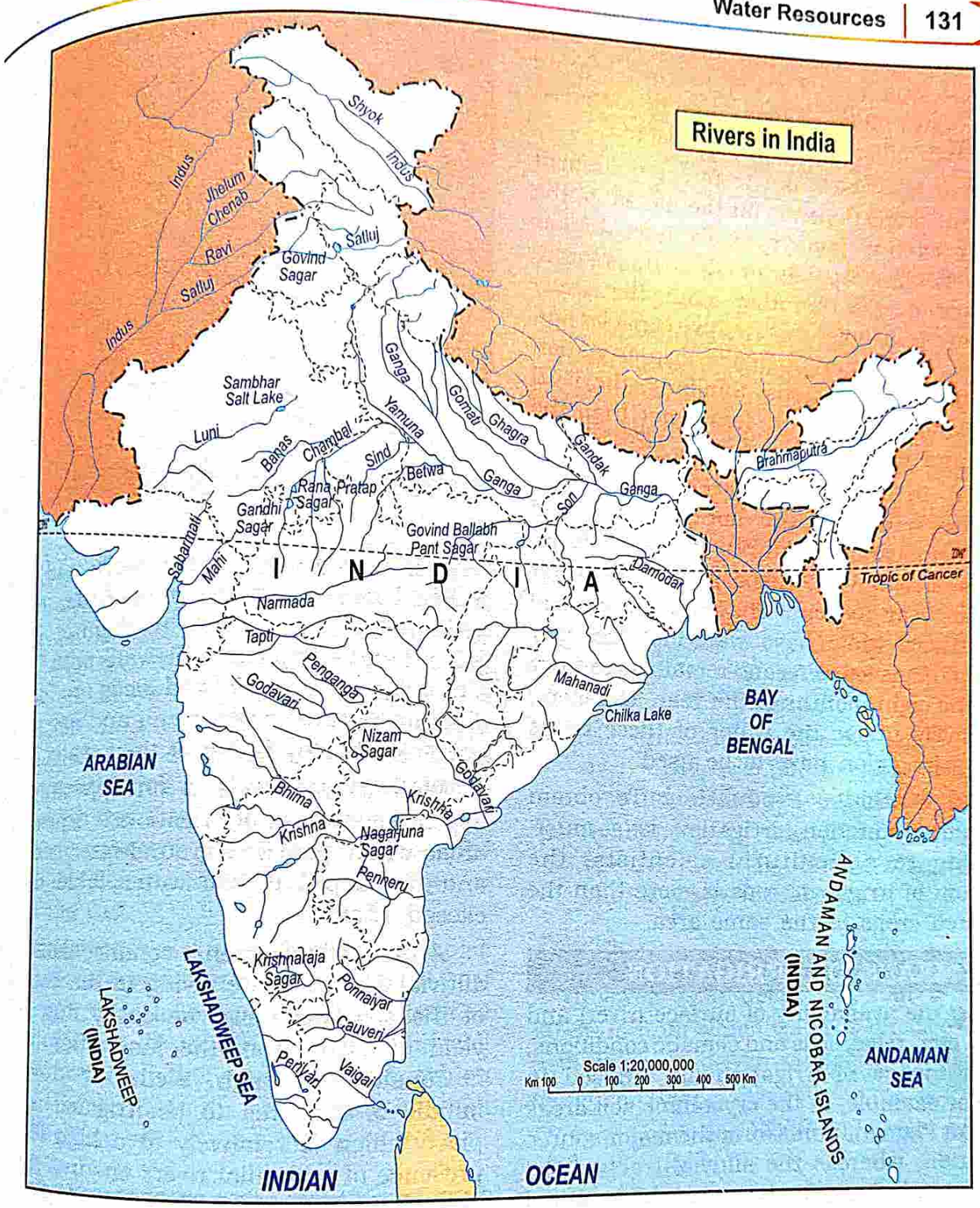
After India attained independence and began planned development, the increase in irrigation potential was regarded as one of the prerequisites for agricultural development in the country. This was because of the following reasons:

1. **Uncertainty of Rainfall:** The rainfall in India is highly irregular in place and time, that is, normal rainfall is marked by wide fluctuations in different parts of the country. Sometimes the monsoon arrives early and at times it comes late. Not only is the arrival and withdrawal of rainfall uncertain but also its continuity, rhythm and intensity. The rainfall is not regular throughout the rainy season leading to water scarcity and withering of the crops. Hence, irrigation is the only means to supplement rainwater to raise crops.

2. **Uneven Distribution of Rainfall:** In India, the distribution of rainfall is quite uneven. Most parts of the country receive 80 per cent of the annual rainfall from June to September from the South-west monsoon. Western Ghats and north eastern India receive more than 250 cm of annual rainfall, whereas the northern plains and the eastern Peninsula receive between 100 and 200 cm of rainfall. Saurashtra Kutch region of Gujarat, parts of Punjab and Haryana and western half of Rajasthan lie in the arid zones. Here the amount of rainfall is low and there is a constant scarcity of water. This inadequacy of rainfall has to be met by irrigation.

3. **Crop Requirements:** Different crops require different quantities of water for their growth.

(i) Most of the crops do not require water when they are maturing. However, grain crops require more water during the time ear heads are formed.



Rivers in India

i] India has three cropping seasons—kharif, rabi and zaid. The kharif crops which occupy the largest area in the country are dependent on the monsoon rains. Where irrigation facilities are not developed, these crops are grown as rainfed crops.

Rabi crops are grown on the soil moisture which is left after the harvest of kharif crops, or over the area where assured supply of irrigation is available.

Zaid or summer crops are exclusively irrigated crops.

Further, the rapidly growing population has forced the farmers to raise two or three successive crops in a single year. This cannot be done without the help of irrigation.

(iii) High yielding varieties requiring higher quantity of chemical fertilizers need more moisture which could be supplied only through irrigation.

(iv) Commercial crops like sugarcane need higher quantity of water as they require frequent watering which could be managed through efficient irrigation system.

4. **Nature of the Soil:** The water requirement of different crops depends on the nature of the soil. For example, clayey soils have higher moisture holding capacity and therefore, require less irrigation. On the other hand, the sandy loams have less moisture retentive capacity and need frequent watering hence drip irrigation is suitable in dry regions. Similarly, the level and lowland areas require less water than the sloping and highland areas.

5. **To Utilise River Water Effectively:** Many rivers in India are not perennial and carry insignificant flows during the rabi season. There is also a wide disparity in the water flow from year to year. The rivers of central and southern India have water for the four months of monsoon rains and remain largely dry during the eight months of the year. Therefore, to effectively utilise the water of these rivers means of irrigation have to be used.

6. **To Maximise Production:** To obtain maximum production, irrigation is a must. According to agricultural scientists, the production of irrigated crops is more than the unirrigated crops in the same area.

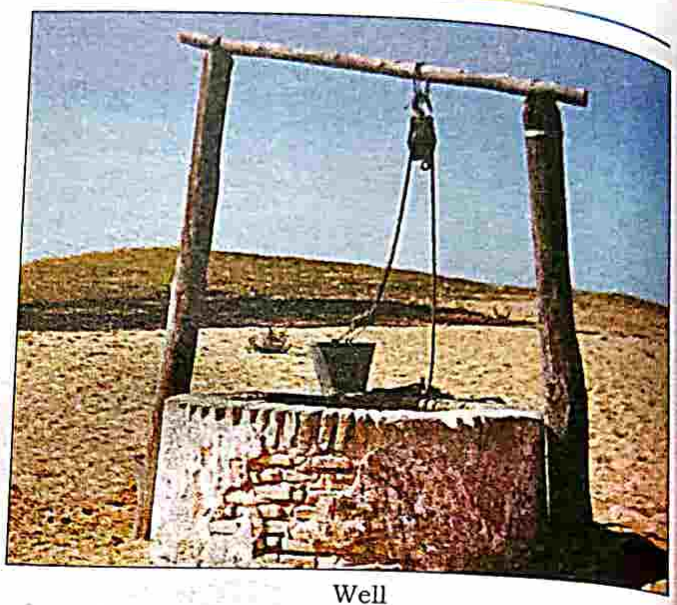
MEANS OF IRRIGATION

Based on the availability of surface (river) and groundwater, relief, soils and climatic conditions, different means of irrigation are utilised in India. For example, in the crystalline soil areas of Deccan Plateau, tanks form the major source of irrigation, whereas the alluvial tracts of the Gangetic and Coastal plains are best suited for canals and well irrigation.

The conventional means of irrigation include wells, tanks, and inundation canals. Irrigation is usually done manually, where a farmer himself pulls out water from wells, tanks and canals or uses animals to draw water. The modern means of irrigation include tubewells, perennial canals, drip irrigation, etc.

WELLS

A well is a small hole dug in the surface of the earth to obtain water from the water table for irrigation and other purposes. Wells are usually of two types: Lined wells and Unlined wells. *Lined wells* are man-made; they are artificially constructed by digging into the ground and supporting the walls with bricks in a circular pattern. *Unlined wells* are formed by different natural phenomena and are normally not protected by lining of their walls.



Well

Well irrigation is a cheap, simple and dependable source of irrigation. It is practised in areas where plenty of groundwater is available and the depth of the water table does not exceed 15m.

Area: Well irrigation is confined mainly to the alluvial plains where owing to the soft nature of the soil, wells can be easily dug and the yield of crops from the land after irrigation is considerably high. Wells are dug in the middle of the area to be irrigated and at a place which is relatively at a high level. The presence of perennial rivers ensures the water table is recharged.

The areas where well irrigation is practised include Punjab, Uttar Pradesh, Goa, Haryana, Bihar, Rajasthan, Gujarat, Maharashtra, Madhya Pradesh, Andhra Pradesh, Karnataka and Tamil Nadu.

The water from the wells is lifted for irrigation in a number of ways:

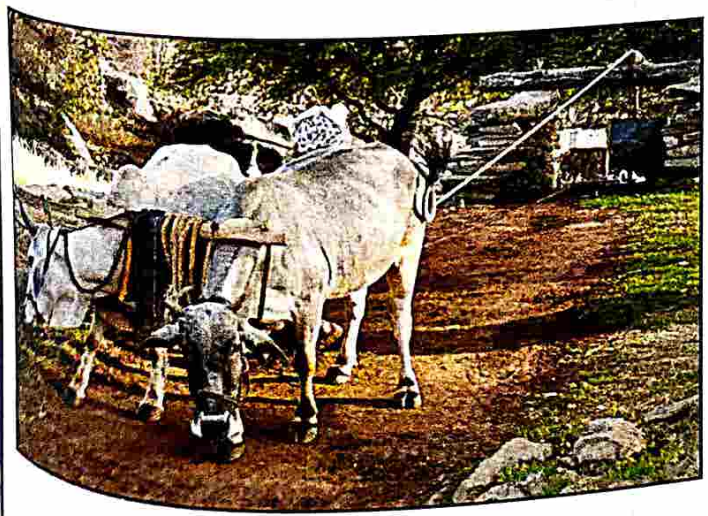
(i) **Persian wheel method:** It is used mainly in Punjab, Haryana and Western Rajasthan. It is a partly submerged vertical wheel with buckets attached to the rim. As the wheel is turned by draught animals rotating a

Persian Wheel

geared horizontal wheel, the buckets are filled and emptied into a trough above, which carries the water to crop-sown fields.

(ii) **Lever method:** It is used in Bihar and Andhra Pradesh. It is very economical and efficient method of lifting water from shallow wells to a height of 3.5 to 4.5 m. The lift consists of a strong log laid across a fulcrum, a bucket attached to the long arm by means of a bamboo or a rope and a heavy weight attached to the other side of the log. When the bucket is full one person gently releases the rope and the bucket comes up as the stone goes down. The bucket is emptied into the field channel and again lowered into the well.

(iii) **Inclined plane method:** This method is also known as *mhote*. In this type, a pair of bullocks move down from the slope (inclined plane), specially constructed from the wall of the well, a bucket or a leather bag which is discharged into the connecting channel pulling from behind. The rope goes through pulley in this process. After discharging the water, the bullocks walk up the slope until they reach the top by which time the bucket reaches the surface of water and gets filled. The process is repeated again and again to irrigate the fields.



Inclined Plane Method

Advantages of Well Irrigation

(i) Wells can be dug at a very low cost which is well within the means of poor farmers.

(ii) Oxen which are kept for ploughing the land can be utilised for drawing water from the wells at no extra cost to the farmers.

(iii) By the use of pumps and tubewells, water can be lifted even from great depths.

Disadvantages of Well Irrigation

(i) Wells depend on undergroundwater resources whose distribution varies from region to region.

(ii) It is difficult to dig wells or bore tubewells in the hilly regions of the north and stony areas of the Peninsula.

(iii) The traditional wells dry up due to the over-withdrawal of the groundwater and lowering of the water table.

(iv) Availability of electricity and diesel to operate tubewells causes many problems and is costly for farmers.

Tubewells

A tubewell is a deeper well at a depth of 20-30 m from which water is lifted up with the help of power driven pumps. It is also known as 'lift method'.

The ideal conditions for the drilling of tubewells are:

- availability of plentiful water at great depths,
- level land and soft soil for the tubewells to be set up,
- large fertile area in its surrounding area to be irrigated; and
- availability of regular cheap electricity to run the tubewells.

Tubewells are used in the northern plains in the States of Punjab, Haryana, Uttar Pradesh, Bihar, West Bengal, Rajasthan, Madhya Pradesh and Gujarat.

Tubewell

Advantages of Tubewell Irrigation

(i) It is an independent source of irrigation.

(ii) It brings up clean water.

(iii) It can irrigate large area of agricultural land.

(iv) It is easier to bring up large amount of water in a short time period.

(v) It is a perennial means of irrigation as it is drilled up to permanent water table. It can be switched off when not required.

Disadvantages of Tubewell Irrigation

(i) Excessive use of tubewell water can lead to depletion of groundwater.

(ii) It is useless if the water is brackish.

(iii) It is expensive as it requires continuous supply of electricity.

Canals

India has one of the world's largest canal systems stretching over more than one lakh kilometres. The irrigation canals are of two types:

(i) **Inundation Canals:** These canals are taken out directly from the rivers without constructing any barrage or dam. Such canals use the excess water of rivers at the time of floods and remain operational during rainy season. As the beds of these canals are at a level higher than those of the rivers, they get supply of water only when the rivers are in flood. Therefore, these canals have limited use.

(ii) **Perennial Canals:** These canals are taken out from the perennial rivers by constructing barrages or dams to regulate the flow of water. They can draw water throughout the year and irrigate large areas. Most of the canals in India belong to this category.

Important Canals in India

States	Canals
Punjab	Sirhind canal, Bhakra canal, Upper Bari Doab canal.
Uttar Pradesh	Sharda canal, Upper Ganga canal, Lower Ganga canal.
Haryana	Western Yamuna canal, Gurgaon canal, Bhakra canal.
Maharashtra	Tapi canal, Pravara canal, Warna canal.
Rajasthan	Indira Gandhi canal, Bikaner canal.
Tamil Nadu	Mettur canal, Aliyar canal, Lower Bhavani Project canal.
Bihar	Son canal, Kosi canal and Gandak canal.
Karnataka	Vishweshwarya canal, Malprabha project canal.

Canal irrigation is in practice in Uttar Pradesh, Madhya Pradesh, Andhra Pradesh, Rajasthan, Haryana, Jammu and Kashmir, Assam and Tripura. Canals also supply water to a sizeable part of the irrigated area in Bihar, Odisha, Karnataka, Tamil Nadu and West Bengal. Mizoram, the least irrigated State, is solely dependent on canals. The Northern Plains have elaborate system of Canals.

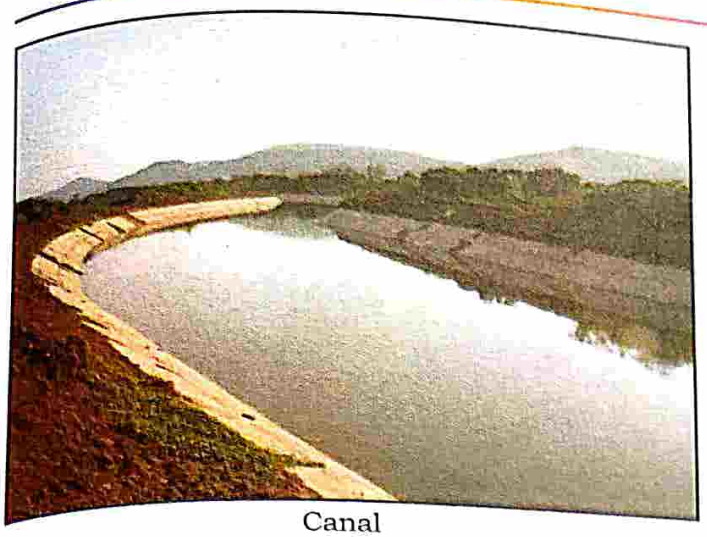
Advantages of Canal Irrigation

(i) The rainfall deficiency in some areas is made up by canals taken out from the perennial rivers.

(ii) In arid areas like Rajasthan, canals have proved to be boon as a result of which sandy patches are yielding good agricultural harvests.

(iii) Canal irrigation has enabled Punjab and Haryana to be called the 'granary of the country' and nucleus of the Green Revolution.

(iv) Major parts of Tamil Nadu enjoy rainfall during winter season while summer remains dry. Thus, irrigation is needed in summer to make up the lack of rainfall. Canal irrigation provides a solution to this problem.



Canal

Disadvantages of Canal Irrigation

(i) At some places where the perennial unlined canals flow at the ground level and between raised high banks, the water table may reach the surface and make the once cultivable soil completely waterlogged. Complete saturation of the soil with water may give rise to swamps.

(ii) In the canal irrigation, where the water table is a few feet below the ground, the alkaline salts come to the surface, mix with the soil and make it unproductive.

(iii) Due to waterlogging, the capacity of soil to absorb water decreases. So a few centimetres of rainfall in excess of the normal covers the land with a sheet of rainwater, which in the absence of proper drainage ruins the standing crops, houses and even stored food grains and fodder.

Tanks

Tank refers to a small bund of earth or stones built across a stream to impound water which is then led through narrow channels to the cultivated fields.

Tank irrigation is in practice in Peninsular India including Maharashtra and Gujarat. Tanks constitute a special feature of irrigation in the Deccan because of the following reasons:

(i) The rivers of the Deccan are not snow-fed and are mainly dependent on the rainwater;

(ii) There are many streams which become torrential during the rainy season but dry up when the rain ceases.

(iii) The hard rocks in the area do not absorb water, so wells also cannot be made there. But the tanks can be easily made by means of making dams in hollow spaces in which rainwater is stored in large quantities for distributing regular supply of water through the channels to the arable lands in the dry seasons.

(iv) The terrain of the Deccan Plateau is very uneven with many natural depressions where tanks can be easily built.

Tank irrigation has reached its highest perfection in the south, specially in Andhra Pradesh, Telangana and Tamil Nadu. In Tamil Nadu, it is significant in the districts of Chingleput, North Arcot and South Arcot; in Nellore in Andhra Pradesh and in Warangal in Telangana. States of West Bengal and Rajasthan too have some irrigation tanks, particularly in their southern and south-eastern regions respectively. Some irrigation tanks do exist in Bundelkhand area in Uttar Pradesh and South Bihar.

Advantages of Tank Irrigation

(i) In the uneven rocky plateau of Peninsular India, where rainfall is highly seasonal, tank irrigation is useful.

(ii) In the large stretches of the Indian plateau, due to hard rocky terrain, wells and canals are difficult to construct, so only tank irrigation is feasible.

(iii) Tank irrigation is highly significant in storing the abundant rainwater that would otherwise flow out and go waste.

Irrigation Tank

Disadvantages of Tank Irrigation

(i) Tanks get silted up soon and regular desilting is required to make them suitable for irrigation.

(ii) When the monsoons fail these tanks go dry and therefore, are not dependable source of irrigation.

(iii) Most of the tanks are non-perennial and become dry during the winter and summer seasons when water is urgently required for rabi and zaid crops.

(iv) Due to large area coverage and its shallow depth, huge quantity of stored water either evaporates or sinks underground without being used in the irrigation.

(v) Tanks occupy a large fertile area which otherwise could have been utilised for growing crops.

(vi) The lifting of water from the tanks and bringing it to the fields is a strenuous and costly task.

But even then tanks are effective means of collecting rainwater and their use should be popularised for irrigation, aquaculture, drinking water and water sports.

Drawbacks of Conventional Methods of Irrigation

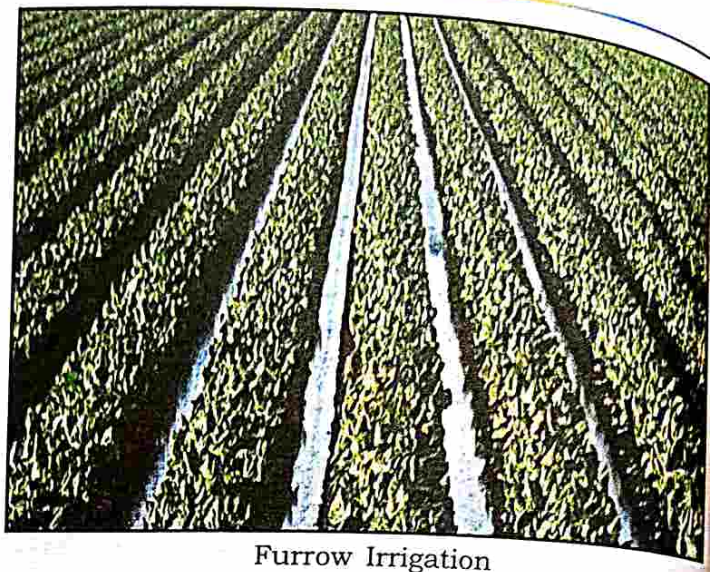
The conventional irrigation systems suffer from a number of constraints leading to improper utilisation of water. These are the following:

(i) In the conventional system of irrigation a large quantity of water is not properly utilised.

(ii) Crops are usually subjected to cyclic changes of flooding and water stress situations, by providing heavy irrigation at one time and leaving the fields to dry up for about 10 to 15 days. The moisture availability to the crops therefore keeps on changing. This results in poor yields in the crops.

(iii) The fields situated in low areas always get excess water causing prolonged waterlogging. Thus, crops are subjected to water-logging resulting in poor yields.

(iv) In the fields about 10-15 per cent of land is utilised for preparing channels and distributions, *etc.* which decreases effective area of cultivation.



Furrow Irrigation

(v) Extensive areas of land in the arid and semi-arid regions of India are no longer used for cultivation due to accumulation of salts. Excessive irrigation and poor water management are the main reasons of water-logging and gradual build up of excessive salts. Progressive build up of soil salinity has made the soils unsuitable for cultivation.

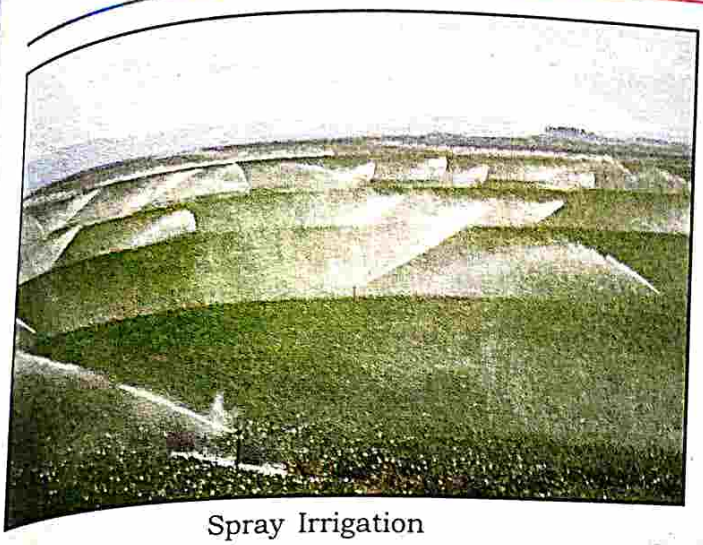
Modern Irrigation Methods

All these constraints have led to the utilisation of modern irrigation methods which are highly scientific. Some of the important ones are discussed below.

Furrow Irrigation: It is a type of flood irrigation in which the water poured on the field is directed to flow through narrow channels dug between the rows of crops, instead of evenly distributing the water throughout the whole field. The furrows must have equal dimensions, in order to guarantee that the water is distributed evenly. Furrow irrigation is useful in areas where water is easily available.

Spray Irrigation: In spray irrigation systems, a long hose is set to a water source on one side and on the other side the water is released through spray guns to the field.

The spray irrigation is expensive as it requires complex machinery; but utilises water more efficiently, reducing the amount of water needed to irrigate a field. However, water is lost



Spray Irrigation

through evaporation in spray irrigation and plant diseases, that are caused due to excess moisture, can occur due to over-watering.

Drip Irrigation: It is the most advanced and efficient method of irrigation. Usually used to irrigate fruits and vegetables, this system consists of perforated pipes that are placed between rows of crops or buried along their root lines and give water directly on to the crops. As a result, evaporation is drastically reduced and irrigation water is conserved. Drip irrigation allows the grower to customise an irrigation programme most beneficial to each crop.

Sprinkler Irrigation: In this method of irrigation a pipe fitted with a nozzle on the top is used through which water is sprayed directly to the required plants. It is often referred as 'overhead irrigation' method.

Advantages of Sprinkler Irrigation

(i) There is no loss of water by seepage.

(ii) There is no loss of water by evaporation.

Disdvantages of Sprinkler Irrigation

(i) It is an expensive method of irrigation.

(ii) It is helpful for a small area.

(iii) It is used for crops which require less water.

EXERCISES

I. Answer the following questions:

Q.1 (a) What do you understand by the term 'water resource'?

(b) Give two points of difference between 'surface water' and 'ground water'.

(c) (i) What is meant by rainwater harvesting?

(ii) Mention any two rainwater harvesting systems practised in India.

(d) Give a geographical reason for each of the following:

(i) Need to adopt different means of irrigation.

(ii) Need for conserving water.

(iii) Man is responsible for water crisis in India.

Q.2 (a) What is meant by the term irrigation?

(b) What is meant by the term 'water scarcity'? What has caused this scarcity in India?

(c) (i) What is meant by traditional or conventional methods of irrigation?

(ii) Name any two conventional methods of irrigation.

(d) Give a geographical reason for each of the following:

(i) Inundation canals are being converted to perennial canals.

(ii) Tank irrigation is preferred over other means of irrigation in Peninsular India.

(iii) Groundwater reserves are depleting at a fast rate.

Q.3 (a) State any two drawbacks of conventional methods of irrigation.

(b) Give two advantages and two disadvantages of well irrigation.

(c) (i) Name any two states where well irrigation is practised.

(ii) Give one advantage and one disadvantage of tubewell irrigation.

(d) Give a geographical reason for each of the following:

(i) Well irrigation is confined mainly to the alluvial plains.

(ii) In Tamil Nadu, nearly one-third of the net irrigated area is under canal irrigation.

(iii) Drip irrigation reduces loss of water through evaporation.

Q.4 (a) Name the two types of canals. Name two states where perennial canals are widely used.

(b) How are the fields irrigated using the Persian wheel method?

(c) (i) Name two states in which tubewells are extensively used.

(ii) State why tubewell irrigation is important in Punjab.

(d) Give a geographical reason for each of the following:

(i) Canals make the soil infertile.

(ii) Tubewell irrigation is quite expensive.

(iii) Excessive accumulation of salts make the soils unsuitable for cultivation.

Q.5 (a) What is meant by rainwater harvesting?

(b) State any two methods of rainwater harvesting.

(c) (i) What is watershed management?

(ii) How is it beneficial for farmers in the long run?

(d) Give a geographical reason for each of the following:

(i) Many farmers in India still use wells.

(ii) There is very little recharge of groundwater.

(iii) The traditional wells dry up.

Q.6 (a) What is 'drip irrigation'? How is it useful?

(b) Explain briefly the need to conserve water.

(c) What is meant by furrow irrigation? What is its advantage?

(d) Give a geographical reason for each of the following:

(i) Modern means of irrigation are gaining popularity.

(ii) Sprinkler irrigation helps in conserving water.

(iii) Spray irrigation is quite expensive.

II. Practical Work

1. With the help of a suitable sketch show the various methods of rainwater harvesting.
2. Enlist the ways in which water can be reused and recycled in various activities.
3. Make a Power Point Presentation showing the various methods used for rain water harvest from ancient times to the present.

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Chapter 12 Mineral Resources

Syllabus

Mineral Resources

Iron Ore, Manganese, Copper, Bauxite — uses and their distribution.

Minerals are natural substances of organic or inorganic origin with definite chemical and physical properties. Based on the chemical and physical properties, minerals are broadly classified as *Metallic* and *Non-metallic.*

Metallic minerals are the source of metals like iron, copper, gold, *etc.* Metallic minerals are further categorised as *ferrous* and *non-ferrous* minerals. Ferrous mineral are those which have iron content like Iron Ore whereas non-ferrous minerals do not have iron content like copper, bauxite, *etc.*

Non-metallic minerals are either organic or inorganic in origin. Organic non-metallic minerals include fossil fuels or mineral fuels which are derived from the buried plant and animal life such as coal and petroleum. The inorganic non-metallic minerals include mica, limestone, graphite, *etc.*

Minerals have certain unique characteristics:

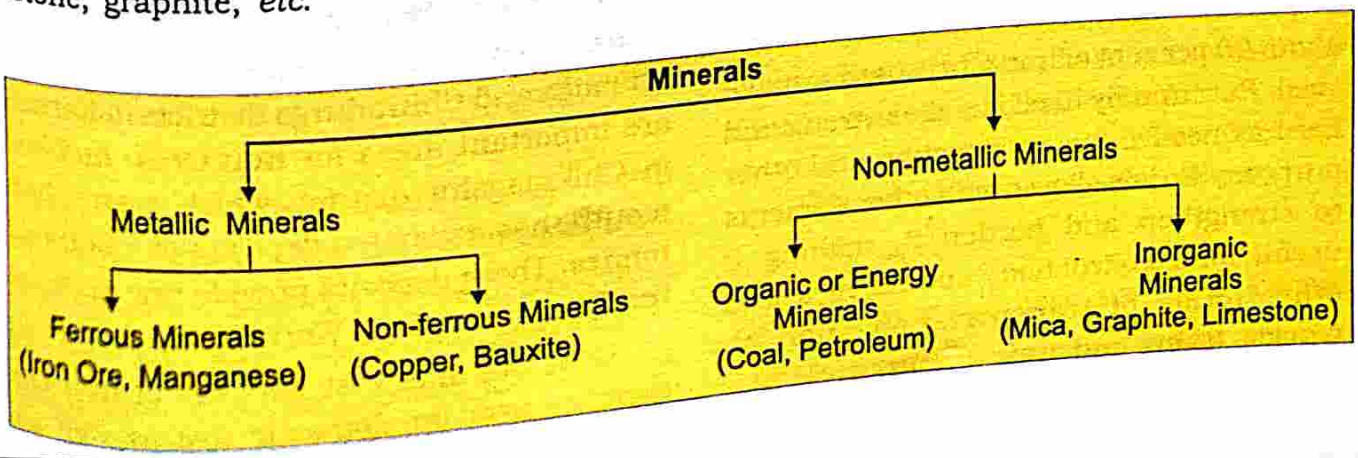
(i) Minerals are not evenly distributed over space.

(ii) Minerals have inverse relationship in quality and quantity, *i.e.*, good quality minerals are lesser in quantity than low quality minerals.

(iii) Minerals are exhaustible over time. They take long time to develop geologically and cannot be replenished immediately when needed. Thus, they need to be conserved as they do not have the second crop.

The economic development of a country is influenced by the availability of minerals. Minerals form the base for several large-scale industries. Agriculture, too, is influenced by the availability of minerals in the form of fertilisers.

India has a rich variety of minerals due to its varied geological structure. Its mineral resources are of considerable importance by world standards. Ranking fairly high among the producers of Iron Ore, coal, mica and manganese, India also has extensive reserves of chromite, bauxite and limestone.



IRON ORE

Iron Ore is one of the most widely distributed minerals found in the Earth's crust. It forms the backbone of modern civilisation and the foundation of our basic industry.

India is fairly rich in iron deposits and some amount of iron is found in practically all parts of the country. India is the largest producer of iron in the Asian continent and is one of the largest iron producing countries in the world.

The Iron Ore deposits in India occur as hill masses and are easily accessible. They are found in close proximity to the areas producing coal, dolomite, limestone and manganese. Therefore, they are well utilised in several iron and steel plants.

In India, three varieties of Iron Ore are found. They are:

(1) Haematite: It is reddish in colour and is also known as 'Red Ore'. It contains 60 to 70 per cent pure iron and is found in Odisha, Jharkhand, Chhattisgarh, Karnataka and Maharashtra.

(2) Magnetite: It is dark brown to blackish in colour and is, therefore, known as 'Black Ore'. It is the best quality of iron and contains more than 70 per cent of iron. Since it possesses magnetic property, it is called *magnetite*. It is found in Tamil Nadu and Karnataka.

(3) Limonite: It is yellow or light brown in colour and contains 35 to 50 per cent of iron. It occurs in the iron stone group in the Raniganj coalfield. It is also found in Garhwal (Uttarakhand) and Mirzapur district (UP) and the Kangra valley (Himachal Pradesh).

Uses of Iron Ore

(i) About 90 per cent of Iron Ore is used to make steel. Raw iron by itself is not as strong and hard as needed for construction and other purposes. So it is alloyed with other elements to strengthen and harden it, making it useful for construction, automobiles and other forms of transportation such as trucks, trains and train tracks.

(ii) Powdered iron is used in manufacturing metallurgy products, magnets, high frequency cores, auto parts and catalysts.

(iii) Radioactive iron (iron is 59 per cent) is used in medicine as tracer element and in biochemical and metallurgical research.

(iv) Iron blue is used in paints, printing inks, plastics, cosmetics (eye shadow), artist colours, laundry blue, paper dyeing, fertilizer ingredient, baked enamel finishes for autos and appliances and industrial finishes.

(v) Black iron oxide is used as pigment in polishing compounds, metallurgy, medicine, and magnetic inks.

Distribution

The main Iron Ore deposit areas in India are:

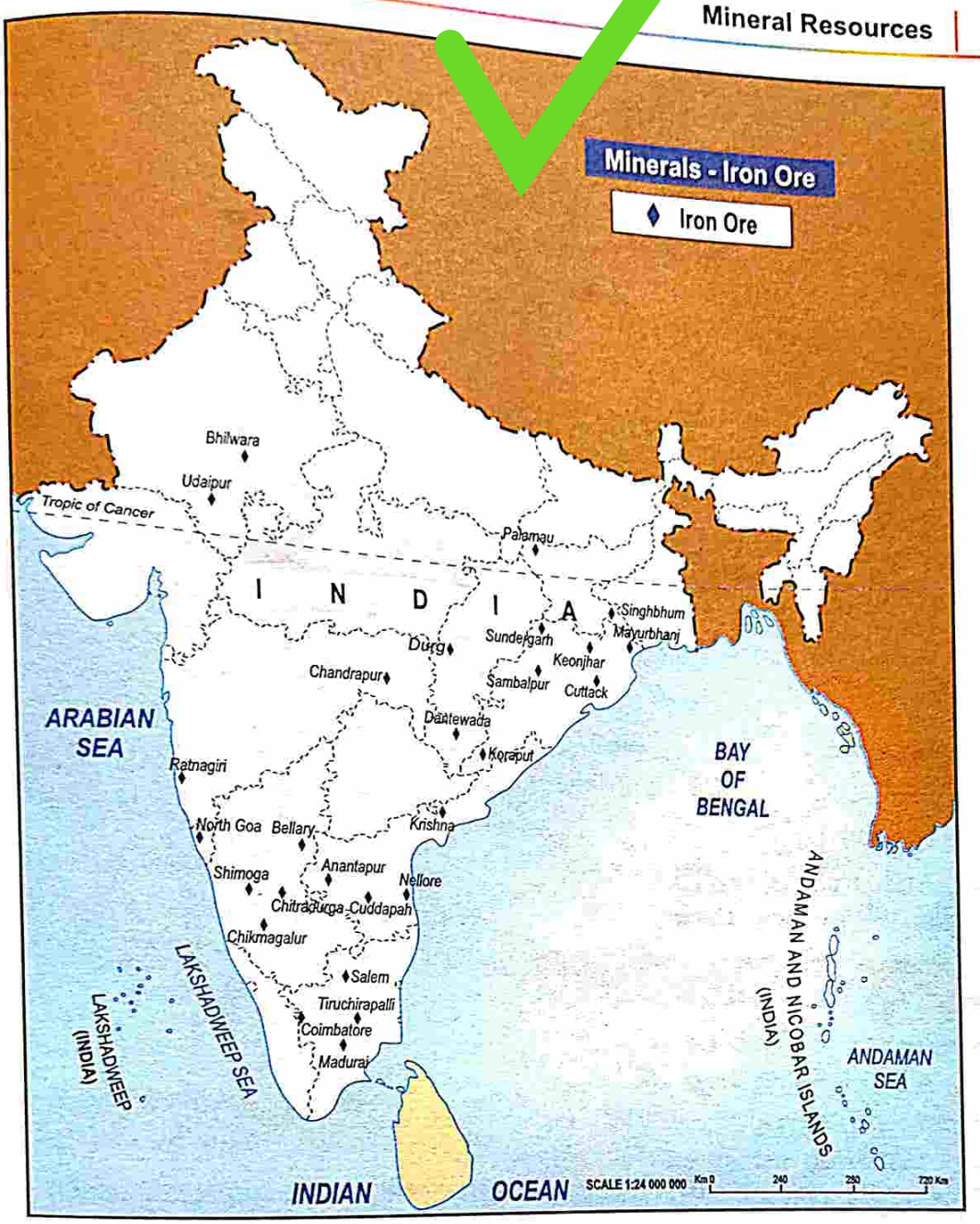
Chhattisgarh: The important areas are Bailadilla in Dantewada district and Durg district. These deposits are supplied to the iron and steel factory at Bhilai.

Jharkhand: A large deposit of Iron Ore has been found at Chiria in Singhbhum district of Jharkhand. Singhbhum and Palamau are the important districts.

Odisha: The Iron Ore deposits in Odisha belong to the haematite variety containing 55 to 68 per cent iron content. Keonjhar, Mayurbhanj, Sambalpur, Sundergarh, Cuttack, Koraput have Iron Ore deposits. The steel plants located at Asansol, Bokaro, Durgapur, Jamshedpur and Rourkela receive their supplies of Iron Ore from these deposits in Odisha.

Karnataka: It has large reserves of magnetite and haematite. Bababudan hills in Chikmagalur district, Bellary and Hospet districts as well as Shimoga and Chitradurga districts in Karnataka are important areas for Iron Ores. *Kudremukh* in Chikmagalur district, which means horse's mouth, has estimated deposits of 1,000 million tonnes. These deposits provide raw material for the Bhadravati Iron Works.

Goa: Goa has vast deposits of Iron Ore. It supplies iron for domestic use as well as for



Iron Ore in India.

export. However, the Iron Ore of Goa is of inferior limonite and siderite variety. In Goa, the richer and larger deposits are confined to north Goa.

Andhra Pradesh: In Andhra Pradesh, the Iron Ore producing areas are scattered through Anantpur, Krishna, Kurnool, Cuddapah and Nellore. The iron content in these deposits vary from 55 to 62 per cent.

Tamil Nadu: Iron Ore is found in Salem, North Arcot, Tiruchirapalli, Coimbatore and Madurai.

Maharashtra: Iron Ore deposits are found in the Ratnagiri and Chandrapur districts.

Rajasthan: Iron Ore deposits are found in Moriza in Bhilwara and Udaipur districts.

The other areas where minor deposits of Iron Ore are prevalent include Assam, West Bengal, Uttar Pradesh, Punjab, and Jammu and Kashmir.

The main Iron Ore exporting ports in India are Mormugao and Vishakhapatnam.

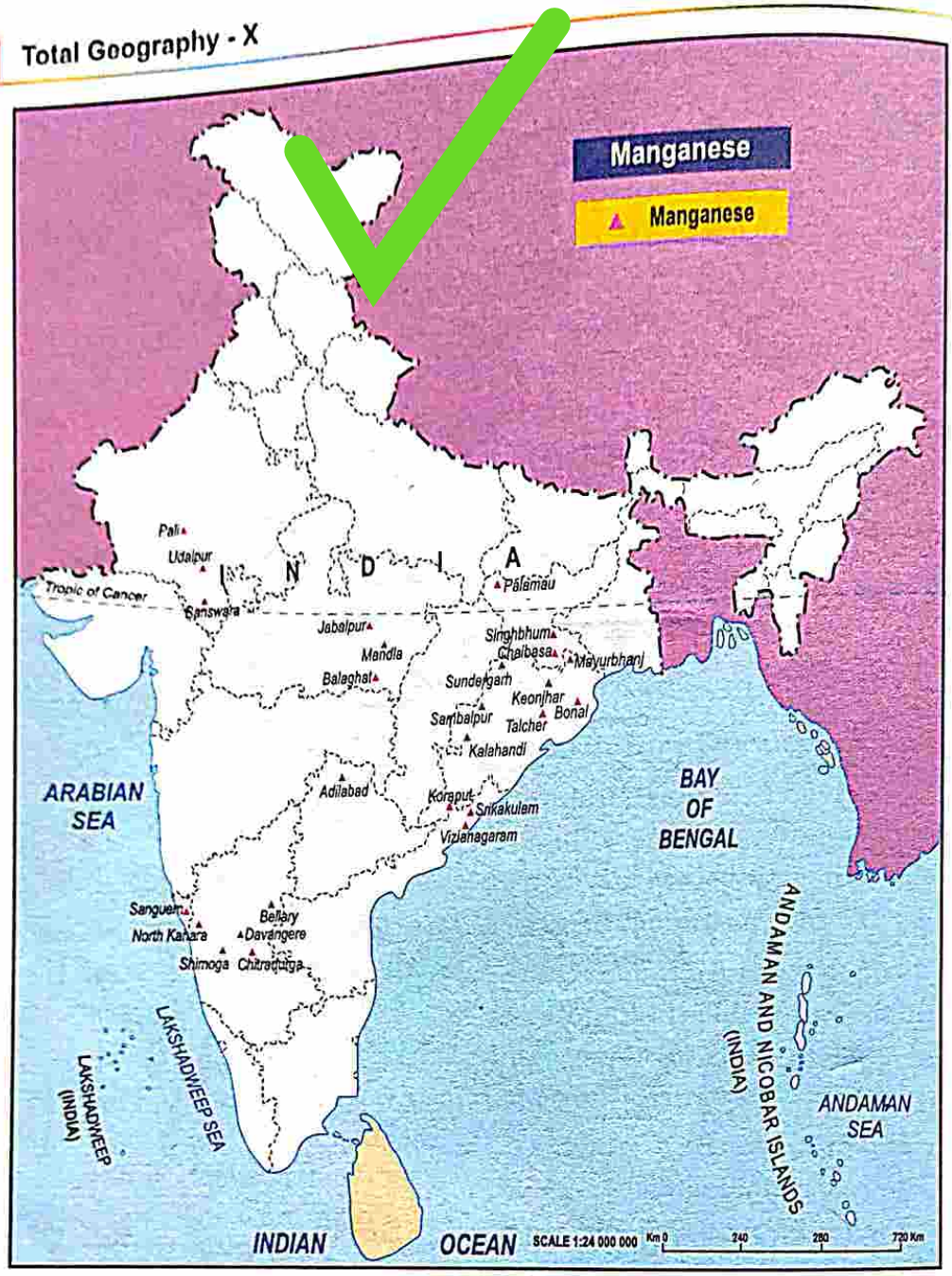
MANGANESE

Manganese is a black, hard and iron-like metal which occurs as natural oxide. It is an important raw material for smelting of Iron Ore and also used for manufacturing ferro alloys.

Uses of Manganese

The uses of manganese are the following:

(i) Manganese is used to make steel tough



Manganese Distribution in India

and resistant to rusting. Therefore, it is an important raw material for the iron and steel industry.

(ii) Manganese is used in the manufacturing of black enamel, in chemical industries for manufacturing bleaching powder and in electrical and glass industries.

(iii) Manganese is used to form a number of important alloys.

(iv) Manganese is used in dry cell batteries.

(v) Manganese is used to manufacture vital enzymes for the metabolism of fats and proteins. Manganese can also regulate blood sugar levels and supports the immune system. It is also involved in bon development and reproduction. Manganes contains various vitamins, such as K an the B-complex group, which are vital i the average human body.

(vi) Manganese is essential for plant growt and is involved in the reduction of nitrate in green plants and algae when distributed in the correct amount.

(vii) Some amount of manganese is needed for humans and animals as it aids in th action of many enzymes. An excess o this element in plants and animals is toxic.

Distribution

Manganese ore found in India is of good quality and therefore, is in great demand in the world market. USA, Japan, UK, France, the Netherlands, West Germany and Belgium are its main buyers.

Manganese is mined in the following areas:

Andhra Pradesh	Vishkahapatnam, Srikakulam, Vizianagaram.
Telangana	Adilabad.
Goa	Sanguem.
Jharkhand	Singhbhum, Palamau, Chaibasa.
Karnataka	Sandur, Shimoga, Chitradurga, Bellary, North Kanara, Tumkur, Belagavi, Davangere.
Madhya Pradesh	Chhindwara, Balaghat, Mandla, Jabalpur.
Maharashtra	Nagpur, Bhandara.
Odisha	Keonjhar, Mayurbhanj, Talcher, Sundargarh, Bonai, Koraput.
Rajasthan	Banswara, Udaipur, Pali.

COPPER

Copper is an important non-ferrous metal and the earliest metal used by man. In nature, copper occurs in the native form and in three principal combinations, that is, sulphides, oxides and carbonates.

Uses

(i) It is a good conductor of electricity, highly ductile and malleable and is therefore, used for making electric wires and other equipment.

(ii) It is used in automobile and defence industries.

(iii) It is alloyed with iron and nickel to make stainless steel, which is used to make utensils and other objects.

(iv) It is alloyed with zinc to form *brass* and with tin to make *bronze*.

(v) It is used in building construction for roofing and plumbing.

(vi) It is used in ship building industry.

Distribution

India is critically deficient in copper and has to depend on exports for its needs. The main areas where copper is found in India are:

Madhya Pradesh	Balaghat, Betul and Jabalpur.
Rajasthan	Khetri belt in Jhunjhunu and Dariba in Alwar district; Ajmer, Bharatpur, Bhilwara, Bundi, Chittorgarh, Dungarpur, Jaipur, Pali, Rajasamad, Sikar, Sirohi and Udaipur.
Maharashtra	Bhandara, Chandrapur, Gadchiroli and Nagpur.
Andhra Pradesh	Guntur, Kurnool and Prakasam.

BAUXITE

Bauxite is an oxide of aluminium. It is found mainly in terti deposits and is associated with laterite rocks uring extensively on the plateau or hill s of Penin India and also in the coasta cts o country.

Uses

(i) Bauxite is the main aluminium, which is a light ht, str and rust resistant met

(ii) Aluminium sed in aircrafts, auto iles, rail wagons, coaches, shipping industry and household appliances.

(iii) It is used in electrical equipment industry and for transmitting electricity because it is a good conductor of electricity.

(iv) Pure aluminium is the best material for making headlight reflectors and mirrors and in telescopes.

Distribution

There are extensive deposits of bauxite in

Bauxite and Copper Distribution in India

India. The main reserves are found in the following States:

Goa	Mopa and Pernem
Odisha	Kalahandi and Sambalpur
Gujarat	Jamnagar, Kheda, Surat, Kutch
Madhya Pradesh	Jabalpur, Balaghat, Shahdol, Mandla and Amarkantak Plateau
Chhattisgarh	Durg, Bilaspur, Raigarh
Jharkhand	Palamau, Ranchi
Maharashtra	Thane, Kolhapur, Ratnagiri, Satara
Karnataka	Belagavi mainly at Karle hills
Tamil Nadu	Salem, Nilgiri, Madurai, Coimbatore

The largest integrated aluminium plant in India at Renukoot in Uttar Pradesh. It gets its supply of bauxite from Amarkantak plateau and Ranchi.

EXERCISES

I. Answer the following questions:

Q.1 (a) What is a mineral? State two characteristics of minerals.

(b) What is the difference between Metallic and Non-metallic minerals?

(c) Name the three varieties of Iron Ore mined in India. Name one state where each is found.

(d) (i) Name the best quality of Iron Ore.

(ii) Name two states where it is found.

Q.2 (a) What type of mineral is copper? Name any two states where copper is found in India.

(b) State two uses of copper.

(c) Bauxite is an oxide of which metal? Where are the deposits of Bauxite found in India?

(d) Describe three main uses of Aluminium.

Q.3 (a) How is brass and bronze made?

(b) Name two leading states producing manganese. State two industrial uses of manganese.

(c) (i) Name two characteristics of Iron Ore deposits in India that facilitate their optimum use in the iron and steel plants.

(ii) Name two industries that require Iron Ore as raw material.

(d) Give a geographical reason for each of the following:

(i) Magnetite is so called.

(ii) Copper is used for making electric wires.

(iii) Aluminium is used for making aircraft.

II. Map Work

On the outline map of India mark and name two centres where each of these minerals are found:

(i) Iron Ore (ii) Manganese (iii) Copper (iv) Bauxite

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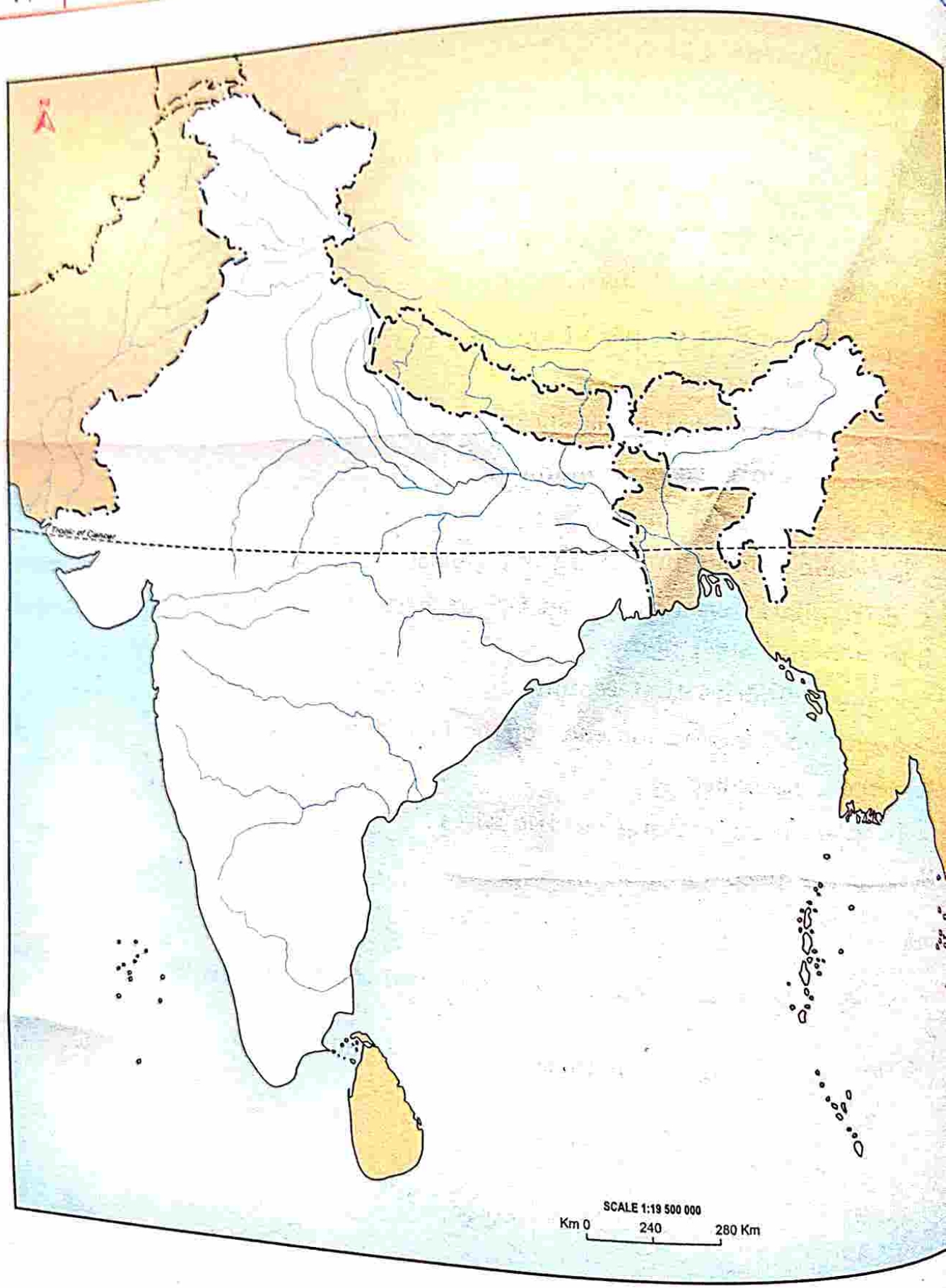
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Chapter 13 Conventional Sources of Energy

Syllabus

Conventional Sources of Energy

Conventional Sources: Coal, Petroleum, Natural gas (distribution, advantages and disadvantages). Hydel power (Bhakra Nangal dam and Hirakud)

Conventional sources of energy are those which have been used by man for a long time and are still being tapped and used abundantly. These include coal, petroleum, natural gas and hydel power. Except for hydel power, these sources of energy are non-renewable, cause pollution and are costlier than renewable sources of energy.

1. COAL

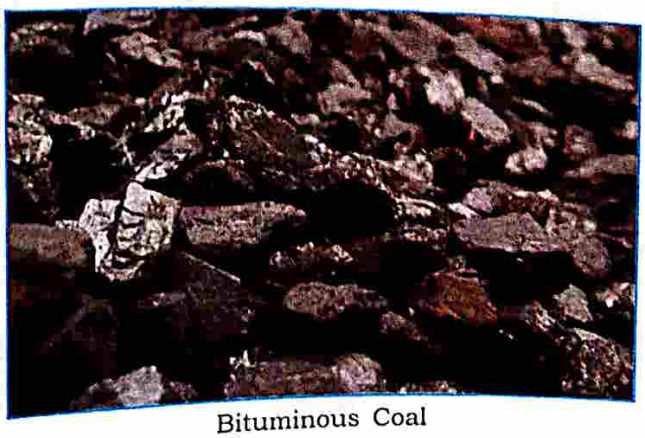
Coal is a combustible solid stratified rock of organic and mineral matter. It is composed of carbon (60 to 90 per cent), hydrogen (1 to 12 per cent), oxygen (2 to 20 per cent), nitrogen (1 to 3 per cent) and also small amounts of phosphorus and sulphur. It occurs as a sedimentary rock in association with carbonaceous shale, sandstone and even fine clay.

Coal is formed due to the accumulation of vegetable matter in swampy areas or broad deltas, coastal plains and basin lowlands. This vegetative matter was subjected to geological processes that resulted in physical and chemical changes. The mass of vegetative matter was probably changed into coal by heat and pressure generated by the increasing weight of overlying sediments and also by the movements of the earth.

Depending on the amount of carbon, moisture and volatile matter, coal can be classified as:

(1) Anthracite Coal: It is the hardest and it ranks highest among different varieties of coal. It is shiny and lustrous, almost jet-black and is so completely compressed that it shows no banded structure. It has a carbon content of 90 per cent and burns slowly without smoke. It burns for a long time and leaves very little ash behind. It has a high heating value. That is why, it is globally preferred for domestic purposes.

(2) Bituminous Coal: It is hard, black and compact and makes up almost 80 per cent of the world's total coal output. It varies greatly in composition and in carbon content, *i.e.*, from 50 to 80 per cent. Steam coal with a carbon content of 80 per cent is the best of bituminous coal. Household coal which is black and lustrous, with a fine carbon content varying from 50 to 80 per cent, has the widest utilisation for domestic purposes in India as it is easily available. Coking coal is high-grade bituminous coal which has special value because when it is heated in coke ovens it fuses into coke, an



Bituminous Coal

Lignite Coal

important ingredient in iron and steel smelting in blast furnaces.

(3) Lignite: It is also known as brown coal and is a lower grade coal. It comprises 40 per cent of carbon and a good deal of moisture and less of combustible matter.

(4) Peat: It represents the first stage of transformation of wood into coal. It has the least carbon content and is inferior to the other three varieties of coal. It is an accumulation of vegetable matter which has undergone varying degrees of decomposition and carbonisation.

Distribution

Resource-wise coal occupies the place of pride in the list of mineral resources in India. India ranks third in the world after China and the USA, in coal production. The oldest coalfield in India is in Raniganj in West Bengal and the largest coalfield is in Jharia in Jharkhand.

Peat

Distribution and Uses of Different Varieties of Coal in India

1. **Anthracite**
   - It is found in Jammu and Kashmir only.
   - India's reserves of Anthracite coal are not sufficient.
   - It is ideal for domestic use as it is a smokeless fuel with high calorific value.
   - It is used for metallurgical processes and in iron and steel industry.
2. **Bituminous coal**
   - It is found mainly in Gondwana coal fields.
   - It is used to produce coke, coal gas and steam coal and is therefore, called cooking coal.
3. **Lignite**
   - It is found in Tamil Nadu, Rajasthan, West Bengal, Kerala and Puducherry.
   - It is used for the generation of electricity.
4. **Peat**
   - Peat occurs on the Nilgiri mountains in patches, in Kashmir valley and swampy areas of coastal plains.

In India, coal occurs in rock sequences mainly of two geological ages, namely, *Gondwana*, little over 200 million years in age and in *Tertiary* deposits which were found at a much later geological epoch, *i.e.*, about 55 million years ago.

India does not have extensive deposits of the highest grade (90% carbon) anthracite coal. The coal of the Gondwana fields, that is, mainly of bituminous quality (50% to 80% of carbon) is mostly available in India.

Advantages

The main advantages of coal are the following:

(i) Coal is used as a source of power for running machines, trains, ships and dynamos.

(ii) Coal is used for manufacturing iron and steel.

(iii) Coal is used as a source of direct heat and energy for domestic purposes, in the potteries and for building materials like

Table 13.1. Gondwana Coalfields

State	River Valley	Coalfields
1. Jharkhand	Damodar	Jharia, Karnpura, Ramgarh, East and West Bokaro, Giridih, Aurongabad, Hutar and Daltonganj.
2. Odisha	Mahanadi	Sambalpur, Sundargarh and Talcher.
3. Madhya Pradesh	Mahanadi/Son	Singrauli, Narsingpur, Chhindwara, Betul.
4. Chhattisgarh	Mahanadi/Son	Sarguja, Sendurgarh, Rampur, Korba and Raigarh.
5. Maharashtra	Godavari	Kamptee, Wardha valley, Chandrapur and Yavatmal.
6. Andhra Pradesh	Godavari	East and West Godavari.
7. Telangana	Godavari	Adilabad, Khammam and Warangal.
8. West Bengal	Damodar	Raniganj, Bardhaman, Bankura, Purulia, Darjeeling and Jalpaiguri.

cement, burning of bricks and tiles and in iron and brass foundries, *etc.*

(iv) It is used as raw material in Thermal Power Plants.

Disadvantages

(i) Calorific value of coal found in India is low.

(ii) Coal reserves are scattered in small amounts in India.

(iii) Cost of production and transportation of coal is quite high.

(iv) There are limited reserves of coal in India.

(v) Large scale pollution is caused at the site of mining and place of use.

I. Gondwana Coalfields

It accounts for 98 per cent of the total reserves of coal in India. Gondwana coal is almost free from moisture and contains sulphur and phosphorus in small variable quantities. It is mined from deep collieries and is used in steel plants.

Gondwana coalfields are largely confined to the river valleys like those of Damodar, Mahanadi and Godavari. The major resources of Gondwana coal are located in coalfields occupying the Indian heartland in the States of West Bengal, Jharkhand, Odisha, Chhattisgarh, Madhya Pradesh, Maharashtra, Uttar Pradesh Andhra Pradesh and Telangana. These coalfields account for four-fifths of India's coal reserves.

II. Tertiary Coalfields

The Tertiary coal of India as compared to the Gondwana coal, has higher moisture content and more sulphur, with less calorific value. Tertiary coalfields are found in Assam, Arunachal Pradesh, Meghalaya, Nagaland and Kashmir. Besides, brown coal or lignite occurs in coastal areas of Tamil Nadu, Gujarat and inland basin of Rajasthan. The Neyveli lignite field in Tamil Nadu is the largest lignite deposit field in South India.

2. PETROLEUM

The word 'Petroleum' has been derived from the two words *'petra'* which means rock and *'oleum'* which means oil. Thus, petroleum means 'rock oil'. It is a complex mixture of hydrocarbon compounds. There is not even a tiniest part of crude petroleum which goes waste or remains unused. That is why petroleum is called *'liquid gold.'* The liquid petroleum is called crude oil, petroleum gas is called natural gas and the semi solid to solid forms of petroleum are known as asphalt, tar, pitch, bitumen, *etc.*

Petroleum is found in underground reservoirs in sedimentary rock formations like sandstone, shale and limestone. In some wells, crude oil is found along with natural gas and water.

Petrol, diesel, kerosene, tar, Liquefied Petroleum Gas (LPG), lubricants and paraffin

wax are some of the products which are obtained during the refining process.

Advantages

When drilled from the earth crude petroleum is a viscous dark liquid made up of many hydrocarbons. It is used both as fuel and raw material. In liquid form it can be transported through pipes or vehicles. Petroleum has high density; one kilogram of oil can generate 10,000 kcal of energy. It has broad area for applications as a source of energy. Some of these are:

(a) It is used as fuel. Its fuel derivatives include ethane, diesel, gasoline, jet fuel, kerosene and LPG. By providing lubricant and a compact and convenient fuel, petroleum plays a major role in transportation on land, on sea and in the air.

(b) Petroleum after refining is used as raw material for the production of various petrochemical products like synthetic rubber, synthetic fibre, polysterene, PVC, phenol, gasoline, carbon black, printing ink, film photography, cosmetics, paints, varnishes, lubricating oil, and paraffin wax.

(c) Petroleum is used for power generation. In India, it is confined to the use in a few thermal stations which are located close to oil wells and refineries and also in diesel and gas turbine stations.

Disadvantages

(i) Petroleum is a natural fossil fuel and non-renewable. So its availability is limited. With ever-increasing demand, petroleum resources are fast depleting.

(ii) Extracting and burning petroleum generate Greenhouse Gases that contribute to environmental pollution and Global Warming.

(iii) Its costs are quite high because of its limited supply and high demand.

(iv) Its highly inflammable and can cause fires.

(v) During extraction from sea or transportation, if oil spills in water, it can pollute water and cause death of a number of marine animals.

Oil Refineries

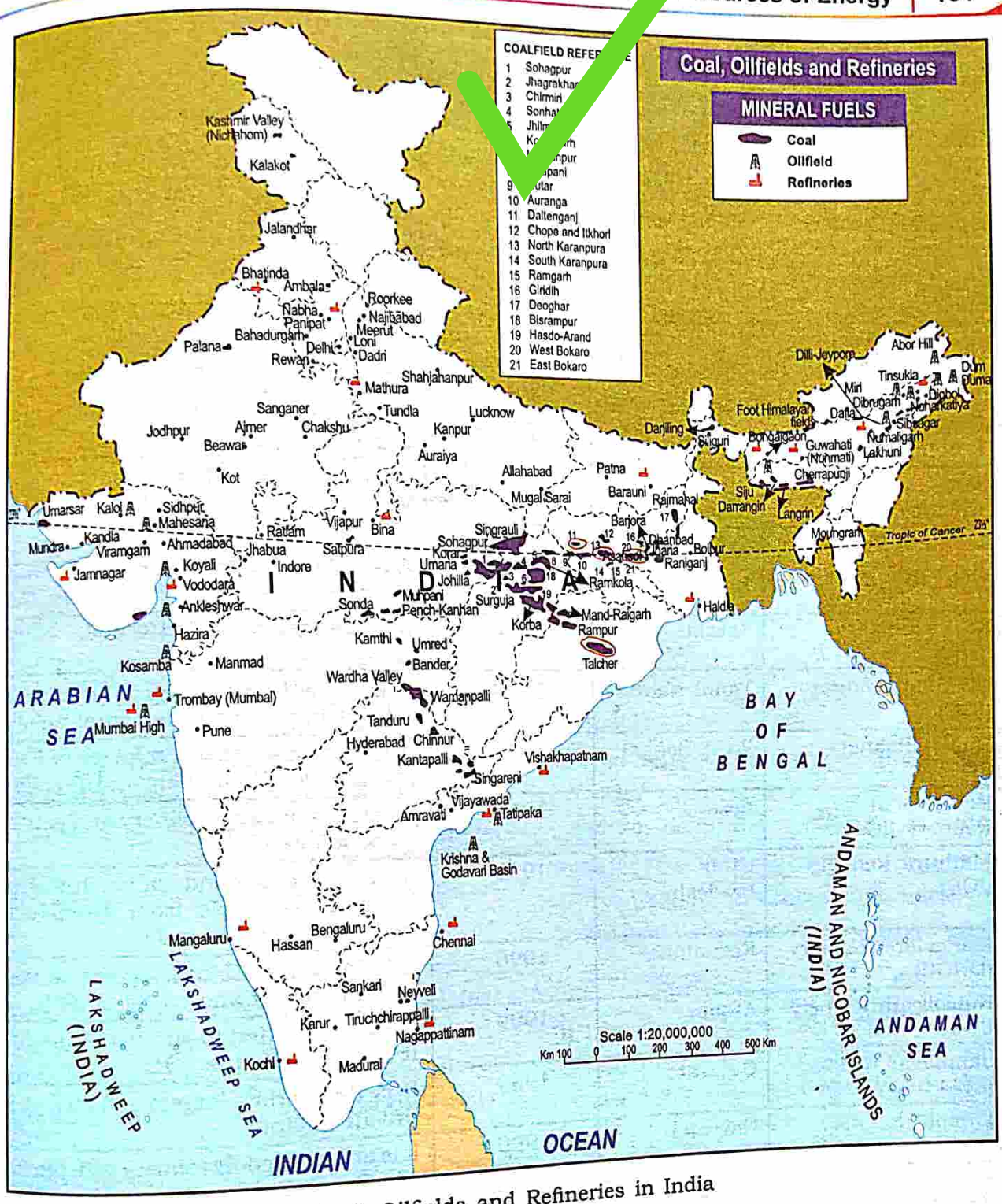
Crude oil is refined and processed in refineries to produce light distillates like gasoline, LPG and naptha; middle distillates such as diesel and kerosene; and heavy ends like fuel and lubricating oils, bitumen, petroleum, coke. In India most of the refineries are in the Public Sector with five in Private and/or Joint Sector. The Reliance Petroleum Limited at Jamnagar in Gujarat was the first refinery in the private sector. Most of the refineries are located near the oilfield or near the coast to minimise the cost of transport and to avoid the risk of transporting the oil inside the country due to its inflammable nature. Some of the important refineries are given in Table 13.2 in this chapter.

Distribution

The entire oil production of India so far comes from the Assam-Arakan belt, the Gujarat-Cambay belt and the Mumbai High offshore zone. The first belt runs from extreme north-east of Assam to the eastern border of the Brahmaputra and Surma valley. The second belt extends from Mehasana (Gujarat) in the north to the continental shelf off the coast of Ratnagiri (Maharashtra) in the south.

In order of importance the main areas of mineral oil deposits are:

(1) Mumbai High. In Maharashtra, about 176 km off Mumbai in the Arabian Sea, a huge oil deposit, known as Mumbai High, was struck in 1974. Mumbai High is the most productive oilfield and has a reserve of 5 crore tonnes of oil. Mumbai High is so called because of the height of the syncline of the rock structure in which the oil has been struck. It is higher than the normal height and oil is taken from the depth of over 1,400 metre with the help of a specially designed platform known as 'Sagar Samrat'. It is a self-propelled jack-up type of drilling platform.



Coal, Oilfields and Refineries in India

(2) Oilfields of Eastern Region. India's oldest and important oil bearing area in the eastern part of the Himalayas is Assam. Digboi oilfield situated in Lakhimpur district of upper Assam is the biggest oilfield in India. Moran, Bappapung, Hausanpung and Hugirijang also have oilfields.

(3) Oilfields of Western Region. In Gujarat, Cambay basin is the site of the main oil bearing sand. The other oilfields of importance in Gujarat are Kalol, Koyali, Kosamba, Sanand, Kathana, Ankleshwar and Navgaon.

Besides these oilfields, a number of potential oil bearing fields have been discovered in the States of Tripura, Punjab, Nagaland, Gujarat, West Bengal and Jammu and Kashmir and also in the Kaveri, the Krishna and the Godavari basins in the south.

Table 13.2. India's Important Oil Refineries

S. No.	Refinery	State	Commission Year	Function
1.	Digboi Refinery (IOC)	Assam	1901	It is India's oldest refinery. It gets crude oil from Moran and Naharkatiya field.
2.	Trombay Refinery	Maharashtra	1954	It mainly gets Iranian crude and oil from Ankleshwar fields.
3.	Trombay Refinery (BPCL)	Maharashtra	1955	It processes imported crude oil.
4.	Visakhapatnam Refinery (HPCL)	Andhra Pradesh	1957	It processes imported crude oil.
5.	Guwahati Noonmati Refinery (IOC)	Assam	1962	It is the first public sector refinery, built with Romanian collaboration. It refines and processes crude from the Moran and Naharkatiya oil field.
6.	Barauni Refinery (IOC)	Bihar	1964	It was built in collaboration with Russia and Romania. It receives crude from Assam oilfields.
7.	Koyali Refinery (IOC)	Gujarat	1965	It refines and processes crude from Ankleshwar oilfields and others in Northern Gujarat.
8.	Kochi Refinery (BPCL)	Kerala	1966	It processes imported crude.
9.	Chennai Refinery (IOC)	Tamil Nadu	1969	It was the first refinery to produce superior lubricating oil and elemental sulphur.
10.	Haldia Refinery (IOC)	West Bengal	1975	It is the only coastal refinery of IOC. It was set up with Romanian and French help.
11.	Bongaigaon Refinery (IOC)	Assam	1979	It serves both as a refinery and petrochemical establishment.
12.	Mathura Refinery (IOC)	Uttar Pradesh	1982	It fulfils the demands of north-western India by utilising crude from Mumbai High as well as imported crude.
13.	Mangalore Refinery (ONGC)	Karnataka	1996	It became a PSU subsequent on acquisition of its majority shares by ONGC.
14.	Numaligarh Refinery (IOC)	Assam	1999	It was dedicated to the nation in July 1999. It is a Mini Ratna PSU.
15.	Jamnagar Refinery (RPL)	Gujarat	1999	It is the world's largest refinery. It is in the private sector.
16.	Panipat Refinery (IOC)	Haryana	1999	It is an eco-friendly refinery with zero discharge of effluent gases.
17.	Tatipaka Refinery (ONGC)	Andhra Pradesh	2001	It is a mini oil refinery of ONGC with capacity of about 0.1 MMTPA
18.	Nagapattinam Refinery (CPCL)	Tamil Nadu	1993	CPCL's refinery, located at Kaveri Basin at Nagapattinam.
19.	Vadinar Oil Refinery (EOL)	Gujarat	2006	It is the second largest refinery in India after the Jamnagar Refinery (RPL).
20.	Bina Oil Refinery (BORL)	Madhya Pradesh	2011	It is a joint venture company between Bharat Petroleum Corporation Ltd. and Oman Oil Company Ltd.
21.	Guru Gobind Singh Refinery (GGSR)	Punjab	2012	It is a joint venture between HPCL and Hindustan Mittal Energy Limited. It processes crude oil and feeds fuel into deficit markets of north India.

3. NATURAL GAS

Natural gas occurs in association with mineral oil. Therefore, an oilfield yields natural gas almost invariably. It is mainly composed of m ne (95%) with ll amounts of pro and ethane. It is a l fuel. Natural eposits mostly accompan deposits l use it has been formed by dec sing ains of dead animals and plants bu er the earth.

The gas used for runn icles is known as Compressed Natura s (and as the name suggests it is ned fro ural gas.

Liquefied Petro n Gas (LPG) gas supplied for h ehold use is calle PG (Liquefied Pe um Gas) and is a by-product obtained after refining crude oil. The main component of LPG is butane, the other being propane and ethane. It is odourless, but the LPG in our domestic gas cylinders gives a foul smell. This is, in fact, due to *ethyl mercaptan*, a foul smelling gas, added to LPG so that any leakage of LPG from the cylinder can be detected instantaneously. In many places, LPG is being replaced by Piped Natural Gas (PNG), which is not stored in a cylinder like LPG ut is continuousl pplied through pipeli om the source.

Compressed Natur as (CNG) is being used as an alternative etr d diesel for transport of vehicles. Delh tally switched over to CNG for public tra ehicles where taxis, buses and autoric aws n this fuel.

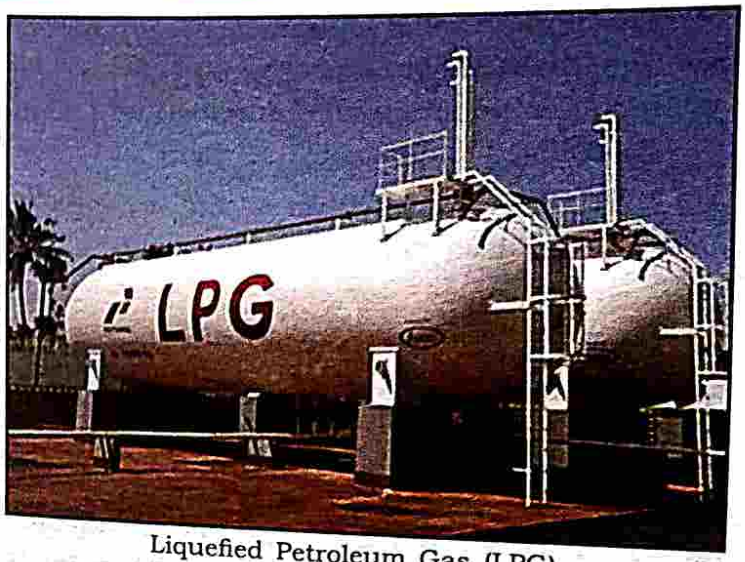
DISTRIBUTION

Over three-fourt India's natural ga es from Mumbai gh; the rest is produced in Assam, Tamil Nadu, Rajasthan and Tripura.

ADVANTAGES

(i) Compared to petroleum or coal, natural gas is an eco-friendly fuel as it causes less damage to the environment. It is made up of methane and results in less carbon emissions.

(ii) It is easier to preserve than other fuels. It can be stored and transported through pipelines, small storage units, cylinders or tankers on land and sea.



Liquefied Petroleum Gas (LPG)

(iii) It can be piped into houses for heating and cooking purposes and running a v ety of applian

(iv) It is a cle cheaper fuel t diesel or gasoline.

(v) It is lighter than nd s to dissipate when there is a l unlike Propane, which being heavier ir, collects into explosive pockets

(vi) It is used for p cing hydro ammonia for fertilizer d some paints a lastics.

DISADVANTA

(i) Leaks of natural gas are difficult to detect and are very dangerous. Such leaks may cause explosions or fire. When inhaled, the gas is highly toxic. Leakage of natural gas can have serious consequences as methane is more toxic than carbon dioxide.

(ii) For use as fuel, except for methane, all other constituents of natural gas have to be extracted. Processing results in many byproducts: hydrocarbons (propane, ethane etc.), sulfur, water, helium, nitrogen and carbon dioxide.

(iii) Like all fossil fuels, natural gas though found in abundance is non-renewable and hence likely to be exhausted at some point of time.

(iv) The infrastructure for natural gas production and distribution is fairly expensive. This includes separate plumbing systems and specialised tanks.

(v) Natural gas when used as fuel in vehicles provides less mileage than gasoline.

4. HYDEL POWER

Electricity generated from water is called *hydel power or hydroelectricity*. Hydroelectricity is produced from the energy that is released when water from a high level great force. The wate wing in a rive collected by constructing a dam wh e water is stored. Then it is all to rom a height. The blades of the turbi ed at the bottom of the dam move wi force of falling water, which in turn ates generator and produces electrici ydropowe s not cause any pollution, i enewable and mally the hydropower cts are multi-purpo ojects which are u d to control floods, for ir tion, navigation, etc.

The total power generation capacity of the hydroelectric power plants depends on the head of water and volume of water flowing towards the water turbine. It is the most widely used form of renewable energy. Once a hydroelectric complex is constructed, the project produces no direct waste, and has a considerably lower output level of the greenhouse gas, carbo dioxide (CO_2) than fossil fuel powered energy ts.

India was one of the pioneering cou s in establishing hydro-electric power plan The power plant at Darjeeling and Shimsha (Shivanasamudra) was established in 1898 and 1902 respectively.

Advantages

(i) Hydel power is a clean, non-p ing source of energy. The water u does not contaminate air or water by producing harmful wastes or poisonous bi-products.

(ii) It does not produce any Greenhouse Gases and prevents us from the harmful effects of Global Warming.

(iii) It is a re able sources o can be use ain and a ergy which

(iv) The dams buil prod hydroelectricity help to save and e water.

(v) It is economical sustainable as saves on fossi els a s cheaper than electricity p ced from il fuels and nuclear r r.

Disadvantages

(i) The cost of building dams for producing hydroelectricity is quite high.

(ii) Building a large dam alters the natural water-table level.

(iii) Building a large dam can cause serious geological damage like triggering earthquakes in the area.

(iv) Building of dams to produce electricity displaces many people from the area and disturbs their life physically, mentally and psychologically.

Bhakra Nangal Dam

The Bhakra Nangal Project is a joint venture of Punjab, Haryana and Rajasthan Governments. The two dams, one at Bhakra and another at Nangal, together is referred to as Bhakra-Nangal Project.

The Bhakra-Nangal project comprises the following:

- Two ns at Bhakra and Nangal
- N al hydel plant
- wer houses
- Bhakra canal system.

The Bhakra Dam is built across the Sutle r near the border between Punjab and H hal Pradesh. The 90 km long reservoi of Bh a dam is known as *Gobind Sagar*. It has a s ge capacity of 9.3 billion cubic meters.

2. **The Nangal Dam** has been constructed at Nangal on the river Sutlej in Punjab. It supplies water to Bhakra irrigation canals.
3. **Power Houses** four power houses at Ganguwal, Kotla, left bank power house

Bhakra Nagal Dam

and the right bank power house have a combined installed capacity of 1204 MW.

4. **Bhakra Canal System** provides irrigation facility to 10 million acres of land in Punjab, Haryana and Rajasthan.

The aim of these projects are

- to provide water for irrigation,
- to generate hydro-electricity, and
- to prevent flooding in Sutlej-Beas rivers.

The dam holds excess waters during the monsoon and provides a regulated release during the year. The dam provides irrigation to fields in Punjab, Haryana, and Rajasthan. The Bhakra main line is a canal that mostly supplies irrigation water to Haryana.

Bhakra Dam has ten power generators with five on each side.

The power generated at Bhakra Dam is distributed among partner states of Punjab, Haryana, Rajasthan, Himachal Pradesh, Chandigarh and Delhi.

Three additional power plants are on the two canals Nangal Hydel Channel and Anandpur Sahib Hydel Channel that originate from Nangal dam.

Hirakud Dam

Hirakud Dam is built across Mahanadi River, about 15 km from Sambalpur in Odisha. It is one of the first major multipurpose river valley projects started after India's independence.

The dam regulates the flow of the Mahanadi river and produces hydroelectricity through several hydroelectric plants.

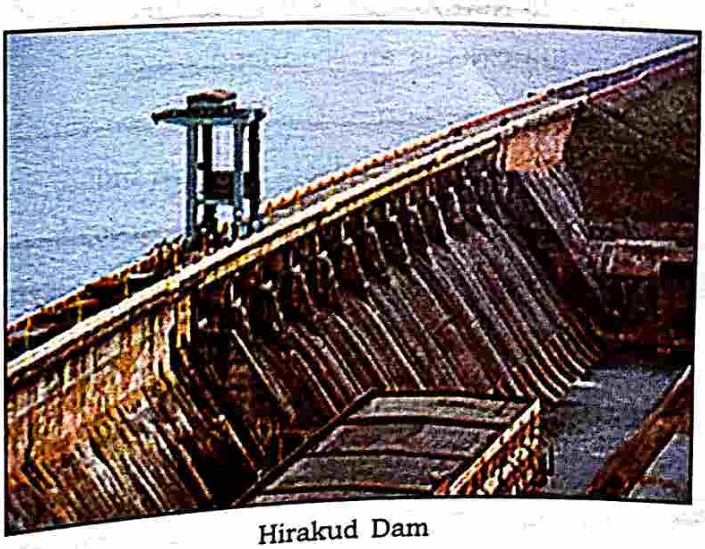
The dam helps control floods in the Mahanadi delta and irrigates 75,000 square kilometres of land.

The project provides kharif and rabi irrigation in districts of Sambalpur, Bargarh, Bolangir, and Subarnpur. The water released by the power plant irrigates in Mahanadi delta.

*Sardar Sarovar Project

Sardar Sarovar Project in the Narmada Basin is one of the largest water resources project in India covering four other states—Gujarat, Rajasthan, Madhya Pradesh and Maharashtra. The Sardar Sarovar Dam, was dedicated to the nation by Prime Minister, Narendra Modi in September 2017. The benefits from the project include:

- *Irrigation:* The project aims to provide irrigation facilities of drought prone areas of Gujarat, drought districts of Barmer and Jallore (Rajasthan) and the tribal hilly track of Maharashtra.
- *Drinking Water Supply:* A special allocation of 0.86 MAF of water has been made to provide drinking water to 28 million people in urban and rural areas in Gujarat specially those in arid region of Saurashtra and Kutch. Water supply requirement of several industries is also met from the project.



Hirakud Dam

*For information only.

- *Power:* There are two power houses viz. River Bed Power House and Ca... Head Power House. The power is shared by t... states — Madhya Pradesh (57%), Maharashtra ...%) and Gujarat (16%). A series of micro hyde... wer stations are also planned on the branch ca... where convenient falls are available.
- *Flood Protection:* It also provid... lood protection to riverine reaches of th... rmada.
- *Wildlife:* Wildlife sanctu... along the river Narmada are benefited.
- *...nal Network:* It has a canal network o... app... nately 75,000 km length within Gujarat. ...n addition, there are benefits of fisheries ...evelopment, recreational facilities, water supply for industries, agro industrial development protection of conserved forest from grazers and ...ondary benefits viz employment generation, in... se in vegetal cover and gains due to tree plant... n.

EXERCISES

I. Answer the following questions:

Q.1 (a) What is meant by conventional sources of energy? Name any two conventional sources of energy.

(b) Name two main coal bearing areas in India.

(c) (i) Name the varieties of coal found in India.

(ii) Give a characteristic of each type of coal.

(d) Give a geographical reason for each of the following:

(i) Anthracite is used for domestic purposes.

(ii) Oil refineries are located close to oilfields or near ports.

(iii) The location of coalfields is an important factor in industrial development.

Q.2 (a) How is Gondwana coalfield different from tertiary coalfield in terms of location and quality?

(b) Name the coalfield that is oldest and one that is largest in India.

(c) (i) State two advantages of coal as a source of power.

(ii) Where is the oldest oilfield located in India?

(d) Give a geographical reason for each of the following:

(i) Petroleum is called 'liquid gold'.

(ii) Natural gas is a fossil fuel.

(iii) CNG is an eco-friendly fuel.

Q.3 (a) What is Natural Gas? Name two variants of natural gas.

(b) Where is natural gas found in India? Name two coastal and two inland oil-refineries in India.

(c) (i) Why do the natural gas deposits mostly accompany oil deposits?

(ii) What is added to domestic gas cylinders, which gives a foul smell? Why?

(d) Give two advantages and one disadvantage of natural gas.

Q.4 (a) Name one important area that has large coal deposits in the States of Jharkhand and West Bengal.

(b) State any one disadvantage of coal found in India.

(c) (i) Name two States that have deposits of the Gondwana coal.

(ii) Name two industries that use large quantity of coal.

(d) (i) Which State is the largest producer of mineral oil?

(ii) Mention any two advantages of hydel power.

Q.5 (a) Why does India have to import oil?

(b) Name one refinery which belongs to the private sector and one in the public sector.

(c) Name the two coastal oil-refineries, one on the west coast of India and the other on the east coast of India. Name one inland oil refinery. List the sources of crude oil for these refineries.

(d) Where are the deposits of Petroleum normally located? Give two uses of Petroleum besides being used as a fuel.

Q.6 (a) Name four products that are obtained during the refining process of petroleum.

(b) State any two advantages of using petroleum as a source of power.

(c) State any three disadvantages of using petroleum.

(d) State any three disadvantages of hydel power.

Q.7 (a) Where is Mumbai High? What is Sagar Samrat?

(b) Why is coal often used near the source of its mining whereas mineral oil is transported to great distances?

(c) Name the region in which India's main coalfields are located. What is the quality of coal found here? What are its uses?

(d) State three advantages of dams.

Q.8 (a) What is meant by hydel power?

(b) With reference to the Bhakra Nangal Dam, answer the following:

(i) Name the river on which it has been constructed.

(ii) Name two states that benefit from this project.

(c) (i) On which river is Hirakud Dam located?

(ii) Give any two uses of this dam.

(d) State three disadvantages of building a big dam.

II. Map Work

On the outline map of India mark and name two centres where each of these minerals are found:

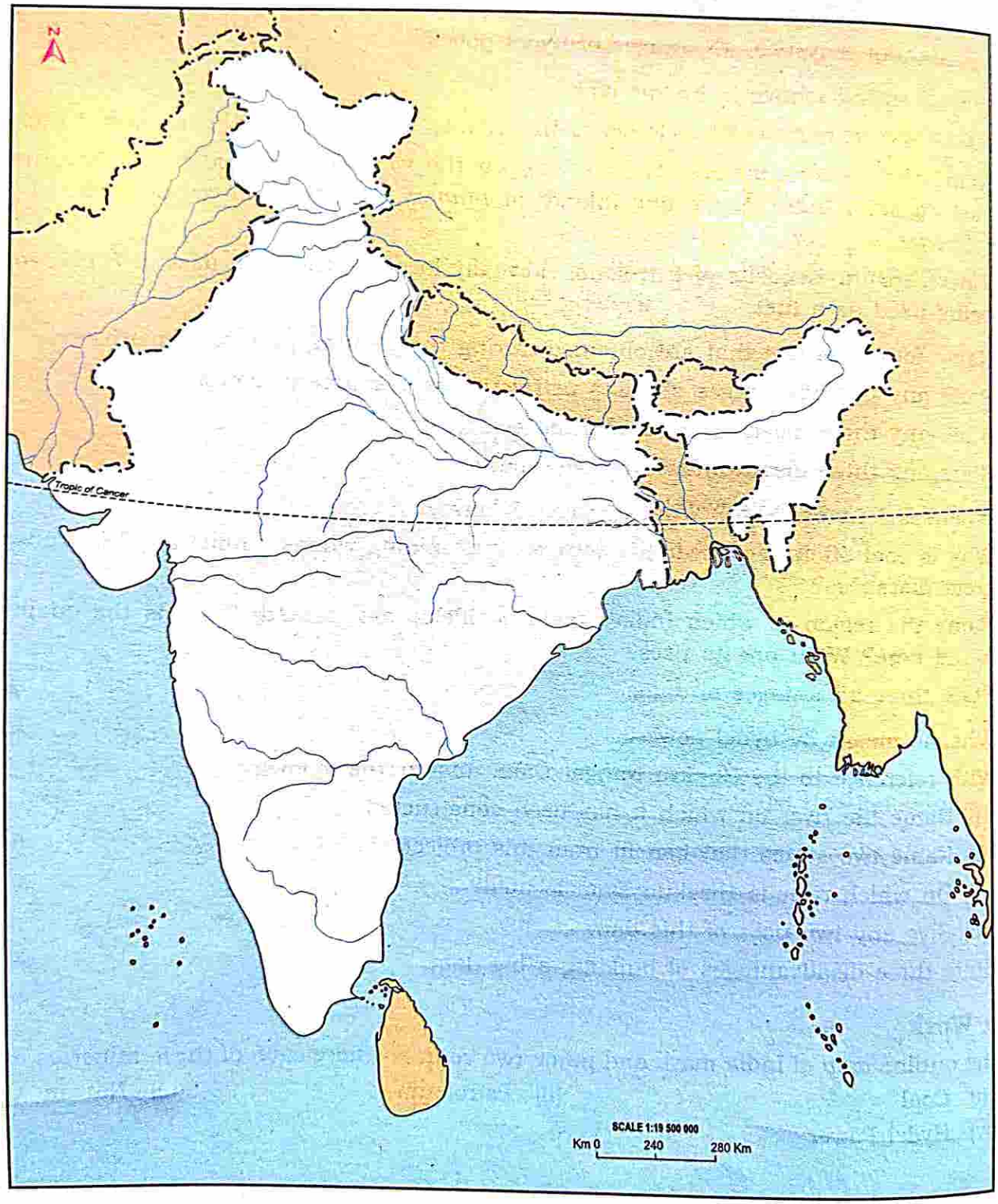
(i) Coal

(ii) Petroleum

(iii) Natural Gas

(iv) Hydel Power

❖❖❖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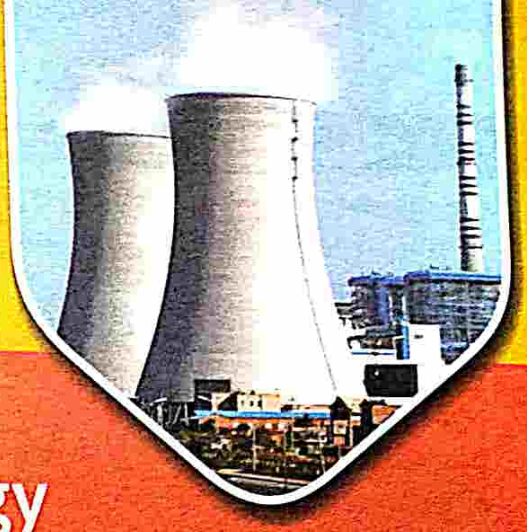


Chapter 14 Non-Conventional Sources of Energy

Syllabus

Non-Conventional Sources of Energy

Non-conventional Sources: Solar, wind, tidal, geothermal, nuclear and biogas (generation and advantages).

Non-conventional sources of energy are those which have been developed in the recent past as an alternative to conventional sources of energy. These include solar energy, wind energy, tidal energy, geothermal energy, nuclear energy and biogas. They are renewable and therefore, inexhaustible, non-polluting, less expensive and easy to maintain.

These sources of energy are considered as the energy resources of the future. Considering their benefits, many countries of the world, including India, have started producing these sources of energy on a large scale. Besides, continuous research is being done for development of technology in this field to reduce the cost of production and to make them more cost-effective.

1. SOLAR ENERGY

Sun is the ultimate source of energy. Traditionally, we have been using solar energy for drying clothes and food-grains, preservation of eatables and for obtaining salt from sea-water. India is fortunate enough to receive higher amount of solar energy, equivalent to 5,000 trillion kWh per year. This is because of India's location on the Tropic of Cancer. Most parts of the country have 300 clear sunny days in a year and per hour per square km availability of solar energy is between 5 to 7 kW.

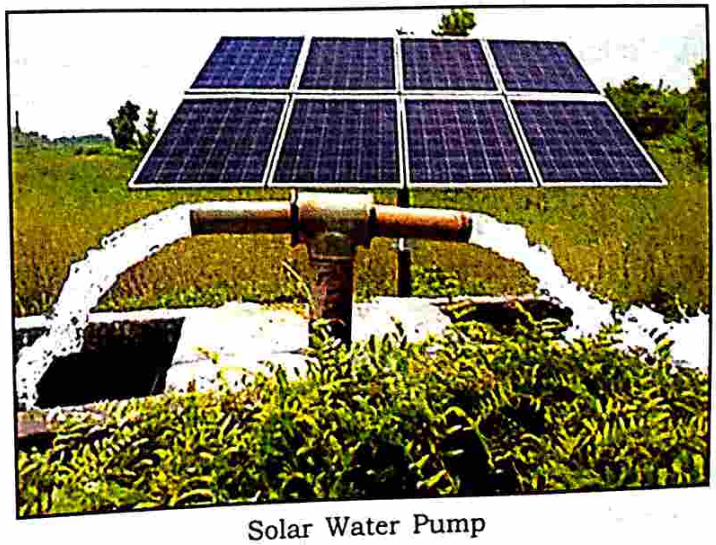
Generation of Solar Energy

Several techniques have been developed in India for harnessing solar energy, as given below:

(i) Solar Cells: They are known as photovoltaic cells. Solar cells are made of thin wafers of semi conductor materials from silicon and gallium. When the sun's radiations strike on them, the sun's energy is converted into electricity. Solar cells are widely used in calculators, electronic watches, street lighting, traffic signals, water pumps, etc.

A group of solar cells joined together in a solar panel can give out a large amount of solar energy and can produce electricity enough to run street-light, irrigation water pump, heating of house, etc.

(ii) Solar Cooker: Solar cookers use solar heat by reflecting the solar radiations using a mirror on to a glass sheet which covers the black insulated box. The raw food is kept in the box. The inside walls of the sides are painted black for efficient absorption of light. The box



Solar Water Pump

is insulated on the outside so that the heat cannot escape. The heated inside of the box emits infra red radiation to which the glass window is opaque. In this way a significant amount of the energy entering the oven is retained. The cooking pot is placed inside the box and cooking is made possible. A new design of solar cooker is now available which involves spherical reflector instead of plane mirror that has more heating effect and greater efficiency.

(iii) Solar Water Heater: One of the most successful applications of solar energy has been in the field of water heating. Sunlight is allowed to fall on flat-plate collectors, which are shallow rectangular trays filled with water and properly inclined so that the efficiency of collection is highest. It consists of an insulated box painted black from inside and having a glass lid to collect and store solar heat. Inside the box it has black painted copper coil through which cold water is made to flow in. The coil gets heated and the water gets heated and flows into the storage tank.

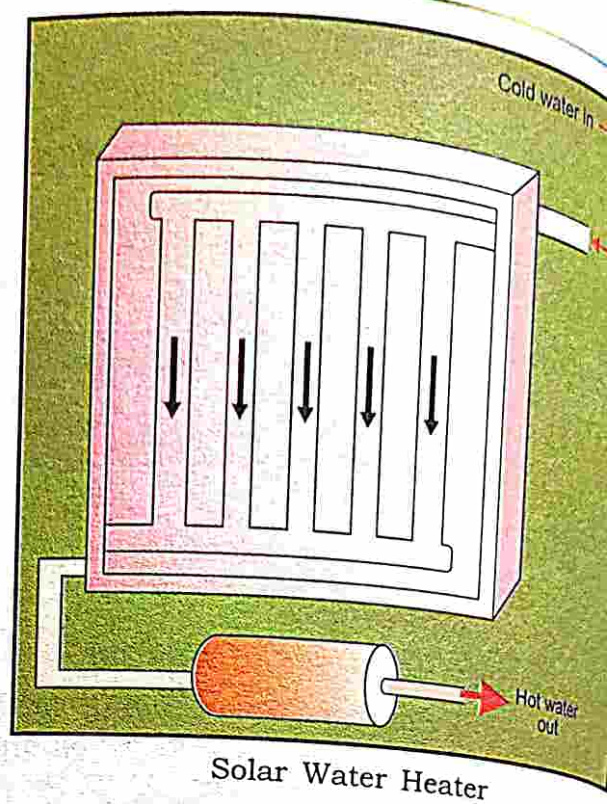
Advantages

(i) Solar energy is a renewable source of energy which can be harnessed in most of the areas of the world.

(ii) It can be used for diverse purposes — to produce electricity in areas without access to the energy grid, to distill water in regions with limited clean water supplies and to power satellites in space.

(iii) Solar energy systems do not require a lot of maintenance. Most reliable solar panel manufacturers give 20-25 years warranty. Also, as there are no moving parts, there is no wear and tear. So, after covering the initial cost of the solar system, it requires little spending on maintenance and repair work.

(iv) It saves fossil fuels like coal and petroleum, used to produce electricity and also reduces electricity bills.



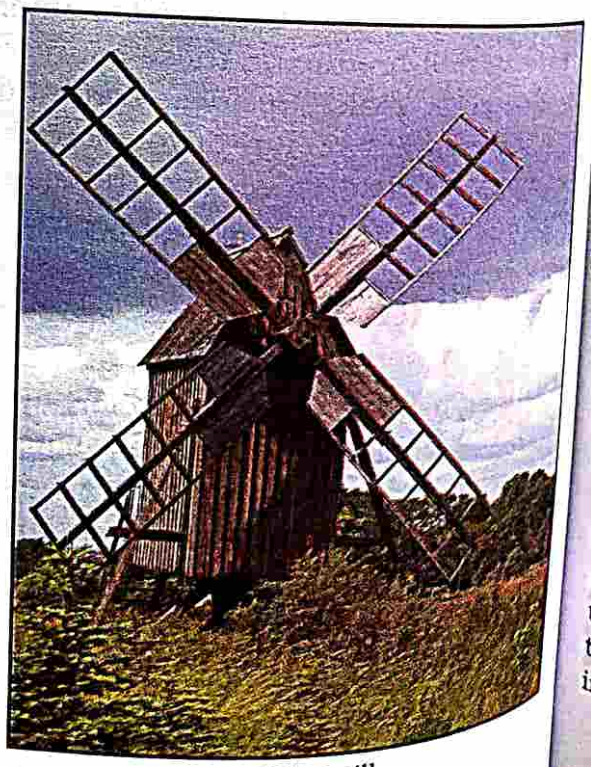
Solar Water Heater

2. WIND ENERGY

Wind is an inexpensive, reliable and non-pollu source of energy for generating electricity.

Generation of Wind Energy

The wind energy is obtained by making use windmills. The blades of the windmill rotate due to the force of the wind. The rotational motion of the blades drives a number of machines like water pumps, flourmills and electric generators.



Windmill

A number of windmills are installed in a definite pattern in clusters called *wind farms*. They generate a large amount of electricity. Wind farms are installed in coastal regions, open grasslands or hilly regions. The Indian wind energy programme is the fifth largest in the world after Germany, Denmark, the USA, Spain and the UK. In India, the largest wind farm cluster is situated from Nagarcoil to Madurai in Tamil Nadu. Besides, Andhra Pradesh, Gujarat, Karnataka, Kerala. Lakshadweep and Maharashtra have important wind farms.

Advantages

(i) Wind energy is a renewable source of energy which can be produced again and again.

(ii) It is the cleanest form of renewable energy which produces no pollution.

(iii) It reduces our dependence on the fossil fuels.

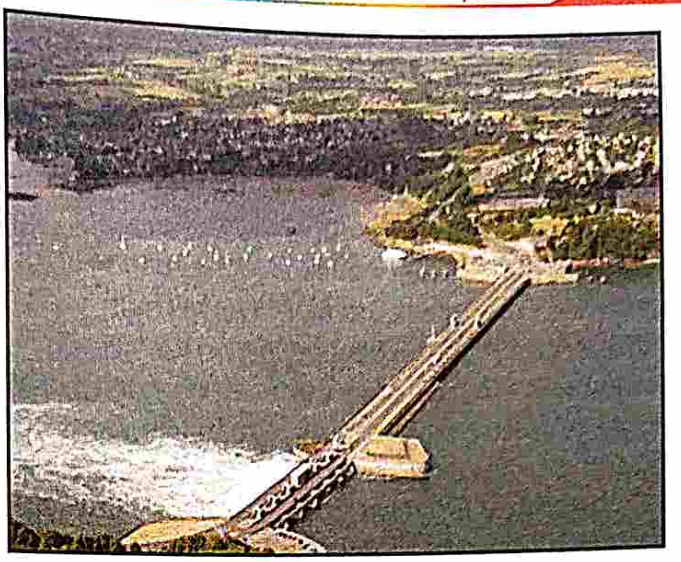
(iv) Land owners can look for additional income by installing wind turbines on land that can even be used for agricultural purposes. The electricity generated by wind power can be used for domestic consumption and reduce monthly electricity bills, and the surplus power can be sold back to the local grid which can result in more savings.

3. TIDAL ENERGY

The term 'tide' is used for the periodic rise and fall of waters of the ocean and produced by the attraction of the Moon and the Sun. This rise and fall of water produces a large amount of energy called *tidal energy*.

Generation of Tidal Energy

The tidal energy can be harnessed by constructing a tidal barrage. During high tide, the sea-water flows into the reservoir of the barrage and turns the turbines which in turn produces electricity by rotating the generators. The reverse process takes place during the low tide, when the sea level is low, the sea water stored in the barrage reservoir flows out in the sea. During the process, the flowing water turns the turbines. There are only a few sites in the world where tidal energy can be suitably



Harnessing Tidal Energy

harnessed. In India the prospective sites for exploitation of tidal energy are Gulf of Kutch, Cambay and Sunderbans. The suitable sites are near Lakshadweep Islands and Andaman and Nicobar Islands.

Advantages

(i) Massive amounts of water in the oceans move in extremely predictable patterns. This makes it easy to harness the tidal energy.

(ii) Tides are controlled by the gravitational pull between the earth, sun, and moon. This means that as long as the earth is being orbited by the moon, the tides will continue to be there producing energy and tidal energy is an inexhaustible source of energy.

(iii) After the initial construction costs, there are very few additional costs to keep the tidal energy plant running. They require little maintenance and minimal personnel as well.

(iv) Tidal energy can be produced even if the water moves at low speed.

(v) There are no carbon emissions from tidal energy plant, making it an energy source that does not negatively affect the global environment.

4. GEOTHERMAL ENERGY

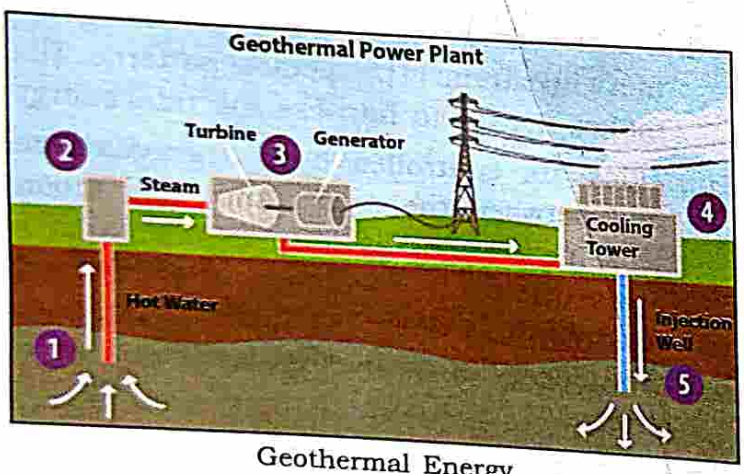
Geothermal energy is the heat energy contained in the rock and fluid that fills the fractures

and pores within the rock in the earth's crust. It is clean and sustainable.

Generation of Geothermal Energy

Resources of geothermal energy range from the shallow ground to steam, hot water and hot rock accessed by drilling wells up to thousands of feet beneath the earth's surface. The extremely high temperatures in the deeper geothermal reservoirs are used for the generation of electricity. The high-pressure steam spins a turbine that rotates a generator and produces electricity.

Hot water is pumped from deep underground through a well under high pressure. When the water reaches the surface, the pressure is dropped, which causes the water to turn into steam. The steam spins a turbine, which is connected to a generator that produces electricity. The steam cools off in a cooling tower and condenses back to water. The cooled water is pumped back into the Earth to begin the process again.



Geothermal Energy

Advantages

The general characteristics of geothermal energy that make it of significant importance for both electricity production and direct use include:

- It is easily accessible because of its extensive distribution.
- It is environment–friendly in nature; has low emission of sulphur, carbondioxide and other Greenhouse Gases.
- It is independent of external supply and demand effects and fluctuations in exchange rates.
- It is independent of weather and season.

Distribution

India has about 12,000 MW of geothermal power potential that can be harnessed for various purposes in India, geothermal plants are located in Manikaran in Himachal Pradesh and Puga Valley in Ladakh.

The surface temperature of the hot springs ranges from 35°C to as much as 98°C. These hot springs have been grouped together and termed as different geothermal provinces. Different regions are – Himalayan geothermal province, Naga-Lushai geothermal province, Andaman-Nicobar islands geothermal province and Cambay graben, Son-Narmada-Tapti graben, West coast, Damodar valley, Mahanadi valley, Godavari valley.

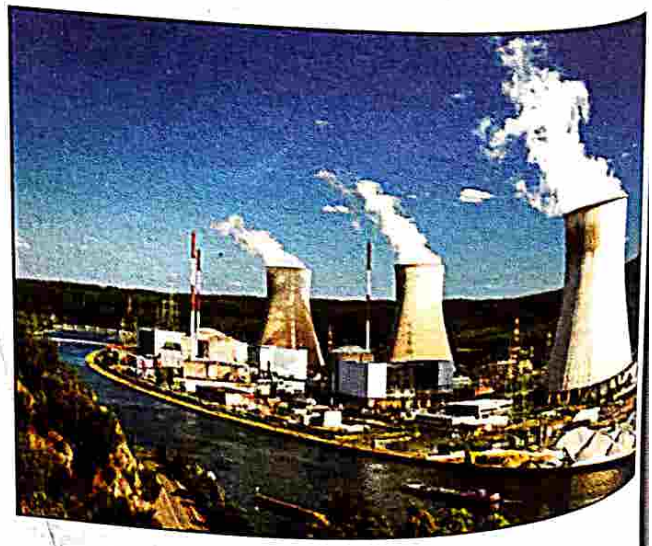
5. NUCLEAR POWER

Nuclear power is obtained from energy stored in the nuclei of atoms of naturally occurring radioactive elements like Uranium, Thorium and Plutonium.

Generation of Nuclear Energy

When atoms of these radioactive substances react, they split apart. This process of splitting of atoms is called nuclear fission.

Nuclear fission produces heat, and this heat is used to heat water and make steam. The steam powers turbines which in turn are used to run generators which produce electricity. The two main types of nuclear reactors used


Nuclear Reactor

Nuclear Power Plants in India

Power station	State
Kaiga	Karnataka
Kakrapar	Gujarat
Kalpakkam	Tamil Nadu
Narora	Uttar Pradesh
Rawatbhata	Rajasthan
Tarapur	Maharashtra
Kudankulam	Tamil Nadu

to generate electricity are the pressurised (PWR) and boiling water (BWR) reactors. In the pressurised water reactor, the water is heated by the nuclear reaction, but because the water is pressurised, it doesn't boil. This heated water is circulated through tubes in steam generators allowing the water in the steam generator to turn to steam, which then turns the turbine. In the boiling water reactor, the water comes to a boil due to the heat produced by nuclear reaction and turns into steam to turn the turbine. The water from the reactor powers the turbine. In both systems, the water is reused.

Distribution

Nuclear power is the fourth-largest source of electricity in India after thermal, hydroelectricity and renewable sources of electricity. India has 21 nuclear reactors in operation in seven nuclear power plants, having an installed capacity of 5780 MW and producing a total of 30,292.91 GWh of electricity.

Uranium and Thorium, which are available in Jharkhand and the Aravali ranges of Rajasthan are used for generating atomic or nuclear power. The Monazite sands of Kerala is also rich in Thorium. India has a flourishing and indigenous nuclear power programme and aims to supply 25 per cent of electricity from nuclear power by 2050.

Advantages

(i) Nuclear energy reduces the amount of energy generated from fossil fuels (coal and oil) and therefore, reduces the use of fossil fuels and lowers Greenhouse Gas emissions.

(ii) saves on raw materials but also in transport, handling and extraction of nuclear fuel. The cost of nuclear fuel (overall uranium) is 20% of the cost of energy generated.

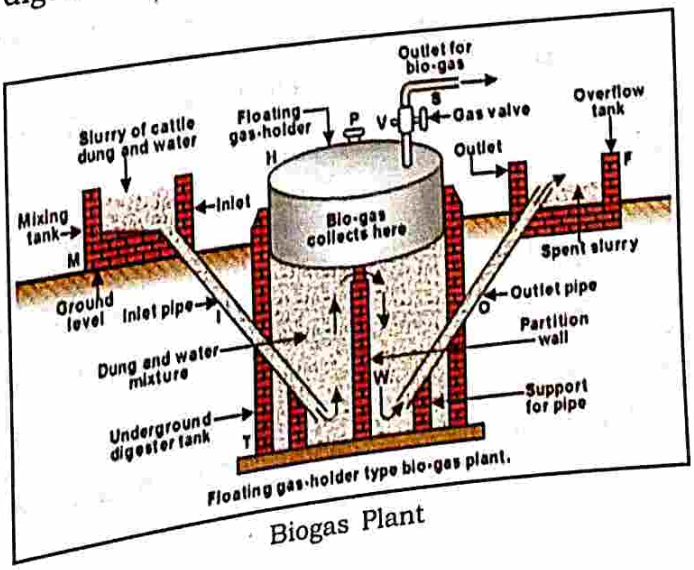
(iii) The production of electric energy is continuous. A nuclear power plant generates electricity for almost 90% of annual time. It reduces the price volatility of other fuels such as petrol.

6. BIOGAS

Biogas is composed of methane, carbon dioxide, hydrogen and hydrogen sulphide. It is produced by anaerobic degradation of animal and plant wastes in the presence of water. Anaerobic degradation means breaking down of organic matter by bacteria in the absence of oxygen. The fermentation of the waste products is carried out by bacteria, which produces hydrocarbon gas, predominantly methane and alcohol. The residue left behind in the tank is rich in nutrients and can be used as manure. The plants which use cattle dung are called 'Gobar Gas Plants'. These plants, using cattle dung, have been set up in many villages. They provide twin benefits to the farmers in the form of energy and good quality manure. The gas is used for cooking, lighting and pumping water from wells.

Generation of Biogas

A digester tank is placed underground. The digester tank receives the dung-water mixture



Biogas Plant

through inlet pipe while the other side discharges the spent slurry through outlet pipe. In the digester tank, there is a gas outlet which is controlled by a pipe. Waste Recycling and Resources Recovery Programmes (WARSE) are now being used from the organic plant waste and night soil. This helps in improving the sanitary conditions in our cities and villages. The plants generate enriched organic manure useful for supplementing chemical fertilisers.

ADVANTAGES

(i) Biogas is a clean, non-polluting and cheap.
(ii) There is direct supply of gas from the plant. Therefore, there is no storage problem.
(iii) The sludge left behind is a rich fertiliser containing bacterial biomass.

The Ministry of Non-Conventional Energy Sources (MNES) has been promoting the Biogass Programme in India. It has set up a number of biogas plants across the country.

EXERCISES

I. Answer the following questions:

Q.1 (a) What are non-conventional sources of energy?
(b) State two differences between conventional and non-conventional sources of energy.
(c) Give three reasons why non-conventional sources of energy are preferred to conventional sources of energy.
(d) How is India in an advantageous position to harness solar energy?

Q.2 (a) State briefly how the sun's energy can be used to generate power.
(b) Name any two devices used to harness solar energy.
(c) State any three advantages of using solar energy.
(d) How is wind energy utilised to produce electricity?

Q.3 (a) What is tidal energy? Give an advantage of using tidal energy.
(b) Give two advantages of using wind energy.
(c) What are wind farms? Where are they usually located?
(d) (i) What is geothermal energy?
(ii) How is geothermal energy used to produce electricity?

Q.4 (a) Name one area each where solar, wind, tidal and geothermal energy is generated in India.
(b) State any two advantages of using geothermal energy.
(c) Name the process involved in generation of nuclear energy. State any three advantages of using nuclear power.
(d) How is biogas beneficial for the farmers and householders?

Q.5 (a) What is nuclear power?
(b) Name two minerals used for the generation of nuclear energy. Name two nuclear power plants in India.
(c) What is biogas? How is biogas produced?
(d) Explain how using nuclear energy in a controlled environment can be a boon for our country.

II. Practical Work

Make a collage depicting the importance of using non-conventional sources of energy.

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Chapter 15 Agriculture — I

Syllabus

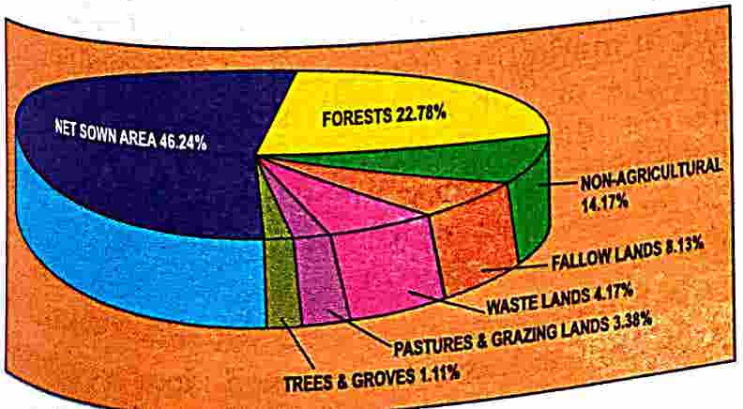
Agriculture

Indian Agriculture – importance, problems and reforms.

Types of farming in India : subsistence and commercial: shifting, intensive, extensive, plantation and mixed.

The word 'agriculture' has been derived from two Latin words, *'ager'* meaning 'land' and *'culture'* meaning 'cultivation'. Agriculture is thus, defined as *the cultivation of the soil in order to grow crops and rear livestock*. The essential purpose of agriculture is the production of food from land for human or animal consumption. India is primarily an agricultural country as two-thirds of its population depends on agricultu Agriculture is the mainstay and the backbo of India's economy. According to the Ministry tatisti and Programme Implementation agricu re allied sector accounts for:

- 15.87 per cent of India's GVA (Gross alue Added).
- 17.1% of its Gross Domestic Produce (GDP).
- 13% share of total value of export.
- employment to 58% of labour force either directly or indirectely.



The vast expanse of level land, rich soil, wide climatic variations suited for various types of crops, ample sunshine and a long growing season provide the necessary conditions for the development of agriculture in India. However, the agricultural output depends on monsoon as nearly 55 per cent of the area sown is dependent on rainfall.

IMPORTANCE OF AGRICULTURE

Agriculture plays a significant role in the Indian economy in the following ways:

(i) It vides food for our expanding population fodder for our livestock.

t generates working capital for non-agricultural development, supplies raw materials for agro-based industries like textile, sugar, food processing, vanaspati, *etc.*

(iii) It provides a large part of the market for industrial goods, especially the farm inputs like fertilizers, pesticides, implements, machinery, *etc.*

(iv) It accounts for a substantial portion of India's exports.

(v) It provides employment to millions of people.

INDIAN AGRICULTURE: PROBLEMS

Despite a number of efforts being made for agricultural development, agricultural yield in India is still low in comparison to the developed countries of the world. This is caused by the interplay of several factors. These factors can be categorised into four groups : (i) environmental; (ii) economic; (iii) institutional; and (iv) technological.

I. Environmental Factors

1. Unreliable Rainfall: I[illegible]an agricultur[illegible] dependent to a large extent [illegible]the monso[illegible], which are uncertain, irregula[illegible]nd unc[illegible]ly distributed. Nearly 55 per c[illegible] of [illegible] net sown area continues to depe[illegible]n[illegible]infall rather than irrigation. That is why[illegible]n rains fail agricultural production is bad[illegible] affected, resulting in scarcity of foodgrains.

2. Lack of Irrigation Facilities: India has the largest irrigated area of the cultivated land. Yet a large per cent of the net sown area lacks irrigation facilities and is dependent on monsoon. The failure of monsoon or too much rainfall leads to crop failure.

Further, free power supply to a section of farmers encourages them to pump groundwater to grow water-intensive crops in low-rainfall areas, for example, sugarcane in Maharashtra and rice in Punjab. This unsustainable pumping of water has reduced water storage in aquifers. Consequently, many wells and tubewells have become dry. This has pushed the marginal and small farmers out of cultivation.

3. Soil Erosion: Soil erosion is not only a major cause for decreasing soil fertility but also results in loss of valuable crop land. The indiscriminate cutting of trees, overgrazing, faulty landuse practices have greatly accelerated the process of soil erosion and soil degradation. Loss of soil fertility is responsible for the low crop yields.

4. Methods of Cultivation: Though a number of crops are grown in India, their average productivity, as compared to other developed countries is quite low. This is because of old and inefficient methods and techniques of farming, inadequate irrigation facilities and inability of the farmers to purchase good quality seeds and modern equipment because of paucity of funds and lack of latest know-how and inputs.

5. Demand for Food Crops: In India, agriculture is practised by repetitive cultivation of the main two food crops—rice and wheat. These two crops deplete the soil fertility.

6. Reduction in Net Sown Area: In the recent decades, there has been a gradual shift from cultivation of food crops to cultivation of fruits, vegetables, oil-seeds and industrial crops. Rather commercial crops are preferred to cultivation of food crops. This has resulted in the reduction of net sown area under cereals and pulses. Further, the competition for land between agriculture and non-agricultural uses, such as housing, *etc.*, has resulted in decline in the net sown area. This has led to a decline in food production.

II. Institutional Factors

1. Small And Fragmented Landholdings: Majority of landholdings in India are very small. These small and fragmented holdings cannot promote modern agriculture. These owners are poor. They do not generate enough income to buy new farm machinery or make heavy investment. Therefore, no scientific cultivation with improved techniques and seeds can take place.

2. Exploitation of Farmers: Land tenure system is another important reason for low productivity in India. Under the Zamindari system, the cultivator was only a tenant who could be turned out of the land. Even though Zamindari system has been abolished but its effects have not been completely wiped out. There is a section of landowners who act as absentee landlords and get their cultivation done through tenants and sharecroppers. Besides the tenants, a large number of landless labourers also exist. They are paid paltry sum as wages and have to work as bonded labourers. Thus, neither the owners nor the tenants have the urge to raise production.

III. Economic Factors

1. Subsistence Agriculture: Subsistence type of agriculture is mainly practised in India. This is because the per capita cultivable land is a mere one-fourth hectare and the farm produce is just enough to sustain the farmer.

2. Human Elements: Farmers are poor, debt-ridden and uneducated. They do not follow the modern techniques of farming, nor can they purchase modern equipment. Due to the lack of marketing facilities and non-availability of loans or fair rate of interest, the farmers are not able to invest the requisite resources in agriculture. They have no security against failure of crops; neither do they have capital to invest in agriculture.

3. Challenges Posed by Globalisation: Till early 1990's India had closed door economic

policy. It was largely felt that by oper... Indian markets to the world, India's econo... would improve.

This had a huge impact on Indian agric... re. Firstly, the withdrawl of the governm... role in promoting agriculture, led to remov... subsidies from government to the farmers. Agricultural infrastructure saw less of aid from the government. This in turn led to the plight of farmers who fell prey to corporate intrusion.

Consequently, Indian farmers are facing a big challenge from international competition. Some of the reasons for this are as follows:

(i) The cost of production of crops is increasing because of government reduction of subsidy on fertilizers.

(ii) The reduction of import duty on agricultural products have proved detrimental to the farmers.

(iii) The cost of agricultural crops in Indian market is increasing, while that of international markets is decreasing.

The prices are declining in the international market due to —

(a) Use of sophisticated farm machinery which has led to the reduction in the cost of production;

(b) Rapid progress in the field of biotechnology, which has made available highly productive seeds to the farmers; and

(c) Heavy subsidies given to the farmers in the developed countries, which result in low production cost.

IV. Technological Factors

Old and Inefficient Techniques: Most of the farmers in India use old and inefficient techniques of farming. Wooden ploughs and bullocks are still used by a large number of farmers. Mechanisation is limited. Farmers continue to use traditional methods of irrigation. With such methods, one-third of the cropped area only could be provided irrigation facilities.

REFORMS

Agriculture has been the backbone of the Indian economy. However, over the years its contribution to ... Gross Domestic Product (GDP) has been ...ining. This is a matter of serious concern ...ecause any decline in agriculture leads to a decline in other sectors of the economy. To check this decline, the Government of India has taken a number of steps like establishment of Indian Council of Agriculture Research (ICAR), agricultural universities, veterinary services and animal breeding centres, horticulture development, research and development in the field of meteorology and weather forecast, and setting up of Kisan Call Centres to address the queries and grievances of the farmers.

The Green Revolution

The 'Green Revolution' is regarded as the greatest revolution in the country which helped to transform the economy from food scarcity to food self-sufficiency. It is the term used for describing the manifold increase in India's farm production and productivity, particularly in the case of major cereal crops like wheat consequent to the adoption of the 'New Agricultural Strategy' since the late-sixties.

The key elements of this new strategy included the following:

(i) Use of large capital and technological inputs;

(ii) Adoption of modern scientific methods of farming;

(iii) Use of High Yielding Varieties (HYV) of seeds;

(iv) Extension of irrigation facilities, particularly ground water resources;

(v) Proper use of chemical fertilizers;

(vi) Improvement in marketing and storage facilities;

(vii) Use of insecticides and pesticides;

(viii) Consolidation of landholdings;

(ix) Supply of agricultural credit; and

(x) Rural electrification.

The Green Revolution had the following impact on Indian agriculture:

(i) It enabled Indian agriculture to change from subsistence to commercial and market-oriented.

(ii) It led to the development of intensive agricultural production system that

increased production a[illegible] paved the w[illegible] for self-sufficiency in resp[illegible] of foodgra[illegible]

(iii) The adoption of new tec[illegible]ology [illegible]der Green Revolution created mo[illegible]mr[illegible]ment opportunities in agriculture s[illegible]

(iv) It enabled the farmers to obtain [illegible]ncreasing returns from agriculture by greater utilisation of agricultural inputs.

(v) It increased rural prosperity.

However, at present the Green Revolution is being criticised by environmental scientists. They allege that it caused land degradation due to overuse of fertilizers and pesticides, drying aquifers and vanishing biodiversity.

Besides the Green Revolution, a number of steps have been taken to improve agricultural production in India. These include the following:

(i) Various land reforms have been introduced. Zamindari and all intermediaries have been completely abolished. According to an estimate, about 173 million acres of land were acquired from the intermediaries and consequently about two crore tenants were brought into direct relationship with the government.

(ii) Consolidation of fragmented agricultural land holdings has been an integral part of the land reforms policy of the Indian government. Legislations have been passed in most of the States to prevent subdivision and fragmentation of lands beyond a certain limit.

(iii) Creation of irrigation infrastructure and its optimum utilisation has been given greater importance. For this, an Accelerated Irrigation Benefit Programme has been started to ensure completion of irrigation projects. The other main elements of the strategy to extend irrigation benefits to more areas include promotion of better management practices, installation of sprinklers and drip irrigation systems in water scarce and drought prone areas, conjunctive use of surface and ground water and farmer's participation in irrigation water systems.

(iv) The Government announces minimum support prices for agricultural crops from time to time to ensure adequate returns to the farmers.

(v) In 2004, the Government started Kisan Call Centres. These are working in 14 different locations covering almost all the states of the country. Kisan Call Centre agents known as Farm Tele-Advisors (FTAs) respond to the queries of the farmers and provide them knowledge about the new and modern methods of farming.

(vi) The Government of India provides subsidy on fertilizers to ensure adequate availability of fertilizers to farmers at reasonable rates.

(vii) The Government is promoting balanced use of fertilizers so that soil fertility is not decreased due to excessive use of chemical fertilizers. For this soil testing laboratories have been set-up in India to check health and fertility of soil.

National Agricultural Policy

The Union Government announced the National Agricultural Policy (NAP) envisaging over 4 per cent growth rate per annum. The policy seeks to promote technically sound, economically viable, environmentally non-degrading, and socially acceptable use of country's natural resources—land, water and genetic endowment to promote sustainable development of agriculture. The salient features of this policy are:

(i) Annual growth rate of over 4 per cent.

(ii) Private sector participation to be promoted through contract farming and land leasing.

(iii) Wider coverage of future markets to minimise fluctuations in price and other risks.

(iv) Plant varieties to be protected through legislation.

(v) Animal husbandry, poultry, dairy and aquaculture to receive high priority to diversify agriculture.

(vi) New location-specific and economically viable improved varieties of agriculture and horticulture crops to be developed.

(vi) Restrictions on movement of agricultural commodities will be removed.

(vii) Review of tax structure.

(viii) Institutionalisation of farm credit.

(ix) Priority to rural electrification.

(x) National Agriculture Insurance Scheme to cover every aspect of agriculture.

TYPES OF FARMING IN INDIA

India is a vast country with various climatic patterns and geographical conditions. Against this background, different types of farming is undertaken in various parts of the country.

1. Subsistence Farming

Majority of farmers in India practise subsistence farming. It is characterised by small and scattered landholdings and use of primitive tools, like hoe and digging sticks by family members. As the farmers are poor, they do not use fertilizers and high yielding variety of seeds in their fields. Facilities like electricity and irrigation are generally not available to them. These result in low productivity. Most of the food production is consumed by the farmers and their families. Where facilities like irrigation and electricity are available, farming has improved. Subsistence agriculture has given way to commercial agriculture in many places.

The main features of subsistence Farming are:

(i) Landholdings are small and scattered.

(ii) The farmers use traditional methods of agriculture.

(iii) It depends upon monsoon, natural fertility of the soil and environmental conditions.

(iv) The output is not very high and it is consumed within the family.

(v) There is a dominance of food crops and there is never surplus for the market.

2. Commercial Farming

This system of agriculture involves cultivation of crops for sale in the market. These crops are called cash crops. They include sugarcane, tobacco, fibre crops and oilseeds. This type of agriculture involves the use of High Yielding Variety (HYV) seeds, chemical fertilizers, insecticides and pesticides to obtain high productivity. The degree of commercialisation of agriculture varies in different parts of the country. For example, rice is a commercial crop in Punjab and Haryana, but it is a subsistence crop in Odisha.

Commercial farming has shown good results in Punjab, Haryana, Western UP, Gujarat and Andhra Pradesh. In most other States there are small landholdings. Therefore, commercial farming cannot be popularised throughout the country. However, the Government is now trying to change the situation through consolidation of such landholdings.

It is usually practised in areas where plenty of land is available and market economy is well developed.

The main features of commercial Farming are:

(i) Crops are grown mainly for sale.

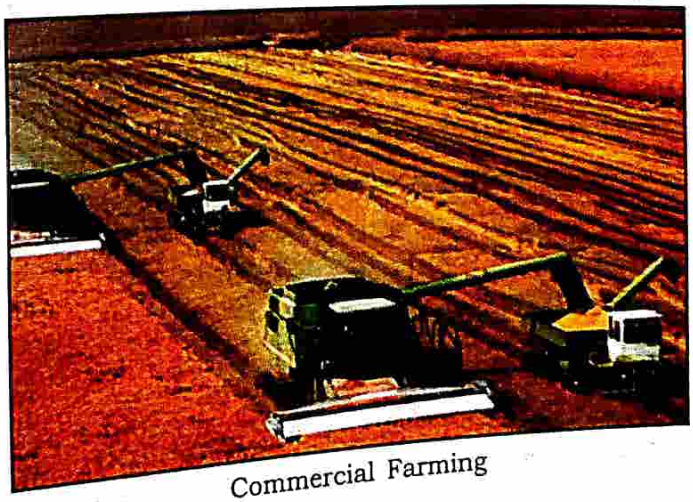
(ii) Large farms are required.

(iii) Mechanised farming is practised.

(iv) It is prevalent in areas where farms are large and market economy is well developed.

3. Shifting Agriculture

Shifting Agriculture, also known as '*slash and burn method*', is a primitive agricultural practice in which a patch of forest is cleared, trees are



Commercial Farming

Shifting Agriculture

felled and stumps are set on fire. The cleared patch is then cultivated for a few years until the fertility of the soil is reduced. Then the farmer moves to a fresh piece of land and the same process is repeated. This type of farming is dependent upon monsoon, natural fertility of the soil and suitability of other environmental conditions.

The main features of Shifting Agriculture are:

(i) A patch of forest land is cleared by cutting and burning of the stumps. The ash is spread on the field as manure.

(ii) After the land is cleared of trees, seeds are sown in the ground. Neither ploughing of the soil nor any other agricultural practices are followed in this type of cultivation.

(iii) After 2-3 years, when soil fertility is lost, the fields are abandoned.

(iv) Again another patch of land is cleared and the same process is repeated.

(v) Shifting cultivation is a great menace to environment. It accelerates soil erosion and causes floods and silting in the lower reaches of the riverine flood plains.

Dry paddy, buckwheat, maize, millets and vegetables are the crops commonly grown in this type of farming. The yield per hectare is low as the farmers do not use fertilizers. Yams and tapioca are also cultivated.

This type of cultivation is known by different names in different regions of India like *Jhum* in Assam, *Ponam* in Kerala, *Podu* in Andhra Pradesh, *Koman* or *Bringg* in Odisha, *Khil* in the Himalayan region, *Kuruwa* in Jharkhand and *Bewar, Masha, Penda* and *Hera* in various parts of Madhya Pradesh. As far as possible government has tried to discourage this type of cultivation due to its wasteful nature and adverse effects on the environment.

Intercropping is used in many areas as an alternative to shifting cultivation. Intercropping refers to the practice of growing two or more crops next to each other at the same time in a way that they do not compete with each other for space, nutrients, water and sunlight. For example, intercropping involves planting one crop with deep roots along with another having shallow roots.

4. Intensive Farming

This is the system of farming under which small farms are cultivated intensively using large inputs of manual labour, manures and fertilizers. Since it is a labour intensive system, it is practised in those areas where the density of population is high. Emphasis is laid on increasing the per hectare yield by using good quality seeds, rich manure and fertilizers and water supply through irrigation. Usually more than one crop is cultivated on the same field and the land is under the crop or the other throughout the year. This type of agriculture is practised in the irrigated areas of the plains of northern India and the coastal areas of South India. The main crops grown are rice and wheat.

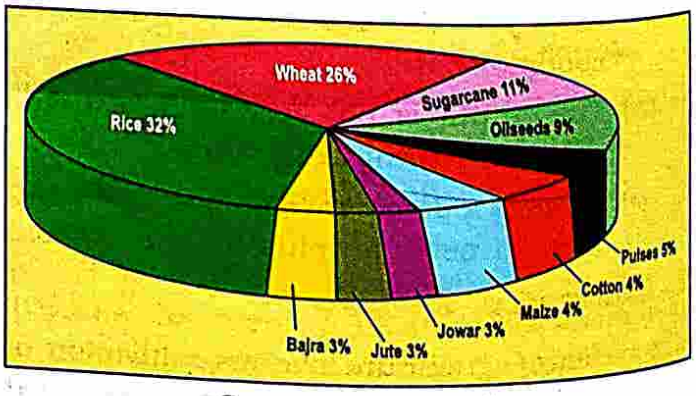
The main features of Intensive Farming are:

(i) Small farms are intensively cultivated.

(ii) More than one crop is cultivated on the same field.

(iii) To increase the output, rich manure and fertilizers, good quality seeds and irrigation facilities are used.

(iv) It is a labour intensive system.



Crops Grown in India

5. Extensive Farming

This type of farming is practised on farms of large size with the help of machines and the input of labour per unit area is low. Crop specialisation is one of the major characteristics of this type of farming, *i.e.*, the farmer specialises in a couple of major commercial crops. The emphasis is laid on increased production. Since the productivity is based on natural fertility of soil, climate and terrain of the area it is practised on large farms to achieve higher yields. The total crop production is high due to large land holding but low in terms of per unit production.

The main crops grown are rice, wheat, sugarcane, *etc.* This type of farming is almost absent in India except some rich farmers of Punjab, Haryana and Uttar Pradesh.

The main features of Extensive Farming are:

(i) Farms are huge in size.

(ii) Machines are used.

(iii) Farmer specialises in the production of one or two major commercial crops.

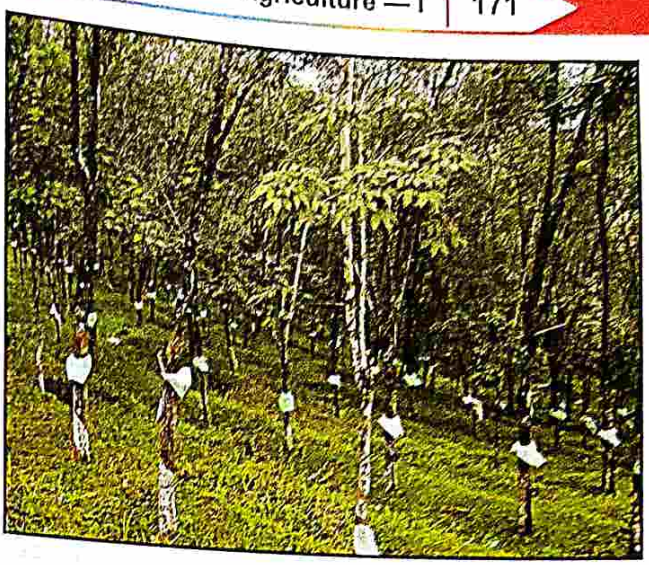
(iv) It is highly capital intensive.

(v) Crop yield is high, with large surplus for sale.

(vi) Due to less use of chemical fertilizers and pesticides, it is an environment friendly method.

6. Plantation Farming

Plantations are large tracts of land or estates used for cultivation of a single agricultural crop like tea, coffee, rubber or spices. A plantation is usually a monoculture over a large area and does not include natural flourishing plants. Such type of farming is labour intensive with huge capital investment involving modern and scientific techniques. Plantations were introduced in India by the Europeans. Many planters in India still lack technical knowledge, managerial ability, quality control and even transport facilities. The plantation crops usually cater to the export market and earn foreign exchange. Plantation farming is carried on in some parts of India, like the hills of South India and North-East India where tea, coffee and rubber are cultivated in states of Kerala, Karnataka, parts of North Bengal and Assam lowlands.



Plantation Farming

The main features of Plantation Farming are:

(i) One crop is cultivated using modern scientific methods.

(ii) Chemical fertilizers, herbicides, and insecticides are used extensively.

(iii) It is undertaken on a large tract of land, using modern machinery.

(iv) Commercial crops are grown for sale.

(v) In order to meet the expenses, capital investment is made.

(vi) Latest technology and modern methods of agriculture are used.

7. Mixed Farming

Cultivation of crops and raising of animals simultaneously is called *mixed farming*. Subsidiary occupations like fruit and vegetable gardening or poultry-farming may also be practised. Two or more crops are grown together. In such cases, a number of crops, with varying maturing periods, are sown at the same time. The crop maturing early is generally harvested before the growth of the long maturing crop. Mixed farming ensures a steady income for the farmers because if the agriculture fails due to adverse climate or any other reason, they can look back to the other options like cattle raising for income.

The main features of Mixed Farming are:

(i) Crops and animals are raised simultaneously.

(ii) Two or more crops are grown together.

(iii) Rotation of crops is practised.

(iv) It ensures steady income to the farmers.

EXERCISES

I. Answer the following questions:

Q.1 (a) What is meant by the term 'agriculture'?

(b) Why is agriculture said to be the backbone of the Indian economy?

(c) Mention any three problems of agriculture in India.

(d) State three advantages of Organic farming.

Q.2 (a) What is meant by Green Revolution?

(b) State any two characteristics of Green Revolution.

(c) State any three negative impact of Green Revolution in India.

(d) What was the impact of Green Revolution on Indian agriculture?

Q.3 (a) Give two points of difference between Extensive and Intensive farming.

(b) State any two advantages of Commercial farming.

(c) (i) What type of farming is practised in areas where population is sparse and land is plenty?

(ii) Name two areas in India where such type of farming is practised.

(d) Give a geographical reason for each of the following:

(i) Plantations are managed by large multinational companies.

(ii) Fields are rotated instead of crops in shifting cultivation.

(iii) In Extensive agriculture, yield per hectare is low but total yield is large.

Q.4 (a) Give two points of difference between Plantation and Mixed Farming.

(b) What is the impact of globalisation on Indian agriculture?

(c) Mention any three measures taken by the government to boost agricultural production.

(d) Agriculture in India is a gamble on the monsoon. Explain.

Q.5 (a) How is shifting cultivation carried out?

(b) Where is shifting cultivation practised in India? State any one disadvantage of shifting cultivation.

(c) State any two steps being taken by the government to discourage shifting cultivation.

(d) What is Subsistence farming? Mention two features of Subsistenee farming.

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Chapter 16 Agriculture — II Food Crops

Syllabus

Agriculture

- Agricultural Seasons (rabi, kharif, zayad).

- Climatic conditions, soil requirements, methods of cultivation, processing and distribution of the following crops: rice, wheat, ~~millets~~ and pulses.

AGRICULTURAL SEASONS

In India, different crops are sown in different seasons. There are two major agricultural seasons in India:

(i) Kharif: The kharif crops are associated with the Southwest Monsoon. They are sown in the months of June and July and harvested in autumn months, *i.e.*, in September and October. Important kharif crops are rice, jowar, bajra, ragi, maize, sugarcane, cotton and jute.

(ii) Rabi: The rabi season begins with the onset of winter in October-November and ends in March-April. The low temperature conditions during this season help in the cultivation of temperate and subtropical crops like wheat, barley, peas, linseed, rapeseed, gram and mustard.

Besides Kharif and Rabi crops, there are certain crops which are raised throughout the year. They are known as Zayad or 'Zaid'. They include:

(a) Zayad Kharif Crops: These are sown in August and September and are harvested in December and January. Most of the oilseeds like mustard are grown in this season.

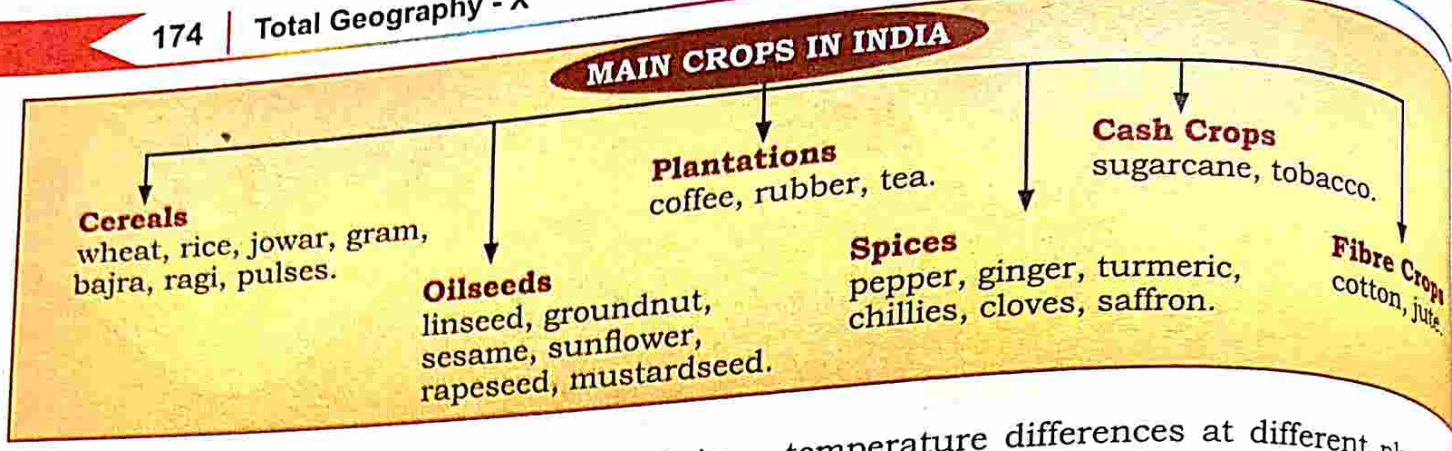
(b) Zayad Rabi Crops: These crops are sown at the beginning of the hot season in February and March and are harvested in the months of April and May. Summer vegetables, jowar, maize, watermelons, cucumbers, *etc.*, are important among these crops.

However, this categorisation of the cropping season does not exist in southern India. Here, the temperatures are sufficiently high to grow tropical crops during any period in the year provided the soil moisture is available.

Indian agriculture is largely dominated by food crops which occupy 65 per cent of the total cropped area of the country. They contribute about 50 per cent of the total value of agricultural production. They are grown throughout the country either as a sole crop or in combination with other crops.

AGRICULTURAL SEASONS

	Kharif	Rabi	Zayad or Zaid
1. Sowing Season	June-July	October-November	Aug.-Sept. (Zayad Kharif) Feb.-March (Zayad Rabi)
2. Harvesting Season	September-October	March-April	Dec.-Jan. (Zayad Kharif) April-May (Zayad Rabi)
3. Crops	Rice, maize, jowar, bajra, ragi, sugarcane pulses, cotton, jute.	Wheat, barley gram, linseed, mustard, potatoes.	Oilseeds (Zayad Kharif) Jowar, maize, summer vegetables and fruits. (Zayad Rabi)



India is by and large self-sufficient in foodgrains. The important food crops grown in India are rice, wheat, barley, maize, millets (jowar, bajra, ragi) and pulses (including gram and tur).

In this Chapter we shall study about the food crops. The main food crops fall under the category of cereals.

The term, 'Cereals' denotes all kinds of grass-like plants, which have starchy, edible seeds. The most common cereals are: rice, wheat, maize, barley, rye, oats, millets. Because of their simple form of cultivation and their high nutritional value, they have formed the basic diet of mankind. India ranks third in the production of cereals in the world after China and the USA. Cereals occupy about 54 per cent of total cropped area in India and 11 per cent of the total production of cereals in the world.

RICE

Rice is the most important staple food crop of India, which feeds more than half of our population. It accounts for one-third production of foodgrains in the country. India is the second largest producer of rice in the world after China. Rice, an indigenous crop, is grown all over the country with highest concentration in north-eastern and southern parts of the country. It occupies above 43 million hectares of land. It is mainly a tropical crop and requires a mean temperature of 24°C and annual rainfall of 150 cm.

Rice is a kharif crop in north India. In the south, it can be grown throughout the year if irrigation is available.

Climatic Conditions

Temperature: Rice cultivation is conditioned by temperature differences at different phases of growth. It grows best in warm and humid areas. The critical mean temperature for flowering and fertilisation ranges from 16°C to 20°C whereas during ripening, the range is from 18°C to 32°C. Temperatures beyond 35°C affect not only grain retention, but also grain-filling. It requires ample sunshine and water. It can grow on different altitudes as long as its temperature requirements are satisfied. For example, it is grown in Kashmir at a height of 2000 m and in Kuttanand region of Kerala which is below sea-level.

Rainfall: Rice requires good rainfall, in the range of 150 to 300 cm. In fact, rice is mainly an irrigated crop. It requires much water both in and upon the soil. During the earlier phase of its growth, it requires 5 to 10 cm of standing water. Therefore, the monsoon lands are best suited for rice production as heavy irrigation is required. Deltas, estuaries, flood plains and valleys of rivers and coastal plains with heavy soils provide excellent conditions for the cultivation of rice.

Upland and Lowland Rice

The rice crops in India can be grouped into two categories :

(a) Upland Rice; and

(b) Lowland Rice.

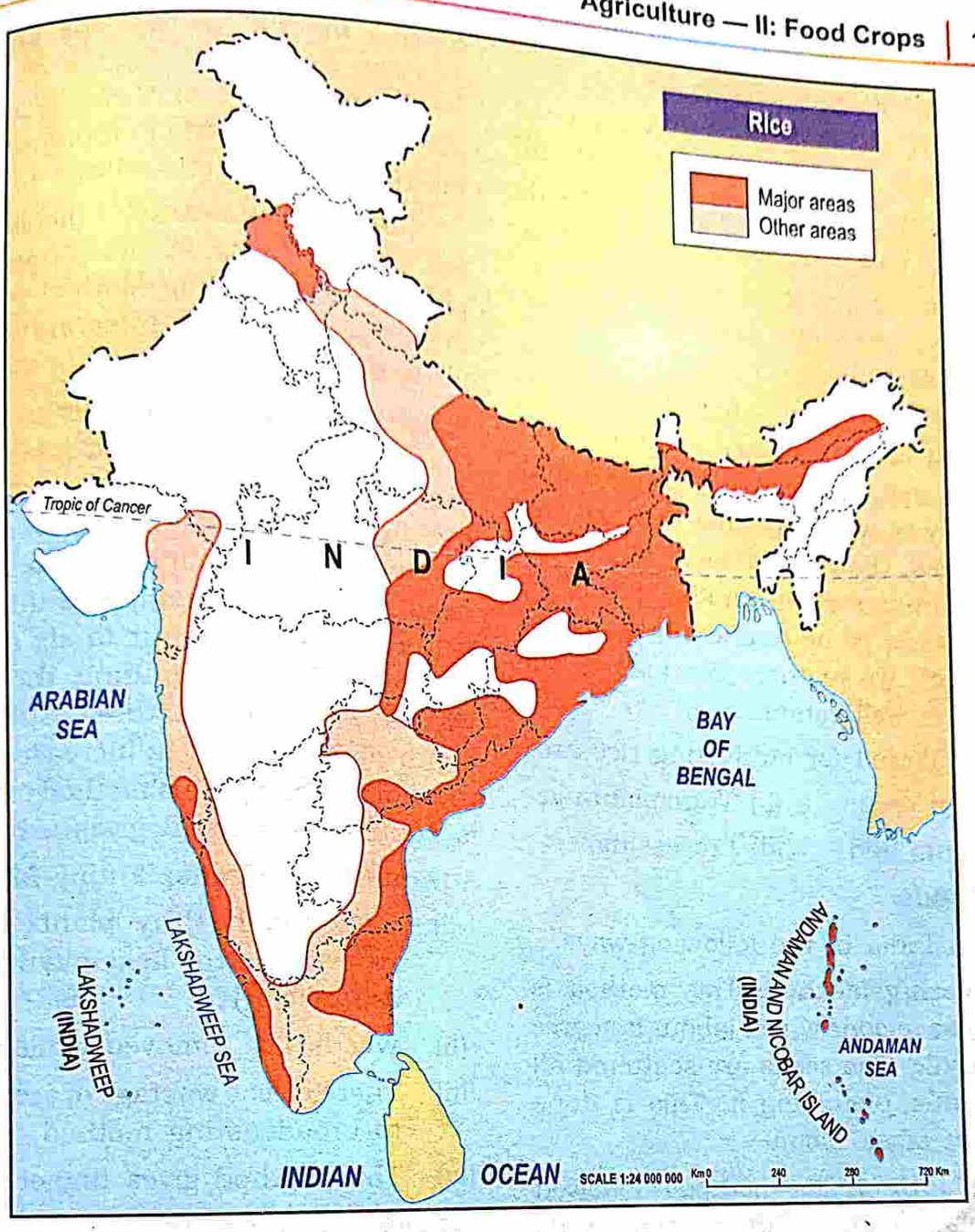
(a) The Upland Rice

(i) This type of rice is grown on mountainous regions.

(ii) Upland rice is sown in March-April and harvested in September-October.

(iii) This type of rice cultivation depends on the distribution of rainfall only.

(iv) The entire crop is used locally.



Rice Producing Areas

(b) Lowland Rice

(i) Lowland rice is grown on low-lying regions.

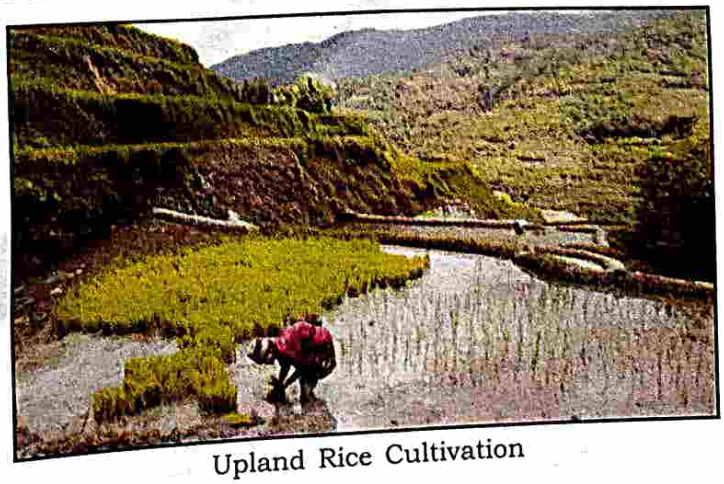
(ii) It is sown in June and harvested in October.

(iii) This type of rice requires plenty of water during the sowing and harvesting period.

(iv) The produce is used for local consumption as well as supplied to other regions.

Soil

Deep fertile clayey or loamy soils are well suited for rice cultivation. Rice thrives in the alluvial soils along the river banks. The soil should be able to retain standing water in the field. This phenomenon protects the plants from pests which cannot survive under water. Soils need manure and fertilisers to produce a higher yield.



Upland Rice Cultivation

Methods of Cultivation

In India, rice is cultivated by two methods (a) the dry method; and (b) the puddled method.

The dry method of cultivation is mainly confined to areas which depend on rains and do not have supplementary irrigation facilities. In this method, the seeds are sown in rows with the help of drills in heavy rainfall areas and scattered with hands in areas of moderate rainfall.

The *puddled* or *wet method* of cultivation is practised in areas which have assured and adequate supply of water. In this method, the land is ploughed thoroughly and filled with three to five centimetres of standing water in the field. This water is maintained in the fields up to a depth of two to three centimetres till the seedlings are well established.

The steps followed for cultivating rice are:

(a) Sowing of seeds; (b) Transplanting;
(c) Harvesting; and (d) Processing.

Sowing of Seeds

Rice is sown in India in the following ways:

(i) Broadcasting Method: This method is prevalent in those regions where labour is scarce and soil is infertile. The seeds are scattered all over the field after ploughing it. This is done before the onset of monsoon.

(ii) Drilling Method: This method is followed in the Peninsular India. In this method, seeds are sown in the furrows with the help of a drill normally made of bamboo. The main advantage of this method is that the seeds fall in the furrows in a systematic way. Therefore, the germination rate of these seeds is high and the wastage of seeds is minimal. However, this method is time consuming.

Transplantation Method of Rice Cultivation

(iii) Dibbling Method: A dibble is an implement for making holes in the ground for seeds or plants. The Dibbling Method refers to sowing of seeds at regular intervals in the furrows by hand.

Transplanting Method: This method is common in the deltaic and flood plain regions and requires abundance of labour. Here seedlings are first grown in nurseries and after 4 to 5 weeks when saplings attain 25 to 30 cm of height they are transplanted into prepared rice fields in groups of four to six at a distance of 30-45 cm. In the beginning, the field is flooded with a 2-3 cm deep water. Subsequently, the depth of water level is increased to 4-6 cm till the crop matures. This method of rice cultivation is popular because it gives a higher yield.

Advantages of Transplanting Method:

(i) Only the healthy plants are picked for resowing in the field and unhealthy plants are discarded.
(ii) Weeds are removed while resowing.
(iii) There is less wastage of seeds as compared to broadcasting method.
(iv) This method gives higher yield.

Japanese Method: This method is an improved form of transplantation method, introduced in 1953 and has gained wide popularity in recent years. In this method, high yielding varieties of seeds, called *'Japonica'* are used. It includes the following practices:

(i) As in the previous method, the seedlings are prepared in the nurseries.
(ii) The rows of plants are fixed at a distance of 25 cm. Similarly, the distance between the plants is about 15 cm. It is easy for the farmer to give proper care to the plants by weeding them.
(iii) Manure is used extensively to increase the yield.
(iv) The Japonica seeds give a higher yield in this method.

Harvesting and Processing

The fields are drained dry just before the crop is harvested. The traditional cutting of the stalk is simple. A sickle (a curved knife) is used for this purpose. It is labour intensive, as each stalk is hand-reaped. Each stem is cut about 60 cm below the grain to facilitate threshing. The moisture content of the crop is reduced by drying the stalks in the sun.

Threshing: Threshing is done by beating the sheaves against the wooden bars. The grains are separated from the stalks. Threshing is done in the rice fields in order to minimise the cost of transportation.

Winnowing: It is the process of removing the unwanted husk from the grains. The simple method involves pouring the grains from a height on a windy day when the grains fall to the ground and the chaff is blown aside.

Milling: Milling is done to remove the yellowish husk from the grains. Traditionally, the villagers used to hit the grain in a wooden mortar with a heavy pestle. This resulted in a high percentage of broken rice. Modern milling is done by machines. Such polished rice has a glossy texture, but lacks nutrition, as much of its vitamins are lost due to excessive rubbing. After this the polished rice is graded and stored in sacks. Traditional method of removing the outer husk is by parboiling the grains and then drying them before removing the outer cover.

Distribution

India is the second largest producer of rice in the world. West Bengal, Punjab, Uttar Pradesh, Andhra Pradesh and Tamil Nadu are the leading producers of rice in the country. The other rice producing States are Haryana, Odisha, Madhya Pradesh, Chhattisgarh, Bihar, Assam, Karnataka, Maharashtra, Kerala, Gujarat and Telangana. Besides these States, Rajasthan, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Manipur, Tripura, Arunachal Pradesh, Goa and Mizoram also produce rice.

West Bengal: Rice is the leading crop of West Bengal occupying about three-fourth of its cropped area. In West Bengal, farmers grow three crops of rice called *'aus'*, *'aaman'*, and *'boro'*.

Uttar Pradesh: Uttar Pradesh has the largest area under rice cultivation. Rice is an important crop in the eastern region of the State (45%). Basti, Gorakhpur, Deoria, Siddharth Nagar, Maharajganj, Gonda and Azamgarh come under 100 leading rice producing districts in the country.

Andhra Pradesh: Rice occupies about one-third of the total cropped area of the state. Although the crop is grown throughout the State but five districts—West Godavari, Krishna, East Godavari, and Guntur together contribute more than half of the State's rice production. The other rice producing districts are Kurnool, Anantapur, Srikakulam, Vishakhapatnam, Nellore and Cuddapah.

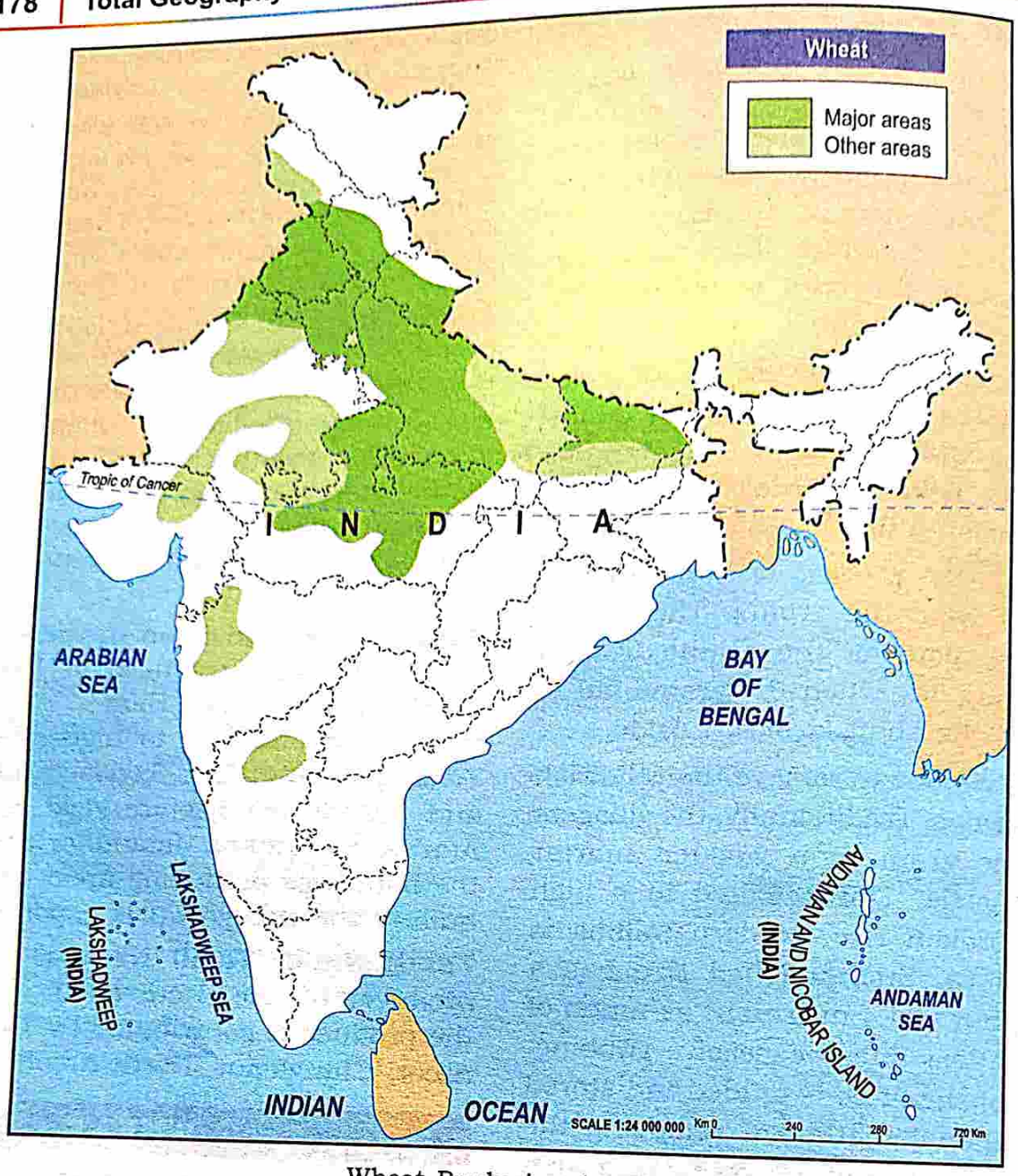
Punjab: Rice cultivation in the irrigated areas of Punjab was introduced in 1970s following the Green Revolution. Here 97% of the rice area is irrigated and due to higher input of High Yielding Variety seeds, fertilisers, mechanisation and finance per hectare yield is the highest. Amritsar, Faridkot, Jalandhar and Patiala are the main rice producing areas in Punjab. The bulk of the rice grown is exported.

Tamil Nadu: Tamil Nadu is an important producer of rice. Here about 75 per cent of the produce is contributed by Tanjavur, South Arcot, Chingleput, North Arcot and Madurai.

WHEAT

Wheat is the second most important food crop in the country after rice both in area and production. About 14 per cent of the total cropped

Wheat Harvesting



Wheat Producing Areas

area in the country is under wheat cultivation. India accounts for about 12 per cent of the total wheat production of world and ranks second after China in wheat production.

The progress in wheat cultivation since 1967-68 has made India self-sufficient in foodgrains. It forms the staple food for people in the northern and north-western parts of the country.

Climatic Conditions

Climate: Wheat can be grown in varying conditions of climate and soil. However, it is mostly confined to the regions of cool winters. It grows best in cool, moist climate and ripens in a warm, dry climate. It is sown usually in October and continues till the middle of November. However, in the south its growing period is shorter than in the north. It is harvested by the end of January in the south, by March/April in Madhya Pradesh, Maharashtra, Western UP, Rajasthan, Punjab and Haryana.

Temperature: Wheat being a rabi crop, is sown just before winter. Ideally, temperature in the range of 10°C–15°C is suitable for sowing; and 20-25°C during harvest.

In India wheat is mostly grown in the Great Plains during the *cold weather* season. The winter rain occuring in northern India is beneficial for this crop. UP, Punjab, Haryana, Rajasthan

and Bihar — all grow wheat as a winter crop. High heat and excessive rainfall is unsuitable for wheat. That is why it is not cultivated in West Bengal and extreme south.

Rainfall: About 80 cm of annual rainfall is ideal for wheat cultivation. The traditional wheat growing region of north-western India receives an annual rainfall of 40 to 75 cm. Here about 12.5 cm of rainfall in winter months (January-February) is good for wheat cultivation. While the shortage of rainfall may be made up by irrigation, the excess of moisture retards the plant growth.

Soil

Wheat grows best in well-drained loams and clay loams. During germination the plant needs sufficient soil moisture. Most of the common bread wheat (*triticum aestivum*) is grown on the alluvial soils of the Great Plains, whereas macaroni wheat (*triticum durum*) is grown on the black soils of central and southern parts of India. *Triticum sphaerococcum* grows on the red soils of the Nilgiri Hills.

Methods of Cultivation

Sowing: Wheat requires a well-pulverised but compact seed-bed for good germination. The fields are ploughed and pulverised several times before the seed is sown.

The seeds can be sown by using drilling or the broadcasting method.

The seeds germinate in about three or four days. When the plant is about 15 cm to 20 cm tall, it needs good irrigation if it does not rain in time.

The temperature should be generally low in the growing season. For the development of grain a gradual increase in temperature is more suitable than a fast increase in temperature.

The plant needs three or four times irrigation during the growing period.

Harvesting: The wheat crop starts ripening in the month of March (temperature about 21°C) and is harvested in April when the temperature is 27.5°C. Wheat is mostly harvested using a sickle.

However, machines have replaced the sickles in Punjab, Haryana and western UP. The traditional method of threshing (to get the crop trampled under the bullock's feet) is used to separate the grain from husk. But this work is now done by threshers as the traditional method is time-consuming. No other crop in India has registered such a sharp increase in its production like wheat. On an average, wheat accounts for 26% of the total area under cereals and 14% of the total cropped area in the country.

Distribution

Uttar Pradesh, Punjab, Haryana, Rajasthan and Madhya Pradesh are the five leading producers of wheat in the country. The yield of wheat is very high in Punjab and Haryana and moderate in Uttar Pradesh, Rajasthan and Bihar.

In Madhya Pradesh, Himachal Pradesh and Jammu and Kashmir, wheat is grown under rainfed conditions and, therefore, the yield is low.

MILLETS

The term 'millets' refers to a number of inferior grains like jowar (or *cholam*), bajra (or *cumbu*) and ragi, which serve as foodgrains for the poorer sections of the society. The straw makes a valuable cattle fodder.

Millets are highly nutritious and easily digestable food. They are a rich source of iron, calcium, zinc and magnesium. India is the largest producer of millets like Bajra. They are grown under conditions where the soil is rather infertile owing to its rocky or sandy character. These are crops of short duration, from three to four months.

Jowar

Ranking next to rice and wheat in both area and production, jowar or great millet is one of the most important food crops in India. It accounts for 5.3 per cent of total cropped area. In the dry parts of the Peninsular Plateau, where rice or wheat cannot be grown, it occupies large tracts and forms the staple food for a large section of the population. It is also grown mainly for fodder in many parts of the country.

Climatic Conditions

Jowar is both kharif and rabi crop. It grows well even in the dry farming areas mostly without irrigation support. Although most of the crop is

Jowar Field

grown on the plains, it can be raised successfully on gentle slopes up to 1,200 m height.

Temperature: Jowar grows well at a temperature between 27°C and 32°C at the time of germination, but it cannot be grown when temperature is below 16°C.

Rainfall: Jowar can be grown in arid and semi-arid areas having rainfall under 45 cm. However its concentration is more in regions having less than 100 cm of rainfall.

Soil

Jowar can grow on a variety of soils ranging from heavy and light alluvium to red, grey and yellow loams. It can even grow on sandy soils. The black clayey loams of the Peninsular Plateau are considered to be most ideal for jowar cultivation.

Methods of Cultivation

Jowar does not require as thorough and prolonged a preparation of the fields as in the case of rice or wheat. However, the soil management before sowing plays an important role in the dry farming areas. The seeds are mostly sown using the broadcast method. But they are also dibbled in some areas. The crop matures in about four to five months.

Distribution

Jowar or sorghum accounts for about 5.3 per cent of the total cropped area in the country. Jowar is largely grown in Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh and Telangana. These states account for about 80 per cent of the total production of jowar in the country. The remaining production comes from Tamil Nadu, Uttar Pradesh, Gujarat and Rajasthan.

BAJRA

Bajra or bulrush millet is an important millet crop. Most of it is used as staple food in north western Rajasthan and Gujarat. Plant stalks are fed to cattle or used for thatching purposes.

Climatic Conditions

Bajra is a short season kharif crop. It is grown either as a pure or mixed crop. As a mixed crop it is grown with cotton, jowar or ragi. It is also a rainfed kharif crop. It is seldom irrigated.

Temperature: The ideal temperature for its growth is between 25°C to 30°C.

Rainfall: Bajra is suited to areas of low rainfall and can be grown even in tracts which receive less than 50 cm of rainfall. It is seldom grown in areas where rainfall exceeds 100 cm. Light monsoon showers followed by bright sunshine provide the most suitable weather condition in the early stages of growth.

Soil

Bajra is grown on the red or the sandy loams. It also does well in black soil.

Distribution

Bajra is a short season kharif crop. It is sown in June-July in Rajasthan, Gujarat, Uttar Pradesh, Punjab and Haryana and harvested in September-October. With the exception of jowar, bajra occupies more area than any other millet

Bajra Field

crop in the country. The principal bajra growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana. As it is a rainfed crop, its productivity fluctuates from year to year.

RAGI

Ragi or Buckwheat is an important millet which is grown in dr parts of sou India and in some areas of no hern Ind

Temperature: Its t rature requirement varies from 20°C to

Cli ic Cond ions

Rainfall: Ragi is one of the hardiest crops. It can grow under conditions of very low rainfall and can withstand very severe drought. It is widely grown in areas where the average annual rainfall is 50 cm to 100 cm.

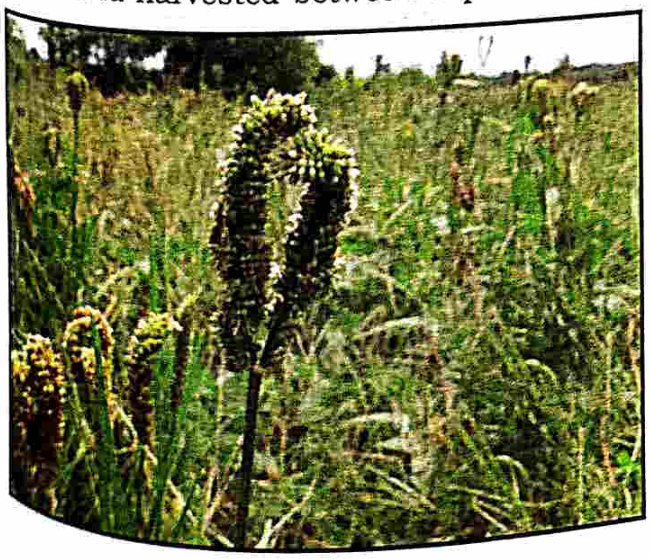
Soil

Ragi is grown mainly in areas of dry farming. It is raised on red, light black and sandy loams in Karnataka and Tamil Nadu and on the well-drained a vial loams Uttarakhand, Jharkhand and Guja t.

The yields of ragi lower than wheat and rice but appre bly igher than most other millets inclu g jowar a bajra. This is because ragi needs lower inputs and attention than most other food crops.

Methods of Cultivation

Ragi is a *Kharif* crop, sown between May and August and harvested between September and January. In many parts of South India it is cultivated throughout the year with the help of irrigation. The seeds are sown by broadcast method or with the help of drills and even transplanted o well-prepared able beds. The crop requires 3 t mont to mature.



Ragi Crop

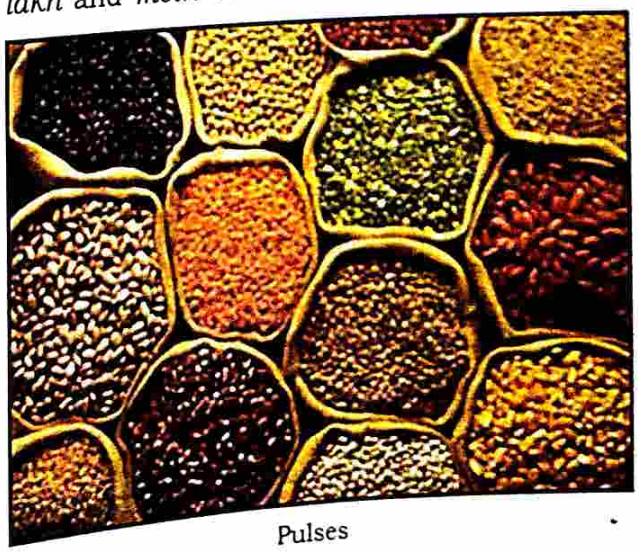
Dist tion

Ragi occupies 1.3 r cent the total cropped area and 5 per c of the total ce ls. Karnataka is the leading producer of ragi in the country followed by Tamil Nadu, Uttarakhand, Maharashtra and Andhra Pradesh. The other ragi producing states are Uttarakhand, Odisha, Jharkhand and Gujarat.

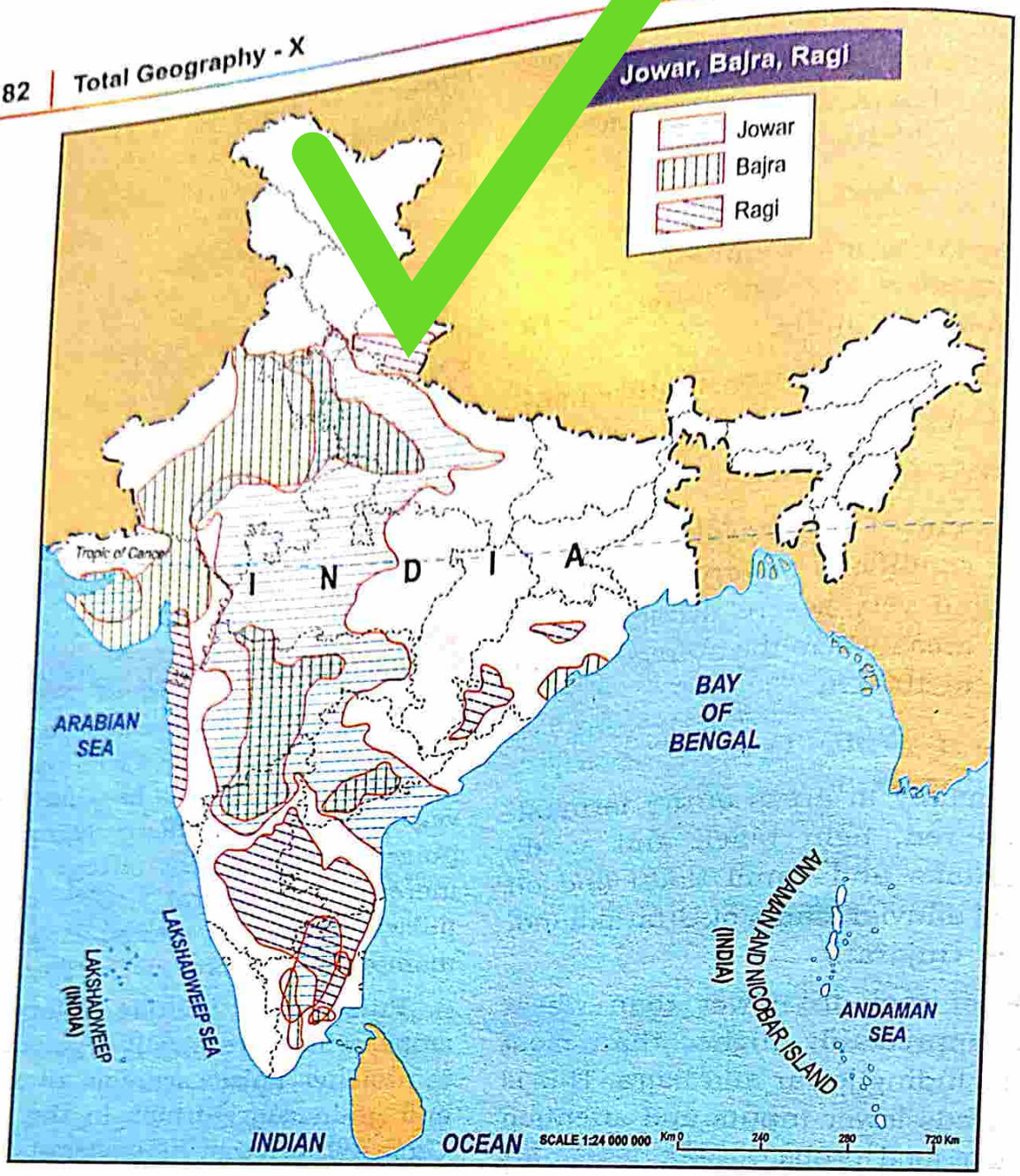
PULSES

Pulses form a very important pa the Indian diet, especially for those who sume starchy vegetarian diet. This is bec pulses provide vegeta protein. Bein guminous crops, pulses i tmospheric ogen in the soil and increase natura rtility of soil. Hence, pulses are ally ated with other crops to maintain or i soil fertility.

Pulse crops include a large number of crops, which are mostly leguminous and rich in proteins. Pulses serve as an excellent forage and grain concentrates in the feed of cattle. *Gram* and *arhar* or *tur* (pigeon-pea or red gram) are the most important pulses; others like *urad* (black gram), *moong* (green gram), *masur* (lentil), *kulthi* (horse gram), *matar* (peas), *khesari* or *lakh* and *moth* or *matki* are also grown.



Pulses



Jowar, Bajra and Ragi Producing Areas

Climatic Conditions

Temperature: 20°C to 25°C.

Rainfall: 50 to 75 cm.

Soil

Dry light soil is required for cultivation of pulses. Gram is the leading pulse crop which occupies about two-fifths of the total area under all pulses. Gram (Bengal) is raised as a rabi crop in those areas which receive about 10 cm of rainfall during winter. Sometimes, gram is sown mixed with wheat. It is the crop of North and Central India. *Tur*, *urad* and *moong* are raised as *kharif* crops almost throughout India. *Khesari* and *masur* are raised as *rabi* crops in north India.

Distribution

India is the largest producer and consumer of pulses and accounts for about one-fifth of the total production of pulses in the world. Pulses occupy about 11 per cent of the total cropped area in India. Pulses are raised on soils ranging from light loams and alluvial soil of Great Plains to the black soils of Madhya Pradesh and Maharashtra and red soils elsewhere. They are mostly cultivated under rain-fed conditions, but in some areas irrigation is provided. The top five pulses producing States are Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan and Andhra Pradesh.

FOOD CROPS OF INDIA

Crops	Temperature	Rainfall	Soil	Leading Producers
1. Rice	Not above 35°C	150-300 cm	Clayey or loamy	West Bengal, Uttar Pradesh, Andhra Pradesh, Punjab, Tamil Nadu.
2. Wheat	10°–15°C (sowing) 21°–26°C (harvest)	80 cm	Well drained loams, and clay loams	Punjab, Haryana, Uttar Pradesh, Rajasthan, Madhya Pradesh.
3. Millets				
(a) Jowar	Not below 16°C	<100 cm	Variety of soils including clayey, sandy loam	Maharashtra, Madhya Pradesh, Karnataka, Andhra Pradesh and Telangana.
(b) Bajra	25°–30°C	40–50 cm	Sandy loam, black and red soil	Rajasthan, Uttar Pradesh, Gujarat, Maharashtra, Haryana.
(c) Ragi	20°–30°C	50–100 cm	Red, light black and sandy loams	Karnataka, Tamil Nadu, Uttarakhand, Maharashtra and Andhra Pradesh.
4. Pulses	20°–25°C	50–75 cm	Dry, light soil	Madhya Pradesh, Maharashtra, Uttar Pradesh, Rajasthan and Andhra Pradesh.

EXERCISES

I. Answer the following questions:

Q.1 (a) Name the three cropping seasons in India.

(b) Which is the most important method of rice cultivation in India? Why?

(c) Name the two states where rice is grown as a cash crop. Why?

(d) Give three points of difference between upland and lowland rice.

Q.2 (a) Why are cereals referred to as 'staff of life'?

(b) State two geographical conditions suitable for the cultivation of rice?

(c) (i) Name the state that produces the highest quantity of rice in India.

(ii) State two advantages of growing rice on lowlands.

(d) Give a geographical reason for each of the following:

(i) Wheat cultivation is confined to the northern parts of the country.

(ii) Punjab is the leading producer of wheat in India.

(iii) Government of India is encouraging cultivation of pulses.

Q.3 (a) What kind of soil is needed for the cultivation of wheat?

(b) State two geographical conditions necessary for the growth of wheat in India.

(c) (i) Name two states that grow wheat extensively.

(ii) What climatic features have helped these states in this respect?

(d) Give three differences between the climatic conditions needed for wheat and rice cultivation.

Q.4 (a) What is meant by "transplantation"? State two of its advantages.

(b) How does the cultivation of pulses usually help in restoration of fertility of the soil?

(c) (i) Why are pulses grown as rotational crops?

(ii) Explain why India is the largest consumer of pulses.

(d) State three methods of growing rice.

Q.5 (a) What are millets?

(b) Why are millets referred to as 'foodgrains of the poor'?

(c) Why are millets known as dry crops?

(d) In what way are the millets different from rice?

Q.6 (a) In which region is ragi grown in India? Why?

(b) In which part of the year is wheat grown in India? Why?

(c) Why is wheat not grown in the eastern and in the extreme southern parts of India? Name the state that is the largest producer of wheat.

(d) Which is a useful 'rotation crop'? Give reasons to support your answer.

Q.7 Study the picture given below and answer the following questions:

(a) Name the crop which is being planted. Give one benefit of this method of planting this crop.

(b) Name the other method of planting the crop. In which area is this method practised?

(c) Mention the climatic conditions which favour the cultivation of the crop being planted.

(d) Give a geographical reason for each of the following:

(i) Rice is not the main crop in the Deccan Plateau.

(ii) Punjab is the largest producer of rice despite deficient rainfall.

(iii) Wheat grows well in loamy soil.

Map Work

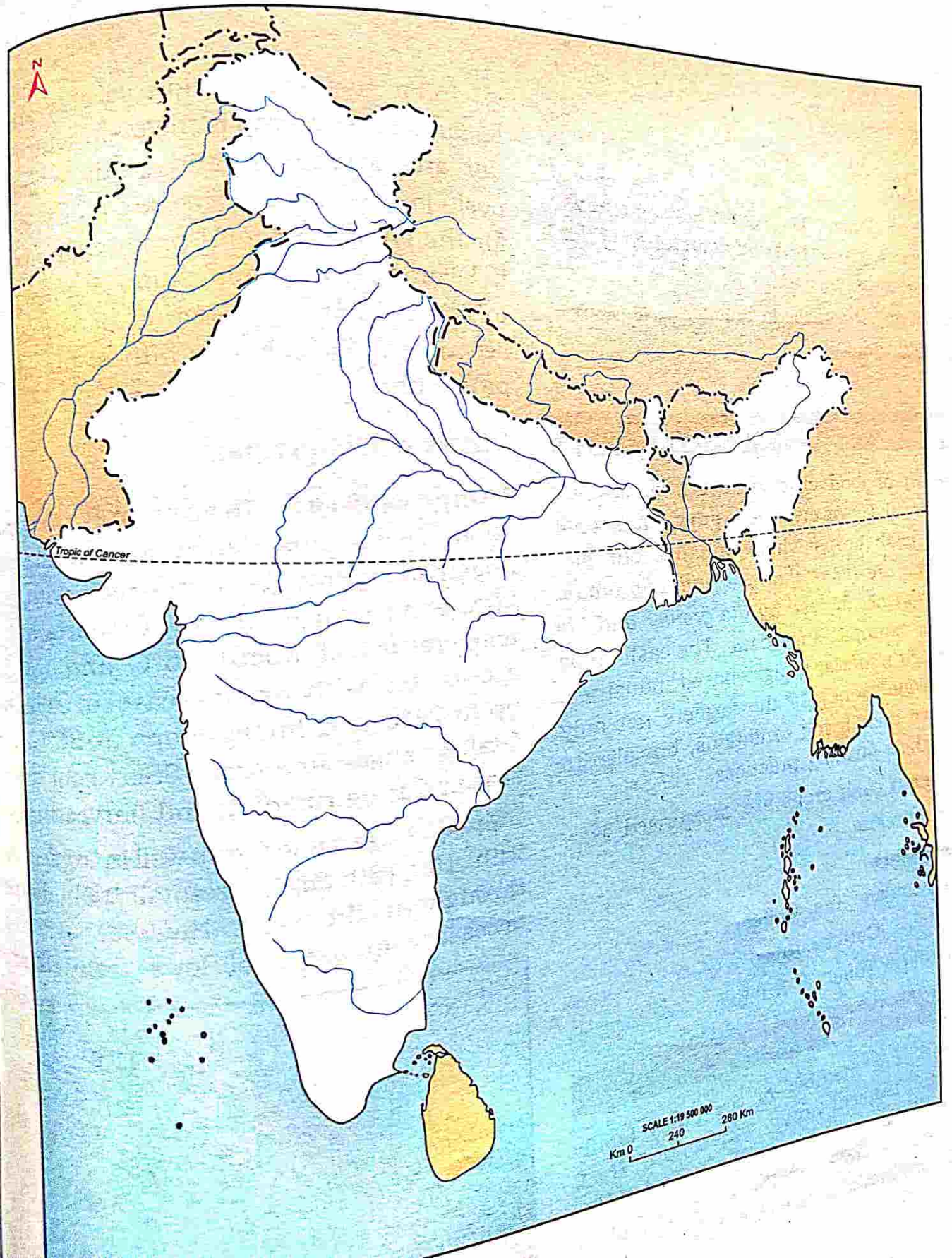
1. On the outline map of India, shade and mark:

(a) The highest wheat producing state in India.

(b) Any two rice producing states in South India.

(c) One ragi producing region.

(d) Two major areas for cultivation of pulses.



Chapter 17 Agriculture — III Cash Crops (1)

Syllabus

Agriculture

Climatic conditions, soil requirements, methods of cultivation, processing and distribution of the following crops:

— sugarcane and oilseeds (groundnut, mustard and soyabean)

CASH CROPS

Cultivation of food crops is essential for our basic survival. However, we also grow commercial crops or cash crops which enhance our life. *Cash crops are those that are primarily grown for sale and not for use by the grower and his family,* for example sugarcane. The cash crops provide raw material to agro-based industries. They provide money to the farmers not only to improve their living conditions, but also to improve their farming practices.

The main cash crops are categorised as:

1. Sugarcane
2. Oilseeds
3. Beverages: Tea, Coffee
4. Fibres: Cotton, Jute
5. Others: Tobacco, Rubber.

SUGARCANE

Sugarcane is a member of the grass family and is a tall tropical variety with a hard, thick stem which grows to a height of 3.5 m or more. Sugar is stored in the stem. The plant probably originated in eastern Asia.

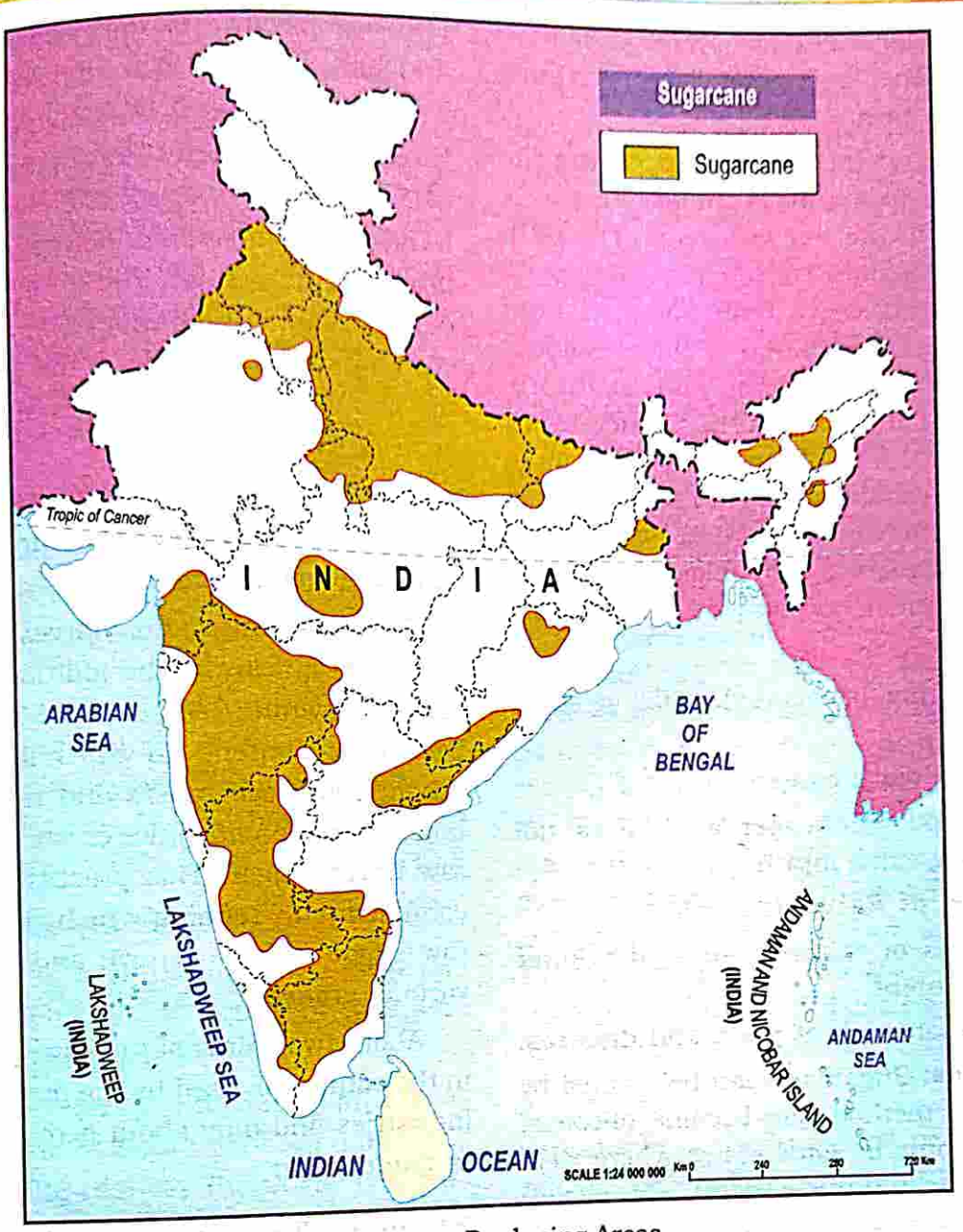
India has the world's largest area under sugarcane. This crop is the main source of sugar, *gur* and *khandsari* and holds a pre-eminent position as a cash crop in the country. It accounts for the largest value of production amongst all the commercial crops. India stands next only to Brazil in the production of sugarcane and accounts for nearly one-fifth of the world cane production.

Climatic Conditions

Temperature: Sugarcane matures in 10 to 18 months depending on the climate. Sugarcane grows well in areas with 20°C to 26°C temperature. Its growth starts at a mean temperature of about 20°C and the growth accelerates with an increase in temperature up to 24°C and finally stops at 26°C. Frost is fatal for sugarcane crop. Short cool dry winter season during ripening and harvesting is ideal.

Rainfall: Sugarcane grows well in tropical regions with 100-150 cm of rainfall well distributed throughout the year. However, irrigation is necessary in areas of lower rainfall or even

Sugarcane



Sugarcane Producing Areas

in areas of higher rainfall during the long dry spells. The sucrose content decreases if heavy rains continue for long and a rainfall deficiency produces a fibrous crop. A slightly dry sunny weather is necessary during the ripening stage of the cane.

Soil

Sugarcane is grown in well drained rich alluvial, heavy loams or lava soil. It is largely grown on loams and clayey loams of the Great Plains and on black soils, brown or reddish loams and laterites in the Peninsular India. Sugarcane exhausts the fertility of the soil. Hence, the soil is supplemented with manures and nitrogenous fertilizers.

Methods of Cultivation

1. Sowing: Sugarcane is a labour intensive crop. The crop is kept weed-free and irrigated frequently if there are no timely rains. Most of the crop is planted just before the hot season, a little earlier in the southern and eastern parts. Sugarcane is planted by following methods:

(a) Sett Method: New canes are usually planted by taking cuttings from old plants. These cuttings, known as *setts*, quickly become established and after a few days buds sprout to

form new stalks. Four to five stalks grow from each cutting. The sugarcane takes anything from 8 months to a year to mature.

(b) Ratooning: In this method after the first harvest the sugarcane is cut leaving little bit of the stalk in the soil with roots. The stalk soon puts out new shoots or ratoons. The second or any other successive crop obtained from the roots of the leftover crop is called Ratoon. Sugarcane is a perennial crop and, in theory, the same plants could continue to produce canes for many years. This is not done because the yield from each successive ratoon crop is lesser than the previous one. After two or three ratoons, the old roots are no longer economical and new setts must be planted.

Advantages of Ratooning:

(i) Crop need not be planted again, it saves labour.

(ii) The ratoon matures early.

(iii) This method is cheaper as it does not involve any extra inputs.

Disadvantages of Ratooning:

(i) The yield is of thinner canes with lower sucrose content.

(ii) There is more risk of pests and diseases.

(c) By Seeds: Sugarcane can be planted by seeds but this method has become obsolete. It is practised only in some states where yield is not high.

Sugarcane is planted in furrows and covered with soil. There is enough distance between rows (30-45 cm) to facilitate hoeing, weeding, irrigation and harvesting. In some parts of the country it is cultivated as a mixed crop.

Sugarcane Harvesting

2. Harvesting: Sugarcane is harvested before the cane begins to flower. In northern India, it is harvested before the winters to protect it from frost. The crop is cut by hand using a long curved knife. The stalks must be cut as near as possible to the ground because the greatest accumulation of sucrose is in the base of the stem.

The cane harvest and crushing operations begin in October–November and continue till April all over the country.

3. Processing: After harvesting, the canes are taken quickly to the mill for they must be processed within 24 hours of cutting to preserve the sugar content. In the mills the cane is crushed between rollers and then boiled with lime. The sugarcane juice crystallises and forms raw brown sugar. This process should not be confused with refining which re-processes the raw sugar to make brown and white sugar of various grades.

About two-thirds of the sugarcane produced in the country is used by the *gur* and *khandsari* industries and only about a third of it is used to make sugar.

Distribution

The Main Regions: Sugarcane is cultivated throughout India between 8°N to 32°N latitude. There are three main areas of sugarcane production in India: (a) Sutluj-Ganga plain from Punjab to Bihar; (b) Black soil area from Maharashtra to Tamil Nadu; and (c) Coastal Andhra Pradesh and the Krishna valley.

North India: Geographically, North Indian States are the chief suppliers of sugarcane, *i.e.*, the belt lying between Bihar and Punjab has the large sugarcane growing tract, especially the Sutluj-Ganga plain. This is because of the fertile alluvium which is renewed every year by numerous mountain streams flowing in this area, sufficiently high temperatures and

rainfall, and availability of high water level enabling easy irrigation.

South India: South India, on the other hand, has higher yield per hectare, a longer harvesting season and better quality of the crop owing to the favourable maritime climate free from the effects of summer *loo* and winter frost, sufficient irrigation and new farming techniques. But in southern parts of India the sugarcane crop has to face stiff competition from other cash crops like cotton and groundnut. Furthermore, the winter rainfall along Tamil Nadu coast is not beneficial for the crop.

On state-level Uttar Pradesh occupies first place both in respect of area and production of sugarcane in the country followed by Maharashtra, Tamil Nadu, Karnataka and Andhra Pradesh. Tamil Nadu is the largest producer of sugarcane in South India. The share of other States like Gujarat, Bihar, Haryana, Punjab and West Bengal and Telangana is less than 10 per cent of the total output of the crop.

Problems of Sugarcane Cultivators

(i) Sugarcane is a soil exhausting crop and therefore the cost of fertilisers increases the cost of production.

(ii) The farms are far from the mills and a delay of more than 24 hours between harvesting and crushing reduces the sugar content.

(iii) The cost of transport increases the cost of production.

(iv) The crop is an annual crop and therefore, the farmers are unable to cultivate any other crop, thereby, limiting their income.

(v) It requires high input of irrigation means.

(vi) The price is fixed by the government which is most of the times not profitable for the farmers.

Role of Government in Solving Farmers' Problems

(i) Cooperative societies have been set up by the government to help the farmers.

(ii) Rural credit banks provide loans to farmers at low interest rate for buying farming tools, high yielding variety seeds, fertilisers and pesticides.

(iii) Better irrigation means are developed to provide regular water for irrigation of sugarcane farms.

OILSEEDS

All the principal oilseeds—groundnut, linseed, castor, sesamum, soyabean, cotton seeds, sunflower, rapeseed and mustard, *etc.*, are grown in India. These oils are used for various purposes. They are used as industrial raw materials in the manufacture of paints, varnishes, hydrogenated oil, soaps and lubricants. Vegetable oils produced from the seeds of groundnut, rapeseed and mustard, sesamum, safflower, sunflower and soyabean are edible. They are commonly used as a cooking medium. Although linseed oil is used for cooking food in some areas of central India, it is categorised as a non-edible oil. Castor oil too is non-edible. Groundnut is the leading oilseed followed by rapeseed and mustard. *Oilcake*, i.e., the residue left after the extraction of oil from the oil seeds is used as a fodder for animals and also serves as a good manure in the fields. Linseed oil is got from flaxseeds and is good for health.

1. Groundnut

Groundnut is also known as *peanut* or *monkey nut*. It is believed that groundnut was introduced in India from Brazil during the 16th century. It contains about 45 per cent oil, which is extracted from the seeds found in the roots of the plant. It is mainly used for the manufacture of hydrogenated oil. It is also used in making

Groundnuts

Crop	Temperature	Rainfall		Leading States
Sugarcane	20°C–26°C	100– cm or irrigatio ilities with high h	Well- ained rich allu , heavy loam o a soil.	UP, Maharashtra, Tamil Nadu (highest yield hectare), Karnataka, Andhra Pradesh.
Groundnut	20°C to 25°C	50 to 100 cm	dy loams, loams a drained soils.	Gujarat, Telangana and Tamil Nadu.
Mustard	10°C to 20°C	25 to 40 cm	Loams, loams	Uttar Pradesh, Rajasthan, Punjab, Madhya Pradesh and Haryana.
Soyabean	13°C to 24°C	40 to 60 cm	Friable loamy, acidic soils.	Madhya Pradesh, Rajasthan and Maharashtra.

yellow and black cotton soils of Peninsular India suit it well. Such light soils are essential as the nut ripens in the soil.

Methods of Cultivation

1. Sowing: The sandy soil is ploughed. Then the seeds are sown broadcasting or drilling in June or July. n the plan mature, they flower. After self linatio flower stalk elongates, turns down d urys the fruit where it matures. The ma fruits have wrinkled shells with one t ur ds per pod. The whole crop takes o 5 mo to be ready for harvest.

Groundnut is a *Khari* crop in most part of India. The crop is sown in June-July and harvested in November-December. But in Tamil Nadu it is a summer crop sown in February-March and harvested in June-July.

2. Harvesting: The entire plant, including the roots, is removed from the soil. Groundnuts are dried and packed into sacks to be sent to mills or commercial establishments.

Distribution

India is the second largest producer groundnuts in the world after China. The crop occupies about 3.6 per cent of the country's total cropped area and amounts to about 4 per cent of the total agricultural production.

Groundnut is a tropical crop and is extensi grown in Peninsular India. Telangana and il Nadu together account for more than alf of the groundnuts produced in India. Gujarat is the leading producer of groundnuts in India. The other groundnut producing states are Maharashtra, Karnataka, Andhra Pradesh, Rajasthan, Madhya Pradesh, Uttar Pradesh d Punjab.

2. Mustard

Mustard oil seeds are crushed to get an important edible oil. It is used extensively in northern India as a cooking medium. In Uttar Pradesh, Punjab and Haryana the oil cake of mustard is an important cattlefeed. The leaves of mustard (sarson) are eaten as vegetable in njab and Uttar Pradesh. It is also used as a manure. Its oil content is about 25-43 per cent.

Mustard thrives only in cool climate and that is why it is widely grown in the Sutlej-Ganga Plain and a very small proportion is obtained from the States of Peninsular India. It is grown mostly as pure rabi crop or mixed with wheat, gram and barley.

Climatic Conditions

Temperatu nd Rainfall: Since mustard grows be cool climate, it is grow well in mpe re which ranges from 10° to 20°C. The equires rainfall varying between 25 to

Soil

Mustard c e grown on loams but slightly heavier soils preferred.

Methods of C...vation

Mustard is grown w...wheat, gram, h... in rows in the same climat...nditions...owing period is four to five mo...s. I...harvested about one or two weeks be...e main crop and collected in heaps in...ranary. The seeds are separated by ...ng t... trampled under the bullocks' f...

Distribution

About 90 per ce... of the area and produ...n is contributed by Uttar Pradesh, Rajasthan, Punjab, Madhya Pradesh and Haryana. The rest comes from Assam, Bihar, West Bengal, Odisha, Gujarat and Jammu and Kashmir.

3. Soyabean

Soyabean has a high protein content. The beans may be eaten as vegetable or made into soya sauce. Soyabean is used as a substitute for animal protein. It is consumed as soya milk and tofu (cheese).

Climatic Conditions

Soyabean is a light coloured oval bean raised as a *kharif* crop. It is sown in the month of June. Care is, however, taken that time-lag between the sowing time and the onset of heavy monsoon rains is about two weeks since heavy rainfall adversely affects the germination of soyabean seeds.

Temperature: It requires temperature in the range of 13°C - 24°C. Temperature above 13°C is necessary for the normal growth of soyabean.

Rainfall: Soyabean grows in regions with 40 cm to 60 cm of rainfall. The rainfall should be well distributed throughout the growing season.

Soil: It is grown on friable loamy acidic soils.

Methods of Cultivation

The crop needs three or four irrigations during its growing period. Before sowing, its seeds are covered with gur (jaggery) and rhizobium. ...present, it is, main...a rainfed crop. It is h...sted in the mi... of October.

Dist...tion

The mos...tant soyabean producing area lies in M...a Pradesh and the adjoining distric... Raj...an and Maharashtra. Madhya Pra...h is the l...ing producer of soyabean.

EXERCISES

I. Copy the chart and fill in the details:

Crop	Temperature	Rainfall	Soil	Leading States
Sugarcane				
~~Groundnut~~				
~~Mustard~~				
~~Soyabean~~				

II. Answer the following questions:

Q.1 (a) Name one state in North and one in South India where sugarcane is grown extensively.

(b) Why is the sugarcane production increasing in Maharashtra?

(c) Explain briefly the Sett method of planting sugarcane.

(d) What is Ratooning? State two advantages of Ratooning.

Q.2 (a) How does heavy rainfall affect the quality of sugarcane?
(b) Why does the cultivation of sugarcane require cheap labour?
(c) Why do the stalks of sugarcane need to be cut as near as possible to the ground?
(d) State any three problems faced by sugarcane cultivators.

Q.3 (a) What extra care needs to be taken for soil health when sugarcane is cultivated?
(b) Mention the climate that is suitable for sugarcane cultivation.
(c) What advantage does South India have over the north with reference to sugarcane cultivation?
(d) Mention two different ways in which sugarcane is propagated.

Q.4 (a) W[illegible] conditions [illegible] temperature and rainfall favour the growth of groundnut?
(b) Which [illegible]wo st[illegible]es in India are the leading producers of groundnut? Why is groundnut mostly grown in [illegible]ninsular India?
(c) Give [illegible]ree u[illegible] of groundnut.
(d) [illegible]hat is the resi[illegible]e after crushing oilseeds called? Give two of its uses.

Q.5 (a) Name any two oilseeds grown in India. Which oilseed is grown as a rainfed crop?
(b) State the [illegible]nditions [illegible] temperature and rainfall necessary for the growth of mustard.
(c) (i) Which so[illegible] favours the growth of mustard? Name an area where it grows.
(ii) Mention [illegible] [illegible]es of mustard.
(d) Mention [illegible] climatic [illegible]nditions necessary to grow soyabean. State two uses of soyabean.

III. Map Work

On an outline map of India, shade and mark the areas where the following are cultivated:

(i) Sugarcane; (ii) Groundnut; (iii) Mustard (iv) Soyabean

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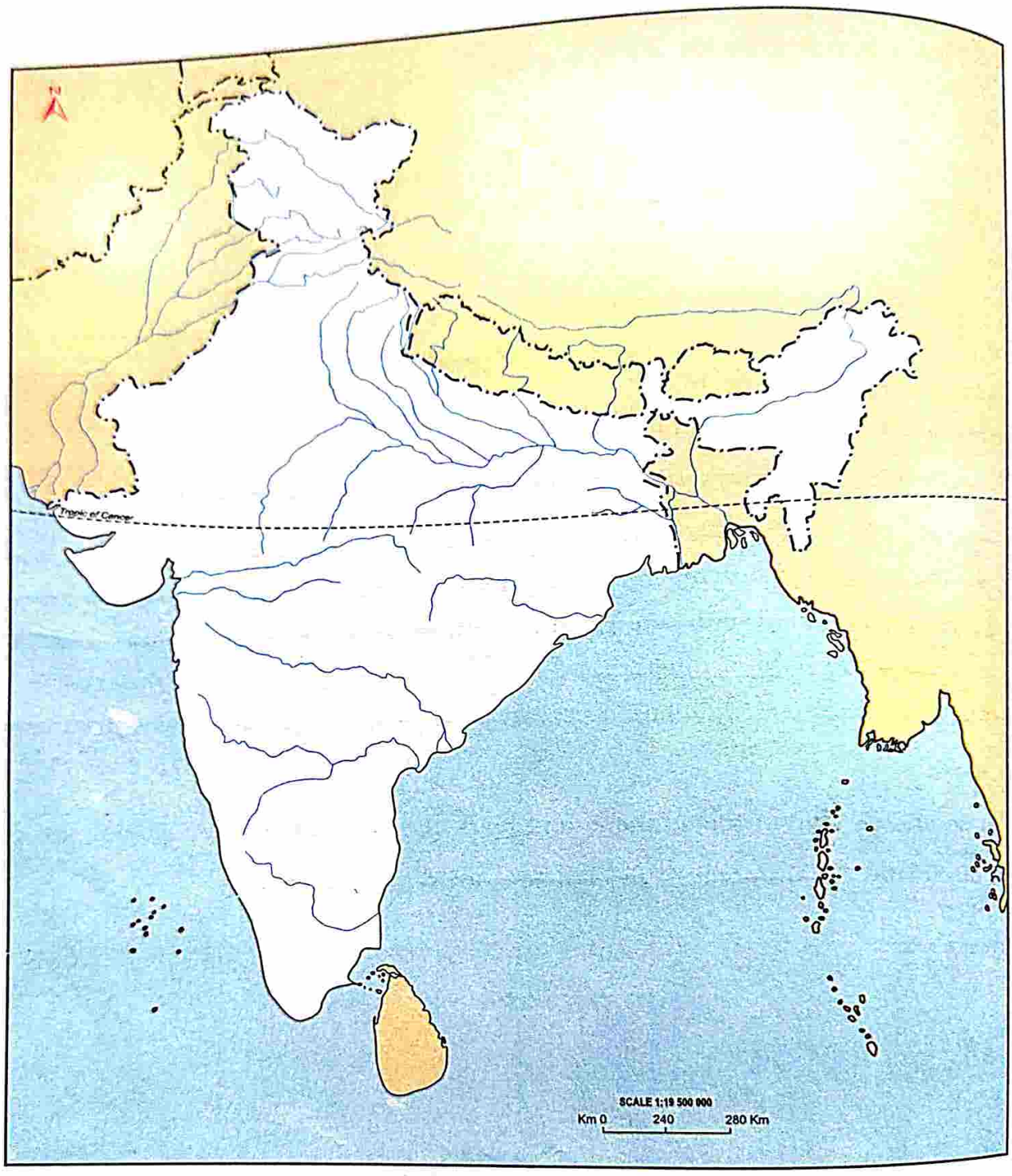
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Chapter 18 Agriculture — IV Cash Crops (2)

Syllabus

Agriculture

Climatic conditions, soil requirements, methods of cultivation, processing and distribution of cotton, jute, tea and coffee.

COTTON

Cotton is a cash crop that supplies raw material to the textile industry in India. India ranks second to the USA in cotton producing area and ranks fourth in the world production of cotton.

Climatic Conditions

Temperature: Cotton is a tropical crop and it is raised in India as a *kharif crop*. Cotton requires uniformly high temperature (during July to September) between 21°C and 30°C. During October, the day temperature should be above 26°C, which helps the opening and bursting of cotton balls under the sunny skies. The minimum temperature should not fall below 20°C as it retards plant growth.

A long growing-period of at least 200 frost-free days is also necessary for the plant to mature. The cotton plant is extremely sensitive to frost and late spring or early autumn frosts which can kill the plant and destroy the crop.

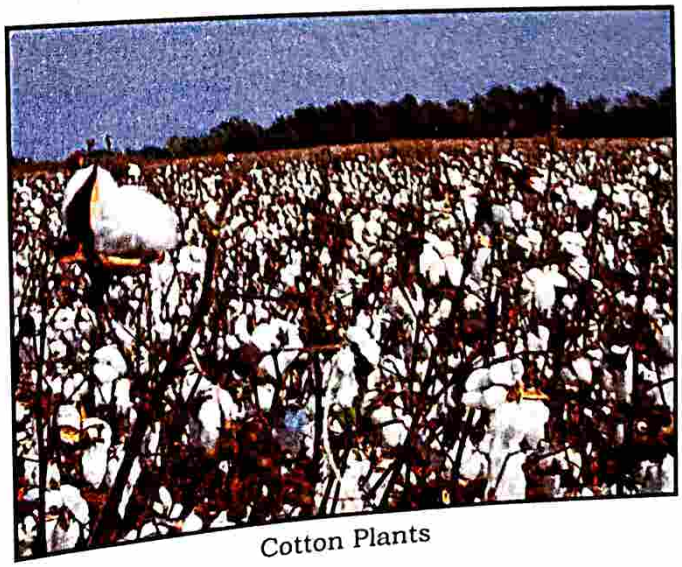
Rainfall: Rainfall should be moderate, ranging between 50 to 75 cm. Rainfall of more than 85 cm destroys the crop. Cotton plant needs sufficient rainfall in the early stages of growth, but a sunny and dry weather is required after flowering. Rainfall during the ball-opening and harvesting periods is harmful for the plants as it makes them vulnerable to pests and diseases.

Soil

Cotton grows well in the well-drained clayey soils containing lime and phosphates. Since cotton crops exhaust the fertility of soils rapidly, regular application of manures and fertilisers to the soils is necessary. The deep and medium black soils of the Deccan and the Malwa Plateaus and Gujarat are considered ideal for cotton cultivation. Besides these, the crop is also raised in fairly large measures on the alluvial soils of the Great Plains and the red and laterite soils of the Peninsular regions.

Methods of Cultivation

Sowing: Some tillage and manuring is necessary before the crop is sown. The seeds are sown by broadcast method or by drills. The duration of the crop season in India is 6 to 8 months. Sowing is done mostly, before the onset of rains in case of the *kharif* long staple varieties and later upto September for the short and medium staple varieties.



Cotton Plants

The seedlings must be thinned out where necessary, the ground must be regularly hoed and cleared of weeds and the plants must be kept free of pests. Where irrigation is used the fields are usually watered every ten to fourteen days.

Harvesting: The crop is harvested in October when the cotton balls ripen and burst into white, fluffy and shiny balls of fibre. The crop is harvested in three to four pickings as the balls mature; yields decrease with successive pickings.

Processing: After harvesting, the cotton crop passes through the following process:

(i) After the cotton has been picked, either by machine or by hand, it is *ginned*. Ginning is the process used to separate the fibres or lint from the seeds and the short fibres or linters which adhere to them.

(ii) The cotton first goes through dryers to reduce moisture content and then through cleaning equipment to remove foreign matter.

(iii) The cotton is then air conveyed to gin stands where its circular saws pull the lint through closely spaced ribs that prevent the seed from passing through. The lint is removed from the saw teeth by rotating brushes and then compressed into bales.

(iv) The lint (fibres) are washed and then *combed* to form a rope-like mass of fibres known as *sliver*.

(v) The sliver is fed to the spindles and *spun* to make cotton yarn.

(vi) The seeds are crushed to yield oil, the residue being used for cattle fodder.

Varieties of Cotton

In India, on the basis of length, strength and structure of fibre, five main varieties of cotton are grown:

(i) **Superior long staple:** Its staple is longer than 27 mm. 33% of the total production in India comes from this variety.

(ii) **Long staple:** The length of staple is between 24.5 and 26 mm. It is long, fine and shiny. It is used for making fine and superior quality cloth. It is largely grown in Punjab, Haryana, Maharashtra, Gujarat, Tamil Nadu, Madhya Pradesh and Andhra Pradesh.

(iii) **Superior medium staple:** The cotton staple in this variety is between 20 and 24 mm. It contributes 37% of India's output. Rajasthan, Punjab, Tamil Nadu, Madhya Pradesh, Uttar Pradesh, Karnataka and Maharashtra are its main producers.

(iv) **Medium staple:** Its staple is 20 to 21.5 mm long. About 9 per cent of the total production comes from this group.

(v) **Short staple:** Its staple is smaller than 19 mm. Uttar Pradesh, Andhra Pradesh, Rajasthan, Haryana and Punjab are its main producers.

Distribution

Cotton occupies about 5 per cent of the total cropped area in India. The chief cotton-growing areas in India are (a) in the north-western Deccan on the fertile black Cotton Soils; (b) the central and southern Deccan of Karnataka and Tamil Nadu; and (c) in the Upper Ganges valley, where much of the cotton is grown with irrigation.

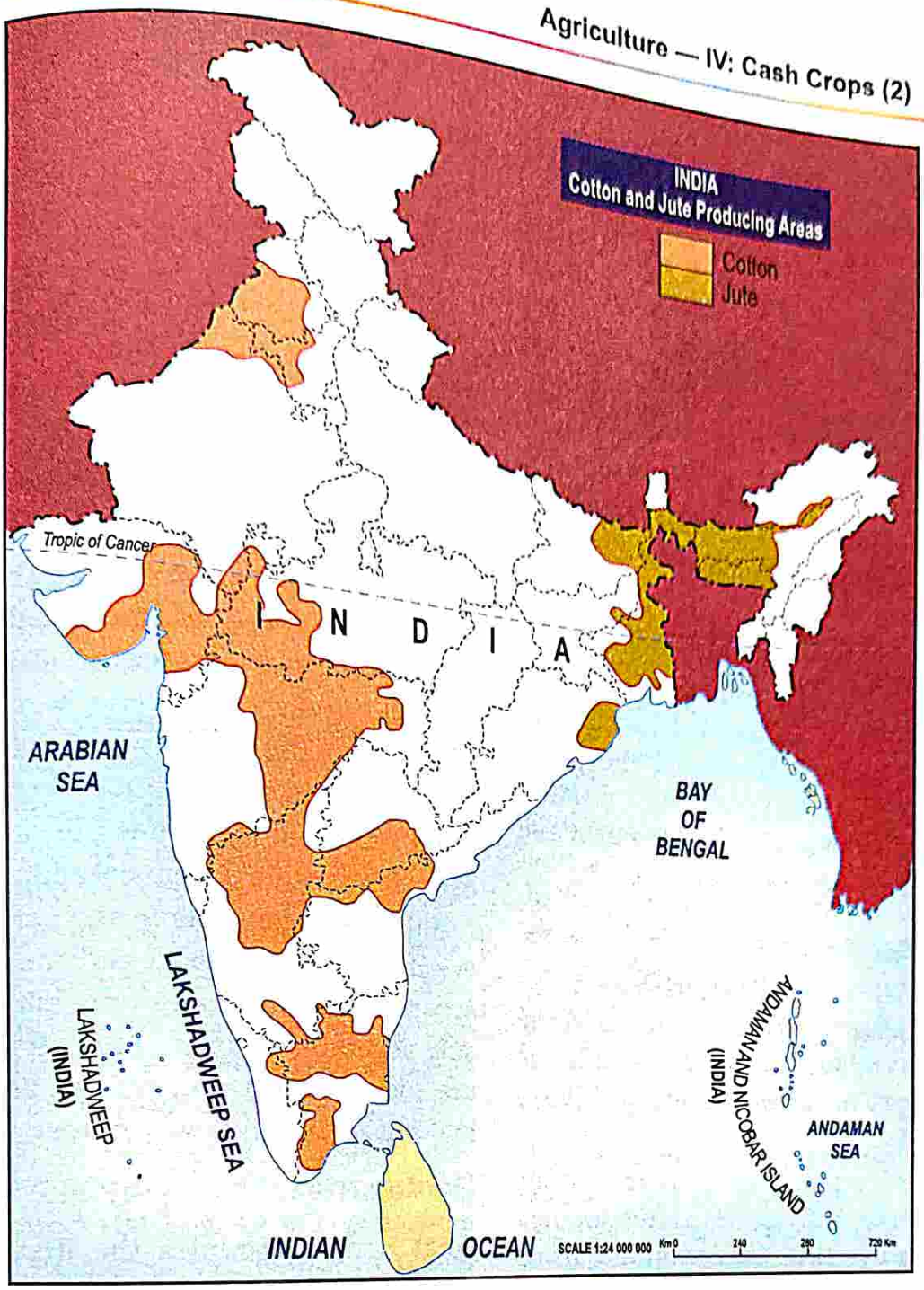
About 72 per cent of the total area and 60 per cent of the total production of the cotton in the country are contributed by four states—Gujarat, Maharashtra, Telangana, Andhra Pradesh and Karnataka.

Madhya Pradesh, Rajasthan, Punjab, Haryana, Karnataka and Tamil Nadu supply rest of the output of the crop.

JUTE

Jute is the most important fibre in India, obtained from the inner bark of two important species, *Corchorus Capsularis* (white jute) and *Corchorus Olitorius* (tossa jute). The white jute accounts

Sheaf of Jute



Cotton and Jute Producing Areas

for 75 per cent of the total area under jute in India. It is hardy, highly adaptable and grows well on both lowlands and uplands. The tossa jute is grown only on uplands as it is averse to flooding and occupies about 25 per cent of the total jute area in the country.

It is used for manufacturing rough quality cloth, sacks and other packing material. It is now used in the making of many utility products like carpets, rugs, twine, upholstery, tarpaulins, *etc.* Jute is also referred to as 'golden fibre' as it provides huge revenue to the government.

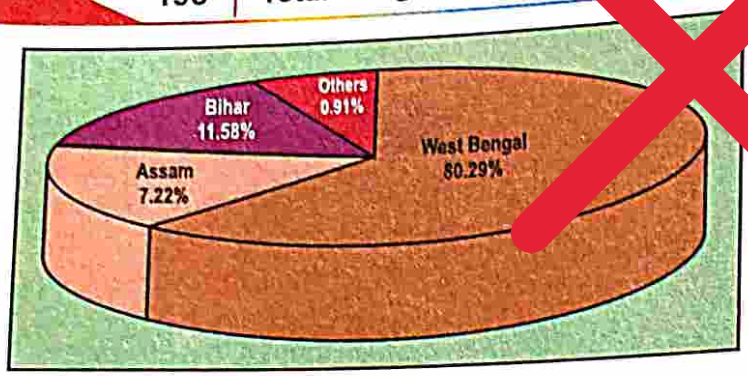
The jute plant grows to a height of 2 to 4 metres. Its fibre in the inner bark is soft and strong and can be drawn out into yarn of good lengths.

Mesta is inferior substitute for jute. It can withstand drought conditions. Therefore, it is grown where jute cannot be grown. Bags for rough use are made from mesta. Mesta cultivation is undertaken in some parts of Assam, Bihar, Orissa and Kerala.

Climatic Conditions

Temperature: Jute requires a hot and humid climate with temperatures between 24°C and 35°C and relative humidity of 90 per cent.

Rainfall: The annual rainfall should be more than 150 cm. About 2.5 cm to 7.5 cm of rain distributed in a month during sowing period is sufficient. Occasional showers (varying from 2 cm to 3cm) at intervals of about a week, are most beneficial



Jute Production in India

Jute Products

for it. However, incessant and untimely rains and prolonged droughts are harmful.

Soil

Jute gr best on th soil enriched by new alluvium ght b ver inundation. Loamy soils are mos le for jute production the clay particles am help to hold the plant nutrients pre th them from getting washed away by wa . The c y soil gives the heaviest yield. Sa y soils prod coarse fibre.

Methods of Cultivation

Sowing: The fields for growing jute have to be thoroughly prepared before the crop is sown in February on lowlands and March–June on uplands. Sowing of the seeds is done by drilling or broadcasting.

Harvesting: The crop is harvested from July to September about 8-10 months after sowing. Relatively higher yields are obtained from the crop sown during the winter season. A delay in harvest also adds to yields but usually produces coarse fibre.

When plants attain the height of 2-4 m and are mature these are cut, bundled and put in ponds for *retting*. After 20 to 25 days the bark is peeled from the plant by hand and fibre is then removed from the pith. It is then rinse washed, dried and pressed into bales.

Processing: Jute is harvested by hand, by pulli up the stem. It is dried and stripped of unwant leaves and is put in water and allowed to rot. Th process, known as *retting*, was once done submerging the jute into ponds and streams b is now done in special tanks. Retting softens t outer bark and facilitates the early removabil of the f e within. Chemic additives help in t retting o ation. The f hy part of the stem eventually c ompo and the fibres are th scraped to re hy remaining pieces of t soft vegetable er. After drying, the fibr are loosely s n a woven, and are used making s s and ba carpet, upholstery, e

Distr tion

West Bengal occupies the first place both respect of the area (74.2%) and productio (80.29%) of jute in India. Assam, Bihar, Odish Uttar Pradesh and Tripura account for most the remaining jute produced in India.

West Bengal: In West Bengal, the jute crop grown in Murshidabad, Dinajpur, Hooghly, 2 Parganas, Nadia, Jalpaiguri, Malda an

Crop	Tempe ture	Rai ll	Soil	Leading States
Cotton	21°C–30°C b not below 21°C 200 frost free day	50-75 c or irriga facility.	Deep black soil (regur), alluvial soils and laterite soil.	Gujarat, Andhra Pradesh, Maharashtra and Punjab.
Jute	24°C–35°C	Hea infall of 150 cm with per cent of relative h idity.	Light sandy or clayey alluvial loam.	West Bengal (80.29 per cent of the production, over 74.2 per cent of the area), Bihar, Assam, Odisha.

Burdwan. It is grown on both the old and new alluvial soils, which have been deposited by Ganga and Brahmaputra during floods in the delta. The hot damp climate and alluvial, loamy soils provide excellent conditions for the growth of jute in the Ganga-Brahmaputra delta.

Assam: Cultivation of jute in Assam is concentrated along Brahmaputra and Surma river valleys in the districts of Goalpara, Tezpur, Kamrup, Darrang, Nowgong and Sibsagar.

Bihar: Major production comes from Purnea, Saharsa and Darbhanga districts.

Odisha: Jute is raised in Cuttack, Puri and Bolangir districts.

Uttar Pradesh: Kheri, Sitapur and Bahraich are the important producers.

TEA

Tea is an important beverage liked by both the aristocrats and the common man. This is because of its unique taste and certain inherent qualities as a tranquilliser and mild stimulant.

A Japanese folklore states that tea was discovered by an Indian Buddhist Monk, who visited China in about AD 500. However, it was Major Robert Bruce who discovered in 1823 that indigenous tea bushes grew wild on the hillsides of Upper Assam. Commercial planting of tea began around 1840, when tea seeds were imported from China and planted on the plains of North-East India (in Assam and Darjeeling). Gradually, tea plantation, which was largely confined to Upper Assam, began to spread to other parts of India and new areas were opened up to tea. Prominent among these are the Duars and Terai in North Bengal and the foothills of Uttarakhand, the Himalayas, around Garhwal and Kumaon. Europeans established tea gardens in the Nilgiris in South India.

Tea Plantation

Climatic Conditions

Temperature: Tea is a shade loving plant and develops more vigorously under light shade. The ideal maximum monthly temperature is 24°C to 30°C. When the maximum temperature in shade falls below 24°C or the minimum temperature below 18°C, the growth is retarded. However, high humidity, heavy dew and morning fog are good for the rapid development of young leaves.

Rainfall: The tea plants grow well in a humid climate, and cannot stand long spells of dry weather at any time of the year. It must have abundant rainfall—at least 150 cm, well distributed throughout the year. In Assam tea areas, the annual rainfall averages between 125 cm and 375 cm, while in Duars and Darjeeling districts it ranges from 250 cm to 500 cm. The tea areas in south receive still heavy rainfall.

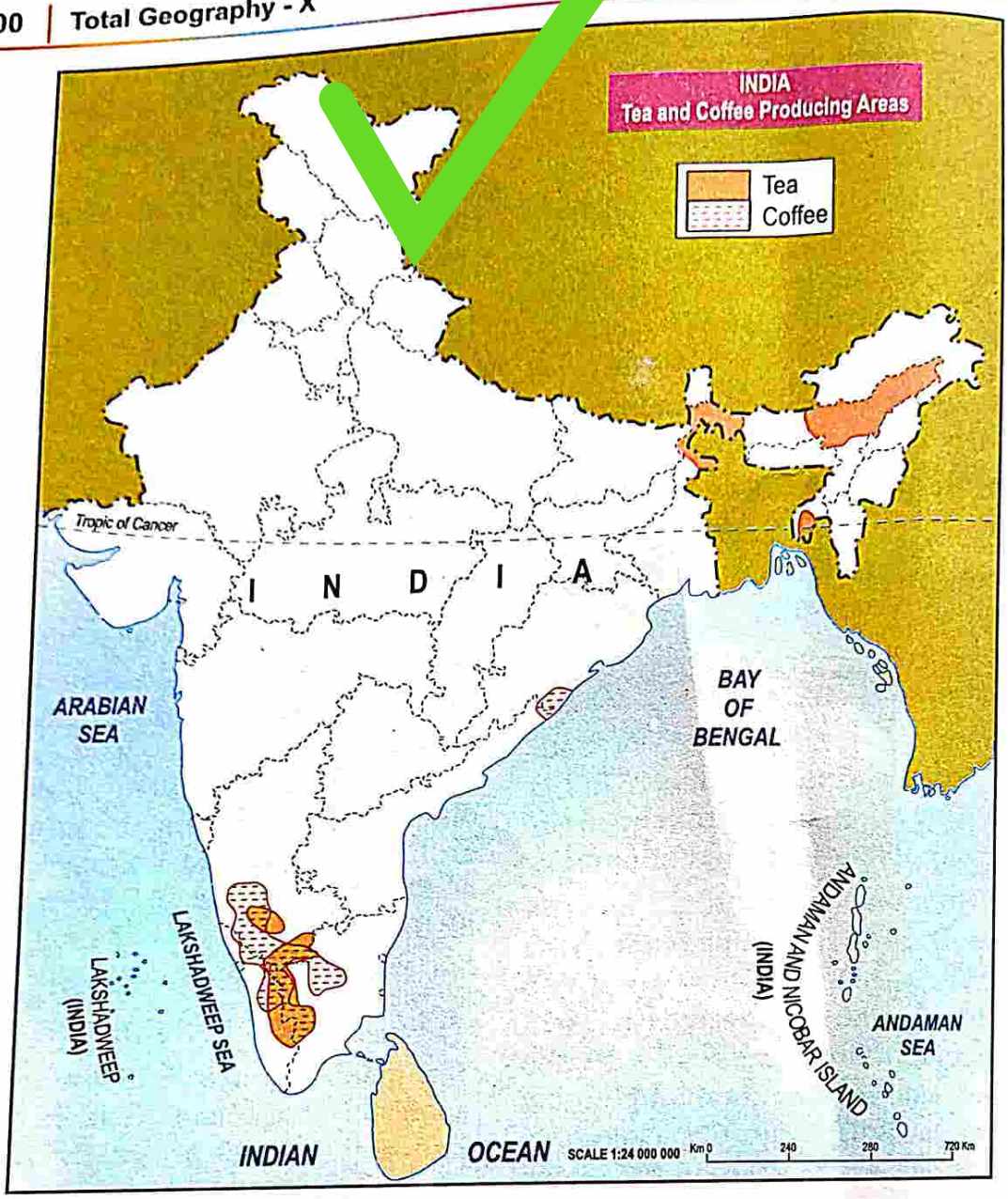
Soil

Tea plant requires well drained, deep friable loams or forest land rich in organic matter. The soil should be gently rolled so as to prevent waterlogging. Therefore, to avoid water logging which is harmful for the growth of tea bushes, tea is grown on hill slopes. Some of the finest plantations in Assam are found on level ground, 17 to 75 metres above sea level. The soil must be deep and have a moderately open texture. Virgin forest soils containing a good amount of iron and humus, are the best ones. Nitrogenous fertilisers like ammonium sulphate increase the yield.

Methods of Cultivation

Tea gardens are laid out on cleared hill slopes under the shade of trees raised in advance. Belts of trees like silver oak to serve as wind barriers are also raised on the borders. Tea is cultivated in two ways:

(i) From seeds: Tea plants can be raised



Tea and Coffee Producing Areas

from tea seeds. High quality seeds are sown in well prepared nurseries. The saplings are transplanted within a year in the proposed tea gardens at the distance of one metre on all four sides.

(ii) From cuttings: Tea shrubs can also be grown in nurseries from cuttings of high yielding varieties. This is known as the *clonal planting* method of propagation of tea. When the saplings are 20 cm high, they are transplanted in the tea garden.

Tea gardens are set up on hill slopes because the high attitude provides the required climatic conditions and the slopes protect the crop from annual inundations and stagnant water during the rains.

Harvesting

Plucking of Leaves: The pruning of the bush starts after two years in order to maintain the height and diameter of the plant limited to one metre. In India, picking is much more frequent.

At lower elevations, tea is picked every ten days during the growing season and at higher altitudes, every fifteen days. Picking goes on all the time during the south-west monsoon season from early April to mid-November. On an average there are between sixteen and twenty

Important Cash Crops of India

Crops	Temperature	Rainfall	Soil	Distribution
Tea	24°C-30°C	at least 150cm	forest s… rich in humus and iron.	1. Assam: the Brahmaputra valley, Surma valley 2. West Bengal: the Duars, Darjeeling 3. Tamil Nadu: highest yield per hectare 4. Kerala
Coffee	15°C-28°C but does not tolerate frost or heat	150-200 cm	well drained, friable loamy soil, rich in vegetable mould.	1. Karnataka 70.4 % of total production; 2. Kerala 21.7 % of total production; and 3. Tamil Nadu 5.8 % of total production.

pickings a year. Frequent pruning encourages the rapid production of fresh leaves and shoots.

The tea shrub continues to be productive for about 50 years, after which restocking is necessary.

Tea-picking is a skilful job, requiring patience and judgement. It is usually done by women who are better pickers and can be employed at relatively cheaper rates. Two tender leaves and a bud or shoot (*known as fine plucking*) are usually plucked from each stem.

Processing: There are four types of tea. Each one is processed differently. These types are:

(A) Black Tea

It is processed by drying the leaves, crushing them in a machine and fermenting them. This tea is taken with milk and sugar in India.

In processing Black Tea the following steps are taken:

1. Withering: The gathered leaves are first withered or dried in the sun for a day or two to extract moisture.

2. Rolling: They are then rolled mechanically between steel rollers to break up the fibres. The leaves are dried again or baked lightly over charcoal fires, until they become reddish brown in colour.

3. Fermentation: The leaves are allowed to ferment and this reduces the amount of tannic acid in the tea by half, but does not impair its flavour.

4. Drying: Further fermentation is checked by roasting and drying the leaves over a fire or in an oven until they are black in colour.

5. Blending: Expert blenders and tea-tasters further *blend* the various grades of tea to give it special aroma and make many proprietary brands.

(B) Green Tea

Green tea is not dried in the sun but in ovens after the leaves are steamed in large vats and crushed in machines. It is not fermented. This variety of tea is consumed in China and the Far East.

In the preparation of Green Tea the picked leaves are heated immediately by roasting them over hot iron pans and are later rolled. There is no fermentation process and the leaves remain green even when they are dried, graded and packed. Green teas are highly flavoured and are stronger stimulants because of their higher tannin or tannic acid content. They are usually taken without milk or sugar after brewing with boiling water.

(C) Oolong Tea

This variety of tea is greenish-brown and is prepared by partially drying and fermenting the leaves. From the tea gardens, a high grade semi-fermented Oolong Tea is produced. Much of it is shipped to the United States.

(D) Brick Tea

In this variety the inferior and coarser leaves, stems and tea-dust are compressed into rectangular blocks of brick tea. Such tea is normally consumed in Russia and Tibet.

Distribution

India has the world's largest area under tea and

However, if the rainfall is well distributed can even be grown in areas having 325 cm of rainfall. A prolonged drought either causes serious damage or reduces the yield heavily.

Soil

Coffee cultivation requires rich, well drain friable loamy soil, containing a good d of vegetable mould. Usually cattle manure, oilcakes, bonemeal and fertilisers are used as manures.

Methods of Cultivation

Sowing: Coffee is propagated from seeds or cuttings in a nursery and after a few months, the saplings are transplanted to the field. Plants are positioned 3 m apart. They are pruned annually to ease picking and to ensure heavy bearing of coffee berries. The tree is kept to a height of 1.5 to 2.5 m. Coffee plants are grown on slopes so that water does not stagnate.

Covercrops: Since coffee plant is susceptible to direct sunrays it is planted under the shade of trees such as silver oak and jackfruit which are planted before the coffee plantation. Other trees like orange, cardamom and p er vines are also interplanted to generate extra ome.

Harvesting: Harvesting of coffee may b n in the third year after planting but is usua done in the fourth or fifth year. Coffee pic is done by hand by removing the ripe ries from the stalk. Indiscriminate picki of both ripe and unripe berries results in coffee beans of inferior quality which fetch low prices.

Processing

There are two methods of processing coffee, namely, the *Wet Parchment method* and the *Dry Parchment method*. In the Wet parchment method, the fruit covering of the beans is removed before they are dried and n pulping, fermenting, washing and drying ta place. After this the coffee beans are ready t se.

In the *Dry parchment method* the follo process is followed:

(i) The harvested cherries are sor and cleaned, to separate the unri overripe and d aged cherries and to remove dirt, so wigs and leaves.

(ii) e coffee cherries are then spread out the sun to dry.

(iii) Th cans are then *fermented* by drying in th n for a week.

(iv) After dry g, machines peel off the two layers of inner husks.

(v) They are sorted according to size and quality and then packed in sacks for use.

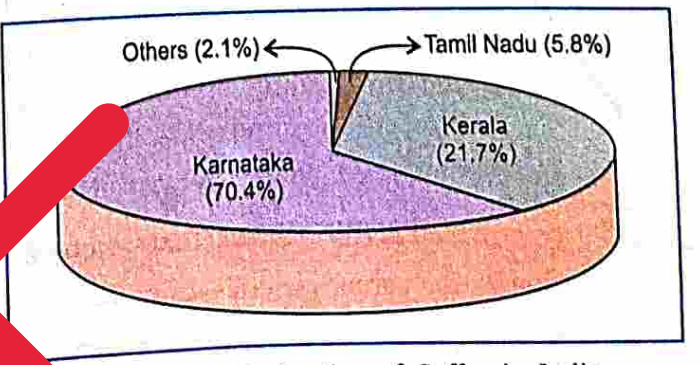
(vi) The beans are *roasted* at temperatures of about 99°C and then ground into coffee powder which is used to make the beverage. Roasting gives it brown colour and characteristic aroma and taste.

Distribution

Almost the entire area and production of coffee in India is shared among only three states namely, Karnataka, Kerala and Tamil Nadu. These are referred to as *Traditional coffee producing Areas*. According to the Coffee Board of India, coffee is also grown in non-traditional areas compris Andhra Pradesh and Odisha in the East Ghats. Besides the traditional and non tr ional areas coffee is also cultivated in the rth Eastern Region comprising the seven sister states of Assam, Manipur, Nagaland, Mizoram, eghalaya, Tripura and Arunachal Pradesh.

T itional Coffee Producing Areas

(a) *arnataka*—Karnataka alone accounts for about half of the area and over three-fourths of the production. Coorg (Kodagu) and Chikmagalur account for over 86 per cent of the total output in Karnataka. Other producers are Hassan, Mysore and Shimoga.



Percentage Production of Coffee in India

(b) *Kerala*—It is the second largest producer of coffee. Most of the production comes from Kozhikode, Palakkad, Wayanad, Idukki, etc. Picking of berries takes place just after the monsoon is over. Sunny weather helps in drying the berries.

(c) *Tamil Nadu*—Tamil Nadu provides 5.8 per cent of the total production of coffee in the country. Nilgiris district alone accounts for half of the production of the state. Other producers include Madurai, Coimbatore, Tirunelveli and Salem districts.

EXERCISES

I. Answer the following questions:

Q.1 (a) What are fibre crops? Give two examples of plant fibre crops.
(b) What conditions of soil favour the growth of cotton? Why?
(c) (i) Name the two chief cotton-growing areas in India.
(ii) Which climatic conditions favour the cultivation of cotton?
(d) (i) How is frost harmful for the growth of cotton plant?
(ii) Why is dry weather necessary at the time of harvesting cotton?

Q.2 (a) What advantages does Long Staple Cotton have?
(b) Why Gujarat and Maharashtra are the leading producers of Cotton?
(c) Describe the process or stages in Ginning of Cotton.
(d) What are the problems associated with the growing of cotton?

Q.3 (a) State the soil conditions that favour the growth of jute.
(b) In what way is Ganga-Brahmaputra Delta suitable for jute cultivation?
(c) (i) Why is jute retted?
(ii) How is this done?
(d) Describe briefly the processing of jute.

Q.4 (a) Why is mesta an inferior substitute for jute? Where is it grown?
(b) By what other name is jute referred to? Why?
(c) (i) Why are floods beneficial for the growth of jute?
(ii) Mention one advantage and one disadvantage of delay in jute harvest.
(d) State any three uses of jute.

Q.5 (a) State any two conditions that favour the growth of tea in the Nilgiris.
(b) State the advantages of growing tea plants on hill slopes.
(c) (i) Name the different varieties of tea grown in India.
(ii) Why is blending necessary for tea?
(d) (i) Name the leading producer of tea in India. State two factors that have helped become the leading state in tea production.
(ii) Define the following terms: (i) Clonal Planting; (ii) Pruning.

Q.6 (a) Give two climatic factors that favour the cultivation of coffee.
(b) Name the three varieties of coffee plants grown on commercial scale in India. Name the state where coffee is grown extensively.
(c) Describe briefly the Dry Parchment method of processing of coffee.

(d) Give a geographical reason for each of the following:

(i) Coffee is grown on the slopes of the hills in Peninsular India.

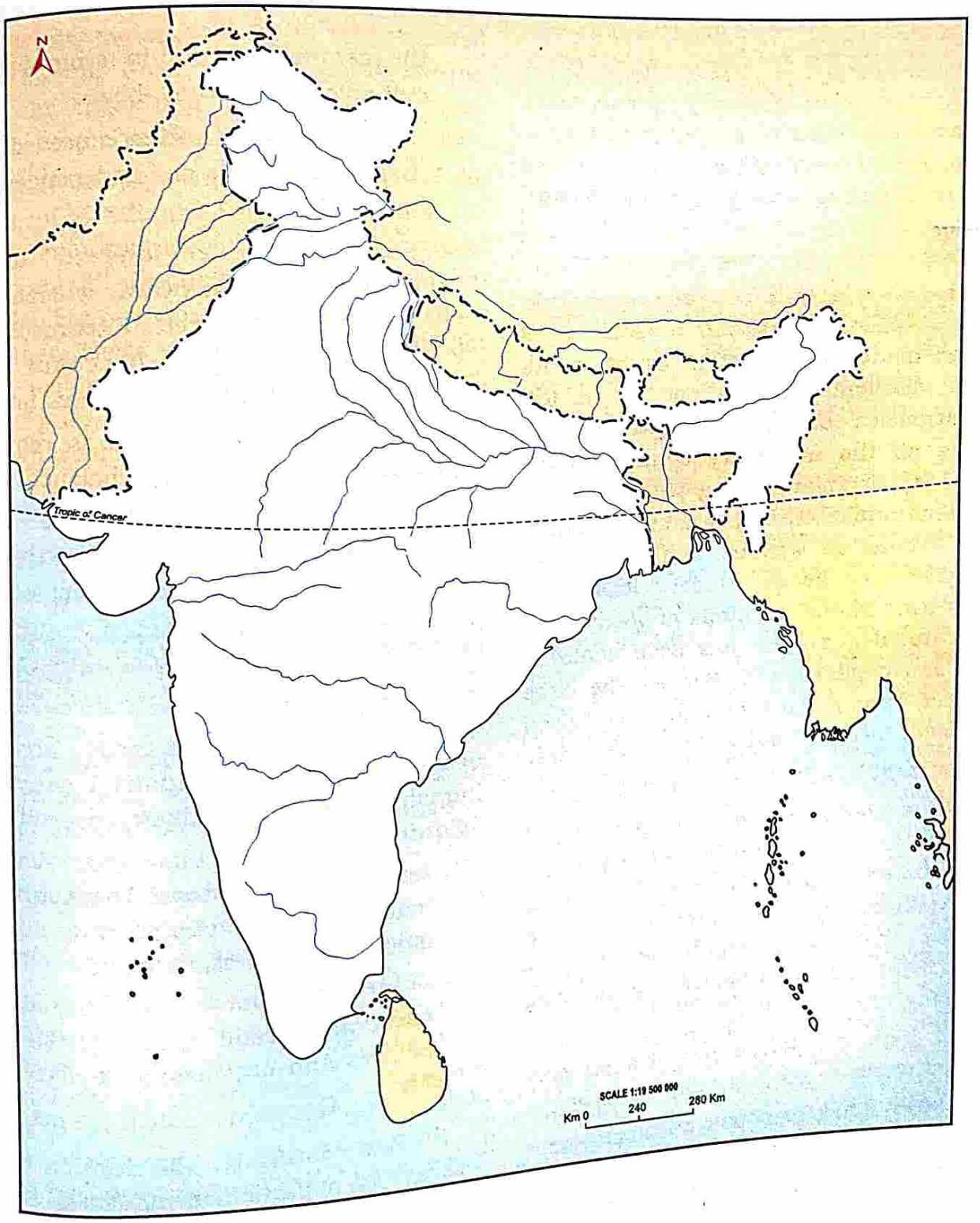
(ii) Coffee estates have coffee inter-planted with orange trees, cardamom and pepper vines.

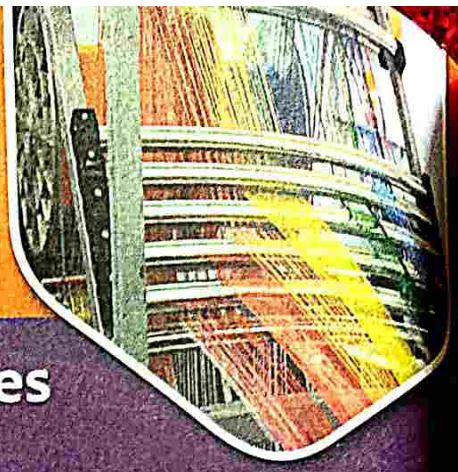
(iii) Tea bushes are pruned at regular intervals.

II. Map Work

On the outline map of India shade and mark the states that are leading producers of:

(i) Cotton (ii) Jute (iii) Tea (iv) Coffee





Chapter 19 Manufacturing Industries (Agro-Based)

Syllabus

Manufacturing Industries

Importance and Classification.

Agro-based Industry — Sugar, Textile (Cotton and Silk).

INDUSTRIALISATION IN INDIA

India has made significant progress in its industrial development. It is one of the top ten industrialised countries in the world. India possesses all the necessary conditions for industrial development. Along with vast and diversified natural resources, its large population provides labour as well as a huge market for manufactured goods. Modern industries manufacturing almost all kinds of goods have been set up. Self-reliance has been achieved in basic and capital goods. Besides the large scale sector, encouragement has also been given to the small, medium and cottage industries.

Need for Rapid Industrialisation in India

(i) India is predominantly an agricultural country and more than 50 per cent of its population is dependent on agriculture for its livelihood. However, agriculture cannot support the growing population and only rapid industrialisation can solve the problem of rising unemployment.

(ii) Rapid industrialisation provides support and strength to our agricultural base.

(iii) Industries produce goods and equipment required for the defence of the country.

(iv) Industries are required to keep pace with the fast moving world in terms of advanced technology and know-how.

(v) Rapid Industrialisation is needed to make India self-reliant and independent for all its needs.

(vi) Some of the regions in India are economically backward, whereas others are quite advanced. Expansion of the industries in these backward areas is needed to counter the regional imbalance.

(vii) Rapid industrialisation is required to maintain a favourable balance of trade, *i.e.*, more exports than imports.

All the above points emphasise the need to promote rapid industrialisation in India.

FACTORS AFFECTING THE LOCATION OF INDUSTRIES

Industries concentrate in certain areas which become centres of industrial activity. The infrastructure of an industry depends on the following:

1. **Geographical factors:** These include raw materials, power supply, water, transport, labour, market and climate.
2. **Commercial factors:** These include capital, bank and credit facilities, Government policies and organisational efficiency.

I. Geographical Factors

1. Raw Materials: The decision regarding location of a particular industrial activity is guided by the availability of raw materials in a particular area. The earliest industries in India

developed near the sources of raw material. For example, the textile mills of Mumbai received the supply of cotton from Gujarat and the jute mills of Hooghly region got the raw material from the delta region of the Ganga. Similarly, the iron and steel industry is located in the region where iron ore, limestone, manganese and coal are available. Availability of raw material nearby reduces cost of transportation.

The nature of raw material also decides the location of industries. For example, the perishable raw materials have to be processed without loss of time before manufacturing. That is why sugar mills are located in areas of sugarcane production.

2. Water Supply: Water is required for the development of industries as it is needed in the process of manufacturing, for cleaning, cooling, washing, *etc.* All industries depend heavily on the availability of fresh water for one purpose or the other. These include iron and steel (for cooling), textile (for bleaching and washing), paper and pulp, chemical, food processing, jute, leather, nuclear power, *etc.* Therefore, these industrial units are located at places where water is easily available.

3. Energy: Uninterrupted energy is required to process raw materials into manufactured goods. That is why iron and steel industry is usually located near the coal resources, as it uses coal for smelting iron ore. Similarly, the electro-metallurgical and electro-chemical industries which require power are located where electricity is easily available. In the coal deficient peninsular region, industries could develop by using hydel power instead of thermal power. Thus, the availability of energy in one form or the other is an important factor in deciding the location of a particular industry.

4. Transport: Transport is an essential prerequisite for industrial development as transport facilities are required to carry raw materials to manufacturing units and finished products to the market. The availability of transport facilities has led to the development of the industries near the port towns that are linked with rail and road to the hinterland.

5. Labour: The availability of both skilled and unskilled manpower is an important factor in the location of industries. The mobility of labour is also a significant factor. It is because of the mobility of cheap labour from the surrounding areas to Delhi and Mumbai, that a large number of industries are located in these metropolitan cities. Some of the small scale industries, traditionally associated with labour are glasswork (Ferozabad), brasswork (Moradabad), utensils (Yamunanagar), silk sarees (Varanasi), carpets (Mirzapur), *etc.*

6. Market: The existence of market is the ultimate requirement of every industry because whatever is produced needs to be sold. High demand and a satisfactory purchasing power provide impetus to industrial development. For example, heavy chemical industries or machine industries are located in industrial areas because their products are required by other industries of the region. Similarly, petroleum refineries are established near the markets as the transport of crude oil is easier. However, refineries using imported crude oil are located near the ports.

7. Climate: It plays a significant factor in the location of industries especially agro-based industries. For instance, cotton textile industry is located in Maharashtra because the moist climate and black soil are favourable for the growth of cotton. Extreme type of climate, *i.e.*, either too hot or too cold climate is also not favourable for the location of industries as it not only affects the availability of raw materials but also the efficiency of the workers.

II. Commercial Factors

1. The role of the Government: The government has a very significant role in the industrialisation process, especially in the developing and under-developed countries. The big industries which require large infrastructure and capital are set up by the government. The government makes rules and regulations for running the industries and also provides the basic facilities like land, water and electricity. Further, it is the government which makes policies and takes decisions to protect and encourage indigenous industries.

2. Capital: Capital is required every stage of setting up and running an industrial concern. Mostly financers and capitalists are available in major cities. That is why most of the major cities are industrial centres. These cities have good *banking and credit facilities* which are necessary for setting up large-scale industries.

CLASSIFICATION OF INDUSTRIES

Industries can be categorised into the following groups on the basis of raw materials used, size, location, nature of the finished product, *etc.*

1. On the Basis of Raw Material

Industries, on the basis of raw material utilised, can be divided into:

(a) Agro-Based Industries: This group of industries depends on the raw material produced by the agricultural sector. The products comprise mostly consumer goods. The major agro-based industries are cotton, jute and textile industries, sugar industry, tea industry, coffee industry, *etc.*

(b) Mineral-Based Industries: These industries use minerals, both metallic and non-metallic, as raw materials and are based on ferrous and non-ferrous metallurgical processes. The major mineral based industries include iron and steel, heavy engineering and machine tool, cement, basic and light chemicals, fertilisers, *etc.*

(c) Forest-Based Industries: These industries utilise forest resources like wood, rubber, lac, resin, *etc.*

(d) Animal-Based Industries: These industries utilise the raw materials provided by animals like woollens, silk, dairy products, hides, skin and leather industry, poultry, *etc.*

2. On the Basis of Nature of Products

On the basis of nature of products, industries can be divided into:

(a) Heavy Industries: These industries produce capital goods and consumer durables which are quite bulky and are therefore, known as heavy industries. They require huge capital, large quantity of raw material, scientific knowledge, sophisticated machinery, *etc.*

(b) Light Industries: These industries produce goods which are light in weight like cycles, sewing machines, electronic goods, etc. They require less capital and less number of workers than in the heavy industries.

3. On the Basis of Size and Investment

(a) Large-Scale Industries: These industries require huge infrastructure and large number of workers. They produce machinery and goods on a large scale like the iron and steel industry, ship building industry, automobile industry, *etc.* These industries play a key role in industrialisation.

(b) Medium-Scale Industries: These industries are neither very big nor very small and as the name suggests require everything on a medium scale. They include paper mills, radio, cycle manufacturing industry, *etc.*

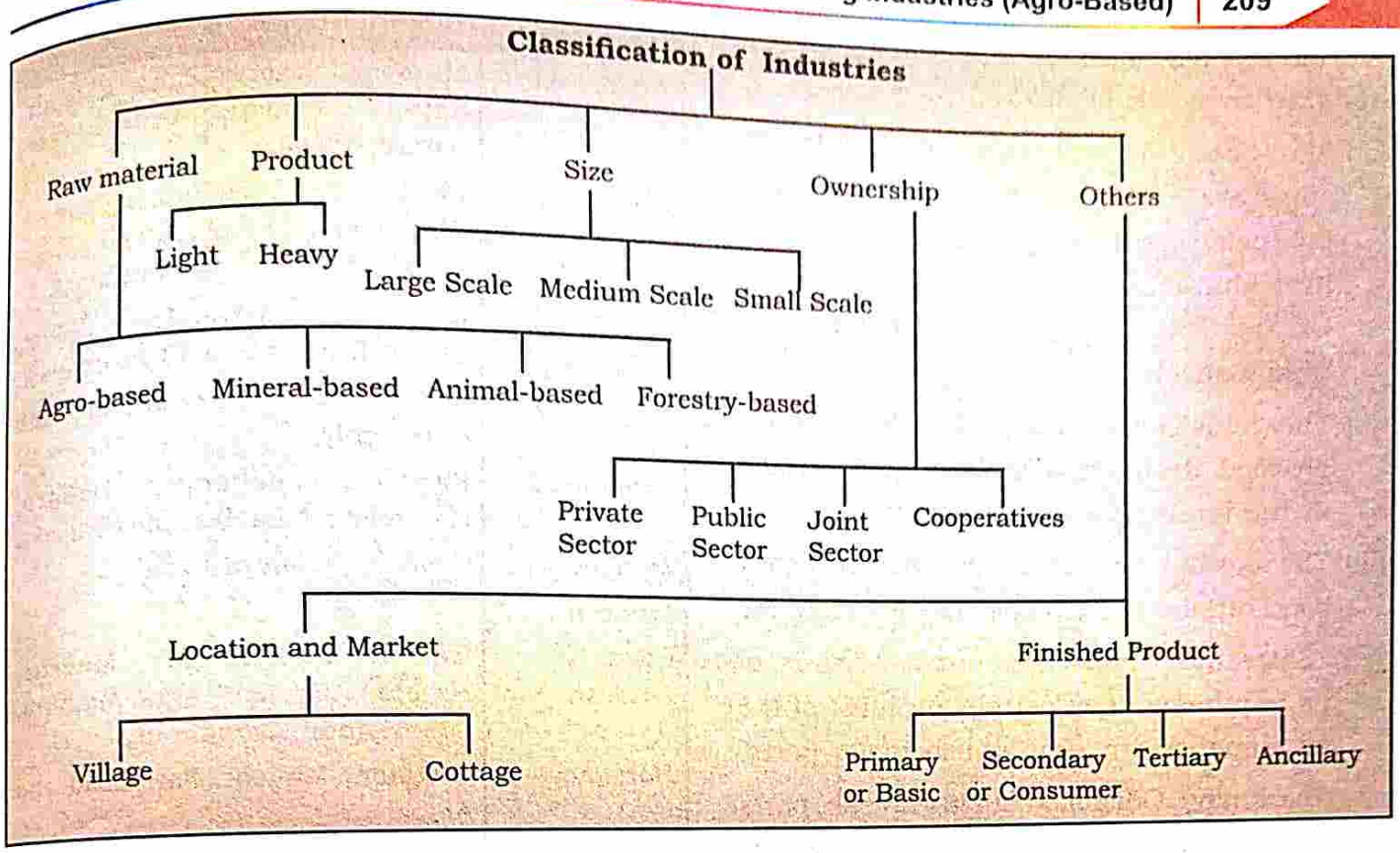
(c) Small-Scale Industries: These industries are small industries managed mostly by private individuals. They do not require huge capital investment and employ only a few workers. They include weaving industry, food processing industry, *etc.*

4. On the Basis of Ownership

(a) Public Sector Industries: These industries are owned and managed either by the Central Government or the State Government. They include public utility industries like railways, post and telegraph, oil refineries, heavy engineering industries, defence establishments, *etc.* The most significant of these are Bharat Heavy Electricals Limited (BHEL), Gas Authority of India Limited (GAIL), Indian Oil Corporation (IOC), Steel Authority of India Limited (SAIL), etc.

(b) Private Sector Industries: These industries are owned and managed by an individual or group of individuals. They include industries like Reliance India Limited (RIL), Infosys, Wipro, *etc.*

(c) Joint Sector Industries: These industries are owned, managed and controlled jointly by the private entrepreneur and the government. An enterprise is called a joint sector enterprise if the Government holds 26 per cent equity or



more, private promoter 25 per cent and the balance by the general public. For example, Automobile Corporation of Goa Ltd. and Ipitata Sponge Iron Ltd. have been established with TELCO and TISCO of the Tata House as private promoters respectively.

(d) Co-operative Sector Industries: Co-operatives are the means by which people with limited resources can pool their physical and material resources. For example, Anand Cooperative Society in Gujarat.

5. On the Basis of Location and Market

(a) Village Industries: These industries fulfill the basic needs of the local markets and all its requirements like raw materials, skills, labour, *etc.*, are met from within the village. They include handloom, pottery making, food processing, pickles, khadi, *etc.*

(b) Cottage Industries: These are also known as household industries and are organised by individuals with private resources and with the help of members of the households. They use locally available resources and skills. For example, carpet weaving, handloom and handicrafts industry, *etc.*

6. On the Basis of Finished Product or Function

(a) Basic Industries: These industries form the core industries on which other industries depend for their manufacturing. For example, iron and steel industry and petroleum industry.

(b) Secondary or Consumer Industries: These industries process the basic raw materials into primary goods for direct use by the consumers. They include textiles, sugar, paper making, *etc.*

(c) Tertiary Industries: These industries provide public utility based services like railways, transport, banking, post and telegraph, *etc.*

(d) Ancillary Industries: These industries provide spare parts or components required by big industries like heavy electrical industry, aircraft industry, locomotives, buses, *etc.*

MAJOR INDUSTRIAL REGIONS

In India, the distribution of industries is highly uneven. This is because of the uneven distribution of necessary raw materials and energy resources and also because of the concentration of enterprises, financial resources and other necessary conditions in large towns.

The uneven distribution of industries can be identified from the following:

(i) Agro-based industries like cotton, jute and sugar are concentrated in the raw material producing areas. For example, cotton textile in Maharashtra and Gujarat, sugar in UP and Maharashtra and jute textile in West Bengal.

(ii) The forest-based industries like paper, plywood, resins and lac are concentrated in the forest areas of various states.

(iii) The coastal belt of Kerala has a heavy concentration of coir, copra and fish canning.

(iv) Since India imports about two-thirds of its requirements of petroleum, most of the oil refineries are located near major ports.

(v) Jharkhand, Odisha, Madhya Pradesh, parts of Rajasthan, Tamil Nadu and Karnataka account for most of the reserves of metallic minerals. That is why these areas have a high concentration of heavy metallurgical industries.

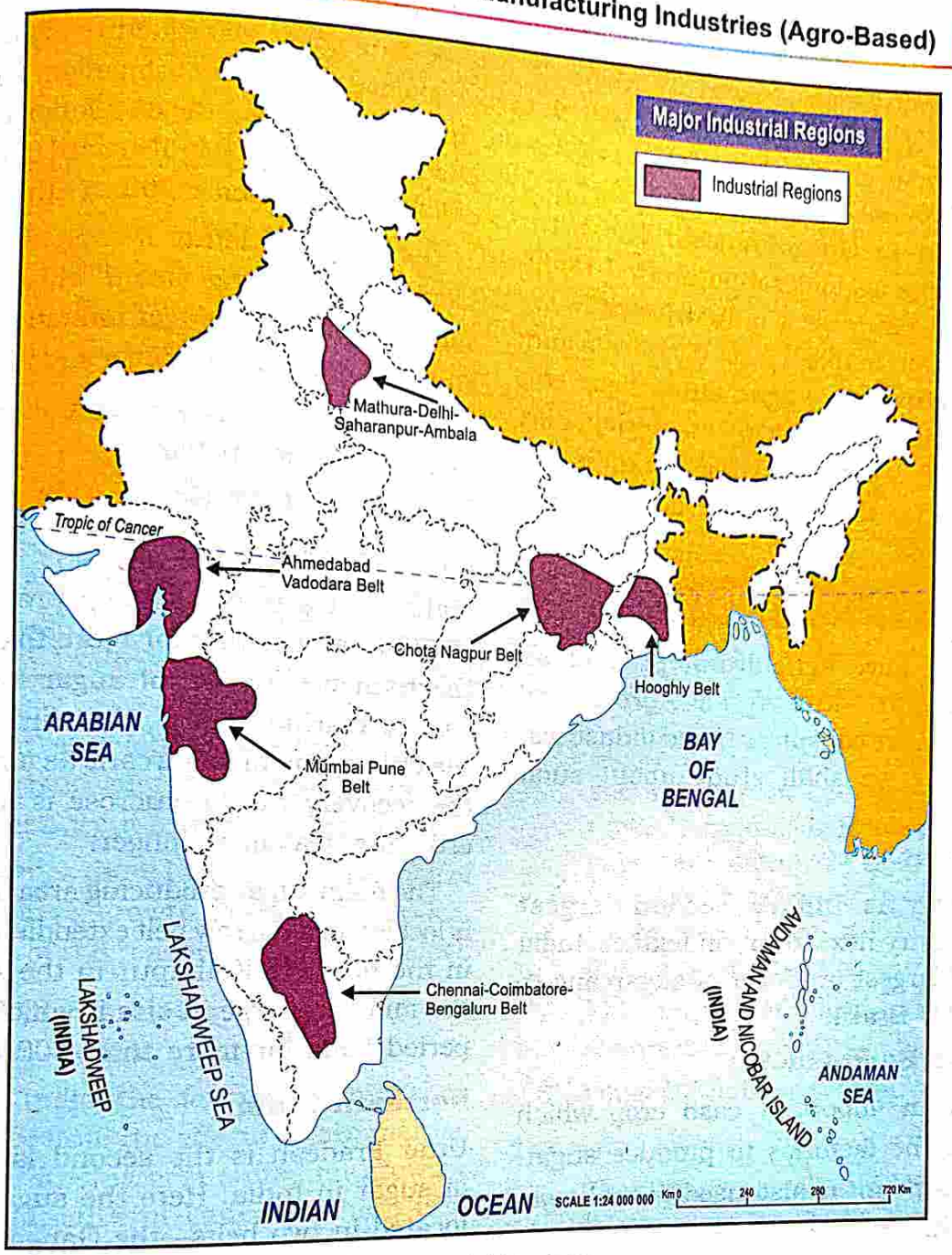
INDUSTRIAL CENTRES	
Maharashtra	Mumbai, Nagpur, Pune, Solapur, Akola, Amravati, Ahmednagar, Satara, Sangli.
Gujarat	Ahmedabad, Vadodara, Surat, Jamnagar, Bharuch, Anand, Khera, Rajkot, Valsad and Bhavnagar.
Tamil Nadu	Coimbatore, Tirunelveli, Salem, Chennai, Madurai and Tiruchirapalli.
West Bengal	Kolkata and centres on the bank of Hooghly.
Jharkhand	Ranchi, Jamshedpur, Bokaro, Hazaribagh, Dhanbad and Chaibasa.
Madhya Pradesh	Gwalior, Indore, Bhopal.
Uttar Pradesh	Kanpur, Modinagar, Meerut, Hathras, Varanasi, Agra, Mathura, Saharanpur, Gorakhpur.
Haryana	Gurgaon, Panipat, Faridabad and Ambala.
Karnataka	Bengaluru, Mysore.
Andhra Pradesh	Vijayawada, Vishakhapatnam, Vijaynagar, Guntur, Kurnool.
Kerala	Kochi, Kollam, Alwaye, Ernakulam, Allappuzha and Thiruvananthapuram.

On the basis of concentration of major industries India can be grouped into the following areas:

1. The Hooghly Belt: It constitutes one of the most important industrial regions of India. Jute textiles, engineering, cotton textiles, chemicals, leather footwear, paper and match works are the important industries in the area. Port facilities of Kolkata, proximity to coal, jute and leather producing areas, cheap transport, availability of large quantity of fresh water attracted the industries close to the Hooghly river.

2. The Mumbai-Pune Belt: This belt has a heavy concentration of cotton textile, engineering, oil refineries, fertilizer and chemical industries. Cotton textile industry, the nucleus of industrial growth in the area, began here during the 1950s. Development of hydro-electric power in the Sahyadris, availability of raw cotton in Maharashtra and Gujarat and cheap labour from Konkan have been responsible for the development of this area. Besides these, the most important factor which has been responsible for the industrial development of this region is the availability of port facilities of Mumbai.

3. The Ahmedabad-Vadodara Region: Ahmedabad, situated in a cotton-growing tract of Gujarat, has emerged as the second largest centre of cotton textiles after Mumbai. Surat, Navsari, Bharuch and Vadodara also attracted cotton textile industry along with many other industries. Today, this region produces cotton textiles, plastics, fertilizers, chemicals and engineering goods on a large scale. The completion of a number of projects including Dhuvaran Thermal Power Station, Uttaran Gas Power Station, Ukai Hydro-Electric Project and Tarapur Atomic Power Station, availability of cheap salt along the coast, raw cotton in south Gujarat and



Industrial Regions

Kathiawar and skilled labour from the Gujarat Plains are the chief advantages of this region.

4. The Chennai-Coimbatore-Bengaluru Region: Cheap cotton, a large market, and cheap and skilled labour were the chief factors which attracted a number of industries particularly cotton textile to this area. Mettur, Sivasamudram, Papanasam, Pykara and Sharavati projects supply cheap hydroelectric power. Chennai, Coimbatore and Madurai are the leading centres of cotton and silk textiles. A number of engineering and chemical industries also have come up at these and several other places particularly Salem and Tiruchirapalli.

5. The Chota Nagpur Plateau Region: This area covering parts of Jharkhand and West Bengal produces over 80 per cent of India's coal, substantial quantities of iron ore, manganese, bauxite, mica and limestone. It has, therefore, become a hub of heavy industries. Jamshedpur, Bokaro, Kulti, Burnpur and Durgapur are centres of steel production. Metallurgical and heavy industries have come up at Asansol, Dhanbad, Bokaro, Ranchi and Jamshedpur. Due to availability of coal, iron ore and other materials in close proximity and large-scale development of metallurgical industries, this area is often compared to the 'Ruhr region' of West Germany.

6. The Mathura-Delhi-Saharanpur-Ambala Region: This region has two separate belts running in north-south direction between Faridabad and Ambala in Haryana and Mathura and Saharanpur in Uttar Pradesh. The belts merge into a large agglomeration around Delhi which is one of the largest industrial cities in India. It has cotton textile, glass, chemicals and engineering industries; sugar industries, *etc.* Besides availability of cheap raw materials like sugarcane and raw cotton, a large market is the main stimulus for the industrial development in the area.

AGRO-BASED INDUSTRIES

Industries that have agricultural produce as raw materials are known as *Agro-based Industries*. These are consumer based industries. In this Chapter we shall study about such industries.

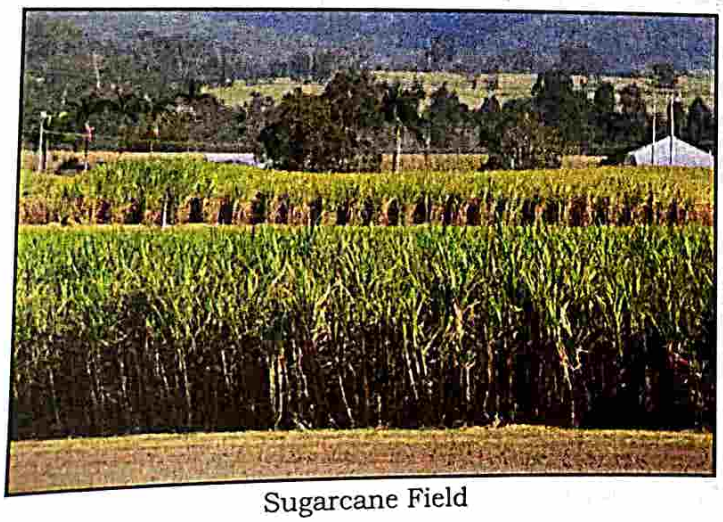
Sugar Industry

Sugar industry is India's second largest organised industry next to cotton textiles. India is the second largest producer of sugarcane in the world, after Brazil.

Products and By-Products

Sugarcane is an important cash crop which is crushed in the factories to produce sugar. A fairly large amount is also used to make *gur* and *khandsari*.

By-Products: Besides providing sugar, *gur* and *khandsari*, it also supplies *molasses*, *bagasse* and *press mud*. Molasses is obtained in the process of sugar manufacture involving repeated crystallisation and centrifugation. It is used in the alcohol industry for the distillation of liquor (rum), power alcohol, *etc.* It is also used in the production of certain chemicals and synthetic rubber.



Sugarcane Field

Bagasse, the left over cane after crushing, is used for producing steam which is used as a source of power for sugar industry. It is also used for making cardboard, paper and insulation board.

Press mud is utilised for making wax, carbon paper and shoe polish.

Distribution of Sugar Industry

Maharashtra

Maharashtra is the leading producer of sugar in India, accounting for more than one-third of the total production of sugar in the country. Due to marine impact, the climate is ideal for the cultivation of sugarcane as a result of which the recovery rate of sucrose is higher and the crushing season is longer.

The main sugar producing area in Maharashtra is located in a narrow belt extending from Manmad in the north to Kolhapur in the south. Most of the mills are large in size in which the crushing period lasts for more than 100 days.

Northern India

Uttar Pradesh is the second largest producer of sugar in India. Here the sugar factories are located in two belts—the Ganga-Yamuna doab and the Terai belt. In the Ganga-Yamuna doab area, the main sugar producing centres are Saharanpur, Meerut, Muzaffarnagar, Bagpat, Bulandshahar and Ghaziabad. In the Terai belt, the main sugar producing centres are located in Basti, Bahraich, Gonda, Gorakhpur and Lakhimpur Kheri. Uttar Pradesh, formerly the largest producer, has been relegated to second place because of old mills, management and labour problems and shorter crushing period.

The other states which produce sugar are Bihar, Punjab, Haryana, Madhya Pradesh and Gujarat.

Peninsular India

Peninsular India has emerged as the leading producer of sugar in the country. Tamil Nadu has higher per hectare yield of sugarcane, higher

CENTRES OF SUGAR INDUSTRY	
Uttar Pradesh	There are two belts—one in western Uttar Pradesh and the other in eastern Uttar Pradesh. The western belt includes Meerut, Bijnor, Saharanpur, Muzaffarnagar and Moradabad, and the eastern belt includes Gorakhpur, Deoria, Basti and Gonda.
Bihar	This is an extension of the eastern Uttar Pradesh belt, which includes Darbhanga, Saran, Champaran and Muzaffarpur.
Maharashtra	Nasik, Pune, Satara, Sangli, Kolhapur, Solapur are the centres well integrated in the cooperative sector in terms of cultivation and sugar factories.
Punjab	Centres exist mainly in the eastern side, in Phagwara, Dhuri.
Karnataka	Belagavi, Bellary, Mandya, Bijapur, Shimoga, Chitradurg and Varuna.
Tamil Nadu	Coimbatore, Villupuram, Vellore, Tiruvanamalai, Thiruvallur, Thanjavur, Perambalur, Pugaluru, Cuddalore and Dharmapuri districts.
Andhra Pradesh	Vijayawada, West and East Godavari, Kakinada, Chittoor, Srikakulam and Vishakhapatnam.
Odisha	Bargarh and Rayagada
Madhya Pradesh	Sehore

sucrose content and longer crushing season. These characteristics along with new machinery has led to higher output of sugar in Tamil Nadu.

In recent decades there has been a tendency of the sugar industry's growth towards the South. This is because of the reasons discussed below.

Tendency of the Industry to Migrate to the South

1. In South India the favourable maritime climate free from the effects of summer *loo* and winter frost is best suited for growing superior varieties of cane. So there is a longer production period.
2. The black soil here is more fertile than the alluvial soil of the northern India. Besides this, the black soil is well drained.
3. The cane is of superior quality with higher yield.
4. The excellent transport facilities, especially in the states of Maharashtra and Tamil Nadu, in relation to export markets have placed these states in a very advantageous position for the further expansion of the sugarcane industry.
5. The sugarcane farms in South India have bigger area and are managed by the co-operative societies. These cooperative societies have access to better facilities like better seeds, fertilisers, irrigation, *etc.*
6. Sugar is a weight losing crop, *i.e.*, its sucrose content goes on decreasing with time. Therefore, it is necessary to crush sugarcane within 24 hours of harvesting. Since the factories in southern India are located near the fields, loss of sugar content due to transportation is minimum.
7. New machinery and crushing devices ensure more yield.
8. Longer crushing season.

Problems of the Sugar Industry

1. The sugarcane cultivated in India is of poor quality giving low yield per hectare and low sucrose content.
2. The cost of production is quite high because of the inefficient and uneconomic nature of production, low yield, short crushing season and location of sugarcane producing areas far away from the factories.
3. About whole of sugarcane is harvested at the same time, as a result there is excess pressure on factories during harvest time and some amount of cane goes waste. This adds to the cost of production.
4. The supply of raw materials to sugar factories is irregular as no plantation industry exists around the factory. Moreover, sugarcane is grown by small farmers who sell their produce to sugar factories.

Sugar Industry — North India	Sugar Industry — Peninsular India
The yield per hectare is low due to unfavourable climatic conditions.	The yield per hectare is high due to tropical climatic conditions.
The crushing season is short in northern India.	The crushing season is longer than northern India.
The factories are old and obsolete machineries are used.	Most of the mills are new and are well equipped with modern machines.
Sugarcane farms are smaller and owned by individual farmers.	Sugarcane farms are bigger and run by cooperatives.

5. The output of cane also depends on the price offered for the sugarcane. Farmers sell the cane to the factories at prices fixed by the government. If the prices offered are not attractive, farmers switch over to other crops.
6. The by-products of sugar like molasses and bagasse are not utilised completely. These can be converted into other useful products to reduce the cost of production.
7. Old and obsolete machinery is used in sugar industry. This should be replaced by new technology and new machinery.
8. Instead of sugar, in rural areas, the demand for *gur* and *khandsari* is more.

COTTON TEXTILE

India is one of the largest cotton textile manufacturing countries in the world. It is also one of the largest exporters of cotton textiles in the world. Cotton textile is a major industry in India as it directly or indirectly supports more than nearly 40 per cent of the country's labour force.

Cotton textile industry is divided into powerloom and handloom sectors. The most important cotton mills in powerloom are located in Maharashtra, Gujarat and Tamil Nadu. They account for three-fourths of the total output of yarn and cotton cloth. The remaining one-fourth is produced by West Bengal, Uttar Pradesh, Madhya Pradesh, Rajasthan, Andhra Pradesh, Karnataka, *etc.*

Handloom industry is located in every Indian state, however small it may be. Mumbai, Ahmedabad, Coimbatore, Kanpur, Delhi and Howrah are important centres. Rajasthan, Kerala, Karnataka, Punjab, Bihar, and Assam are other important states.

The Main Cotton Manufacturing Centres

The cotton textile industry is one of the most widely distributed industries in India. However, it is more concentrated in the cotton growing tracts of the drier western parts of the Peninsula and the Great Plains. Maharashtra and Gujarat are the foremost cotton textile manufacturing states. In these states, Mumbai and Ahmedabad contribute about 50 per cent of the total installed looms and nearly half of India's cotton mill cloth. In fact, Mumbai has become the most important centre of cotton textile in the country and is rightly called the '*cottonpolis*' of India. It is also known as the 'Lancashire' of India. Ahmedabad, being the second largest cotton manufacturing city in India is referred to as 'Manchester of India.

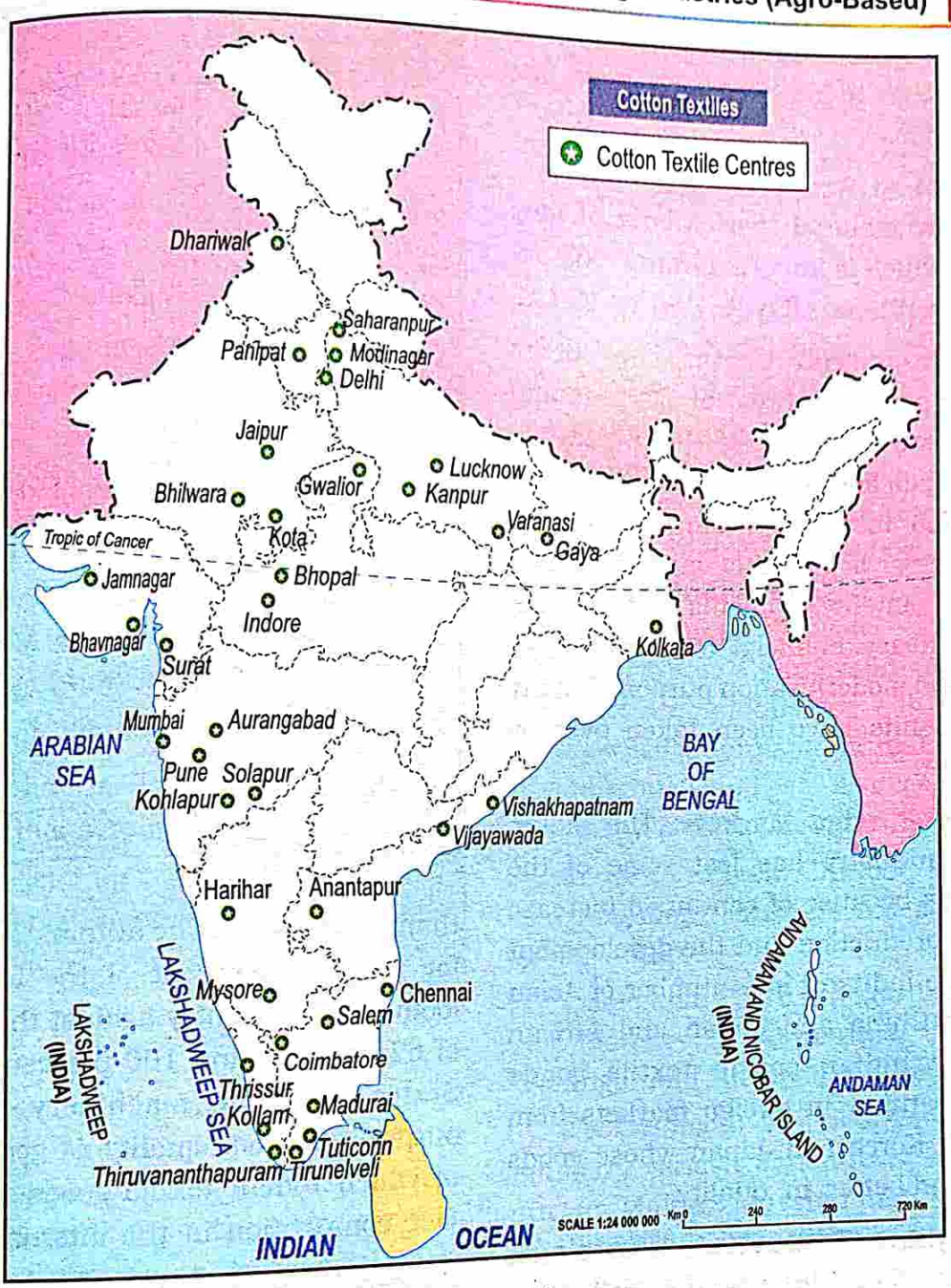
Mumbai and Ahmedabad have emerged as the most important cotton manufacturing centres because of the following reasons:

(i) Proximity to Raw Material: The supply of raw cotton for the mills is supplied by the cotton producing areas of the Deccan Plateau that lie close to these mills.

(ii) Climatic Conditions: The humid coastal climate favours the textile making without breaking the thread.

(iii) Transport Facilities: Mumbai and Ahmedabad are well connected through rail and road links with cotton growing areas of Maharashtra and Gujarat, respectively and also through sea routes with the foreign markets.

(iv) Port Facilities: Mumbai is a leading port with export and import facilities whereas



Cotton Textiles

Ahmedabad utilises port facilities from Kandla. The location of ports facilitate import of capital goods, chemicals, *etc.* and the export of finished goods.

(v) Labour: Mumbai and Ahmedabad have enough labour force from within or nearby states.

(vi) Capital: Both Mumbai and Ahmedabad being the financial and commercial centres of the country have easy access to capital and financial resources. A large number of banks and other financial institutions exist in these cities which provide loans and other credit facilities to the manufacturers.

(vii) Power: Power is of utmost need for the development of any industry. The cotton mills in Mumbai are supplied electricity by the Tata Hydroelectric system located in the Western Ghats whereas electricity is supplied in Gujarat by the Ukai and Kakrapara hydroelectric projects.

(viii) Market: There is a huge market for the cotton cloth in these states as well as in the southern and coastal areas of the country because of the hot climate which prevails in these areas. Besides internal demand, a huge market for the Indian cotton cloth exists outside the country, especially in the Middle East countries which are located comparatively near to Mumbai and Ahmedabad.

Problems of Textile Industry

The cotton textile industry suffers from the following problems:

(a) Shortage of Raw Material: There is a shortage of raw material, particularly of long staple cotton, which is imported from Pakistan, Kenya, Uganda, Sudan, Egypt, USA and Peru.

(b) Sick Industrial Units: The cotton industry faces constant threat of sickness and consequent closure, because of—(i) uncertainty of raw material; (ii) low productivity of machines and labour; (iii) increasing competition from powerloom sector; (iv) lack of modernisation; and (v) management problems. These sick units require heavy financial investments for replacement and modernisation purposes. Many of these sick units have been taken over by the government.

(c) Loss of Foreign Markets: The Indian cotton textile industry has lost some of the foreign markets because of continued increase in the cost of production and the development of cotton textile industry in a number of Asian countries like China and Japan and African countries. The Indian cotton textile goods face stiff competition in foreign markets from Taiwan, South Korea and Japan whose goods are cheaper and better in quality.

(d) Inadequate Production: The cotton textile industry faces inadequate production because of the lack of adequate and unfailing power supply and also because of competition with the decentralised sector. Thus it has to face stiff competition from other Asian countries.

(e) Shortage of Power: The cotton textile mills are facing acute shortage of power. Supplies of coal are difficult to obtain and frequent cuts in electricity and load shedding affect the industry badly. This leads to loss of man hours, low production and loss in the mills.

(f) Obsolete Machinery: In India most of the cotton textile mills are working with old and obsolete machinery. According to an estimate, in India over 60 per cent of the spindles are more than 30 years old. The automatic looms account for only 18 per cent of the total number of looms in the country against the world average of 62 per cent and 100 per cent in the United States. Obsolete machinery results in low output and poor quality of goods as a result of which Indian textile goods are not able to face competition in the international market.

IMPORTANT CENTRES OF COTTON TEXTILE INDUSTRY	
Maharashtra	Mumbai, Pune, Aurangabad, Kolhapur and Solapur.
Gujarat	Ahmedabad, Surat, Jamnagar and Bhavnagar.
West Bengal	Kolkata.
Tamil Nadu	Chennai, Salem, Coimbatore, Tuticorin and Madurai.
Madhya Pradesh	Gwalior, Indore and Bhopal.
Rajasthan	Kota, Bhilwara and Jaipur.
Uttar Pradesh	Modinagar, Kanpur, Varanasi, Moradabad and Lucknow.
Andhra Pradesh	Anantpur and Vijayawada.
Kerala	Kollam and Thiruvananthapuram.

SILK TEXTILE INDUSTRY

India is one of the largest producers of silk in the world. It also has the distinction of manufacturing four varieties of silk, namely *mulberry, eri, tasar* and *muga*. It has the world monopoly of golden-yellow muga silk produced in Assam. It also has a long tradition of manufacturing and producing silk textiles. The rearing of silkworms for silk production is known as *sericulture*.

In India, silk fabrics were made in the cottage industrial sector. The first modern silk textile factory in India was started by the East India Company at Howrah in 1832. After independence there has been a significant increase in the production of silk textiles in the country.

HANDLOOM AND KHADI

A large part of the textile industry is still managed by small marginal weavers using handloom.

The government has introduced many schemes to promote the rich heritage of handloom sector.

Through numerous khadi outlets, and other marketing assistance the weavers and artisans are able to revive their skill of spinning and weaving and make products for customers all over the world.

Handloom industry is the largest cottage industry in the country. It provides direct employment to about 13 million weavers, and is the largest economic activity after agriculture. It employs a lot of women and thus helps in women empowerment.

Khadi or khaddar is handspun and woven by hand. The weavers use a spinning wheel to spin the yarn from cotton. The finished product is a versatile fabric and widely used in fashion circles.

Mulberry Silk

Mulberry silk accounts for about 90 per cent of total natural silk produced in India. It is produced from the silkworms which are reared on the mulberry tree. Sericulture is the name given to the rearing of silkworms on mulberry leaves. The significant producers of this variety of silk are Bengaluru, Mysore, Belgaum, Srinagar and Himachal Pradesh. The major mulberry silk producing states are Karnataka, Andhra Pradesh, West Bengal, Tamil Nadu and Jammu and Kashmir which account for 92% of country's total mulberry silk production.

Distribution

The States dealing with sericulture are Karnataka, Andhra Pradesh, Telangana, West Bengal, Tamil Nadu, Assam, Manipur and Meghalaya.

Karnataka: It contributes 70 per cent of the country's mulberry silk output because it has favourable climate for rearing silkworms. There are nurseries, silk farms and licensed seed distributors. Bengaluru, Mysore, Kolar, Mandya, Tumkur, Belagavi, Chikkaballapura, Ramanagaram, Chamarajanagar and Coorg districts are famous for silk industry. The state-owned Channapatna silk mill has a capacity of numerous spindles. The decentralised sector has many powerlooms and handlooms.

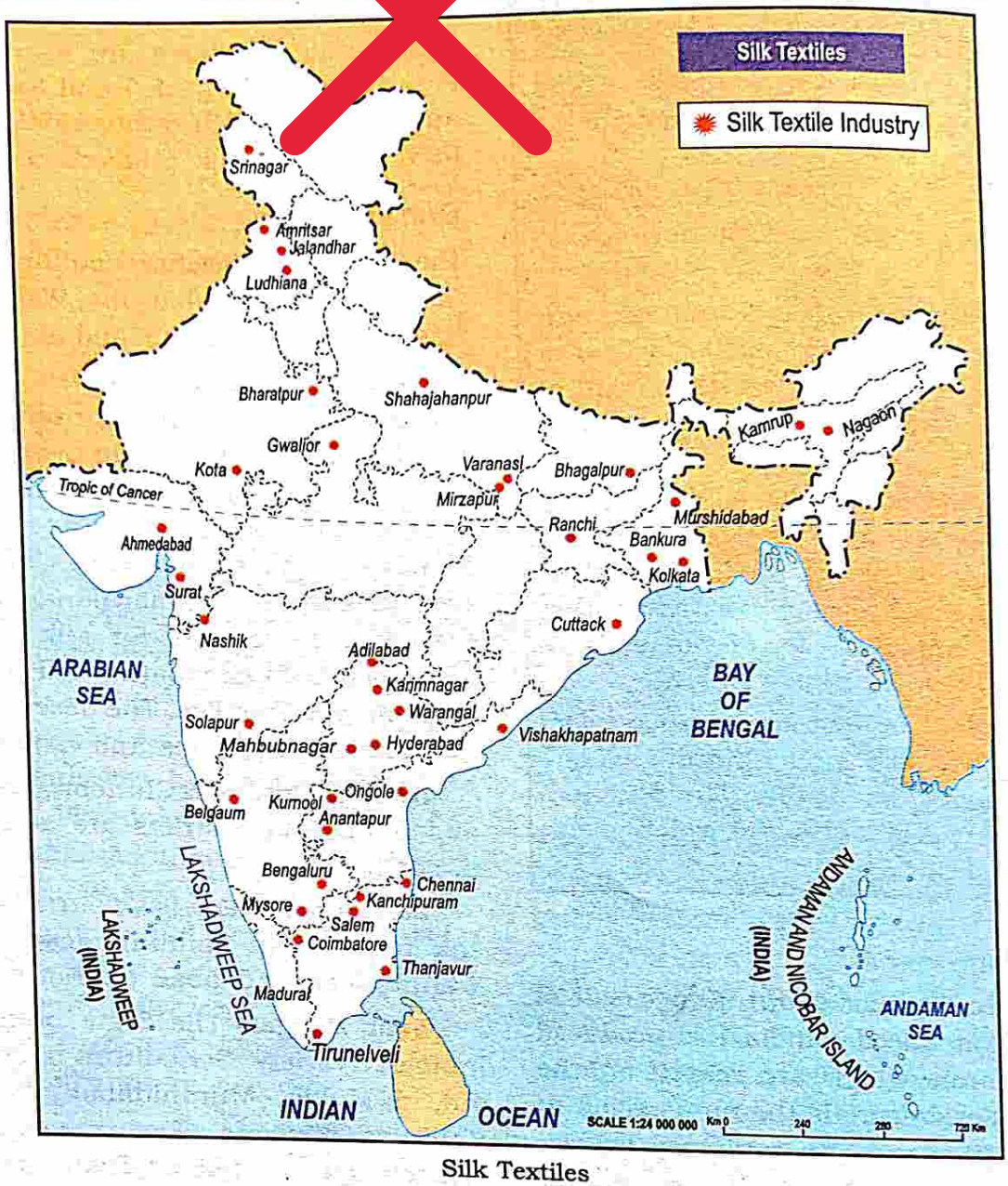
Andhra Pradesh: Chittoor, Visakhapatnam and Anantapur districts are actively involved in sericulture.

Telangana: There is a flourishing handloom silk industry in Mahbubnagar, Karimnagar, Warangal and Adilabad districts.

West Bengal: The State produces silk of mulberry variety. Sericulture is chiefly carried out in Malda, Murshidabad, Birbhum and Bankura districts. The important weaving centres are located at Bishnerpur, Baswa, Raghunathpur, Rishra and Chak Islampur.

Silk Weaving Centres in India

Karnataka	Bengaluru, Hubli, Dharwar, Mysore and Belgaum.
West Bengal	Murshidabad, Bankura and Bishnerpur.
Uttar Pradesh	Varanasi, Mirzapur and Shahjahanpur.
Tamil Nadu	Salem, Tirunelveli, Nilgiris, Kanchipuram.
J & K	Srinagar.
Bihar	Bhagalpur.
Assam	Goalpara in Kamrup and Nagaon.
Punjab	Amritsar, Jalandhar and Ludhiana.
Gujarat	Ahmedabad.
Telangana	Warangal, Mehbubnagar, Karimnagar, Adilabad
Andhra Pradesh	Anantpur, Chittoor, Visakhapatnam and Kurnool



Silk Textiles

Tamil Nadu: The State is the fourth largest producer of raw silk in India. Coimbatore, Dharmapuri, Salem and Tirunelveli districts are the main centres for the production of raw silk. The state has many handlooms which produce the silk-yarn in the country.

Bihar and Jharkhand: These States produce silk of *tasar* variety. These are the largest *tasar* producing states in the country. Palamau, Hazaribagh, Bhagalpur and Ranchi are the leading silk producing districts.

Assam: Sericulture is an important cottage industry in the state providing sustenance to thousands of people. Assam is one of the largest producers of non-mulberry silk (*tasar* and *muga*). It is also the only *muga*-producing region of the country. Goalpara in Kamrup and Nagaon are important silk producing districts.

Problems of Silk Industry

The main problems being faced by the silk industry are the following:

1. Competition from artificial silk is the main problem faced by the Indian silk industry. Artificial silk is cheaper and better in quality.
2. Import of better quality and cheaper raw silk from China is also detrimental for the Indian silk industry.

3. The changes in prices of raw silk badly affect both the weavers and the silk industry.
4. There is no systematic testing and grading of silk as in advanced countries like Japan.
5. The industry needs modern power looms for increasing production.

EXERCISES

I. Give the difference between the following:

1. Large-scale and Small-scale industries.
2. Heavy and Light industries.
3. Basic and Secondary industries.

II. Answer the following questions:

Q.1 (a) What is the difference between Agro-based and Mineral-based industry?

(b) Classify industries on the basis of the nature of products. Give one example of each.

(c) (i) Mention two advantages of setting up a small scale industry.

(ii) Give two points of difference between a public sector and a private sector industry.

(d) Give a geographical reason for each of the following:

(i) Sugar mills are located close to sugarcane growing areas.

(ii) Uttar Pradesh has been relegated to second place in terms of sugar production.

(iii) The Silk industry has a small market.

Q.2 (a) Name two by-products of the sugar industry. Give one use of each.

(b) Why is the sugar industry highly dispersed in India?

(c) Give three important reasons which have made Maharashtra the leading producer of sugar in India.

(d) Give a geographical reason for each of the following:

(i) India produces very little cane-sugar though it is one of the largest producers of sugarcane in the world.

(ii) Higher output of sugar in South India.

(iii) Sericulture flourishes in Karnataka.

Q.3 (a) Mention any two features of the cotton textile industry in India.

(b) Why have Mumbai and Ahmedabad emerged as the important cotton manufacturing centres?

(c) State any three problems faced by the cotton industry in India.

(d) What is sericulture? State any two problems faced by the silk industry.

Q.4 (a) State any two geographical features favourable for setting an industry.

(b) Name two major silk producing centres in Karnataka and West Bengal.

(c) (i) Name the state having the largest production of non-mulberry silk.

(ii) Name the type of silk available in these states: Assam and Bihar.

(d) Give a geographical reason for each of the following:

(i) Sugarcane is a weight loosing commodity.

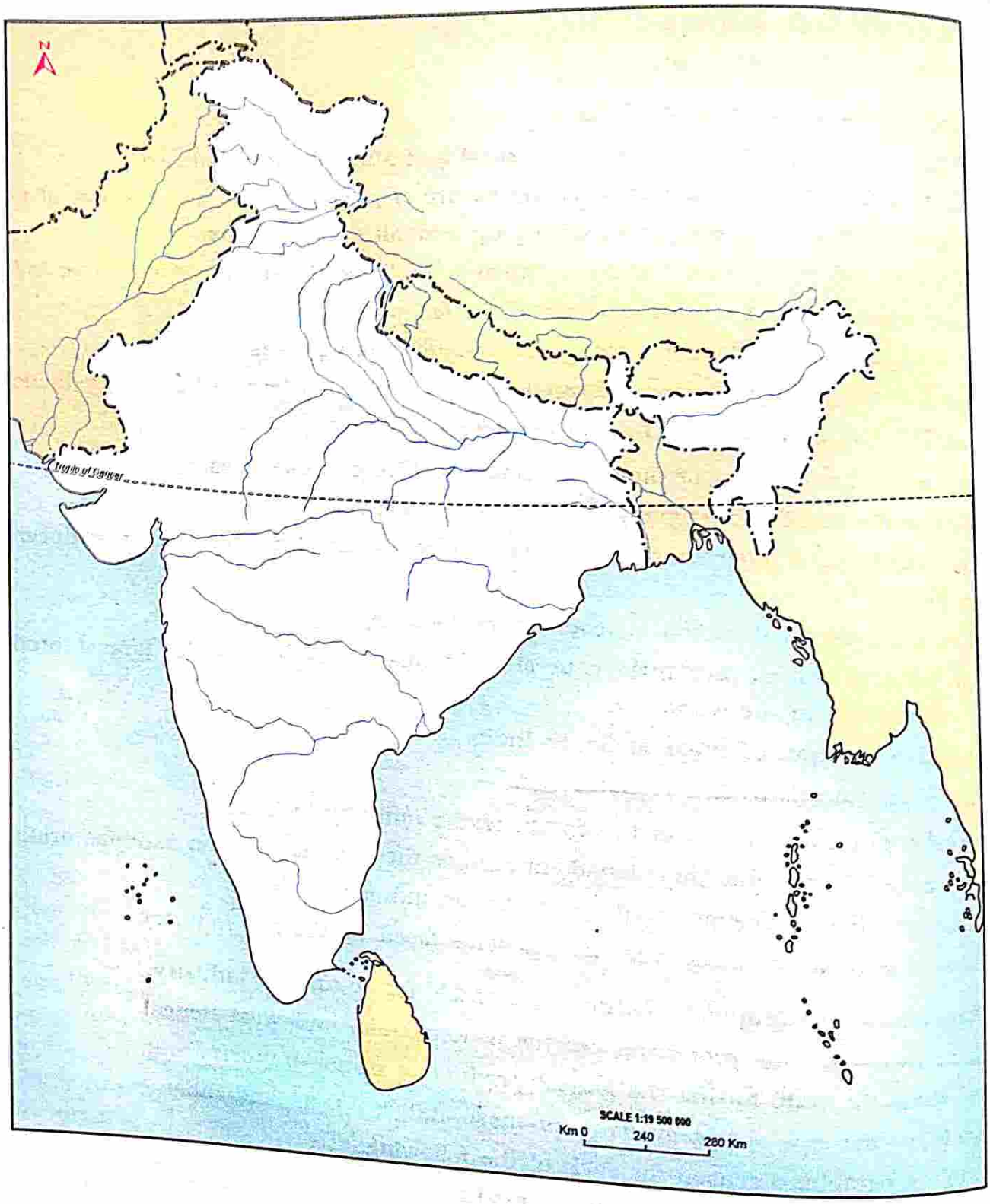
(ii) Mumbai is known as the 'cottonopolis of India'.

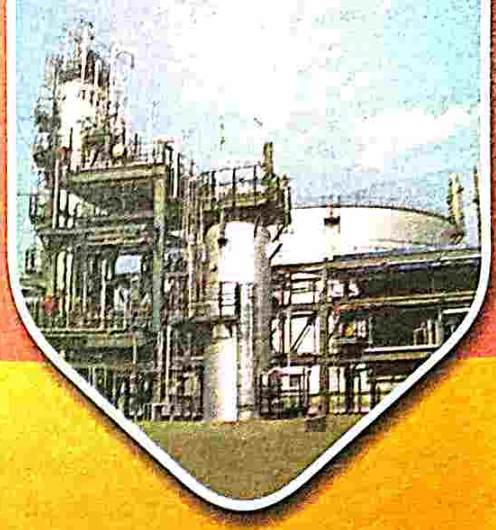
(iii) Ahmedabad is known as the 'Manchester of India'.

III. Mapwork

On the outline map of India mark the following:

1. The Industrial Region in West India.
2. The three largest Cotton Textile Industrial centres.
3. One centre of the Sugar Industry in (i) North India; and (ii) Peninsular India.
4. Three states where sericulture is practised.





Chapter 20 Mineral Based Industry

Syllabus

Manufacturing Industries

Mineral based Industry — Iron and Steel (TISCO, Bhilai, Rourkela, Vishakhapatnam) Petrochemical and Electronics.

IRON AND STEEL INDUSTRY

Iron and steel is a basic industry and forms the backbone of industrial development in any country. It provides raw material for making industrial machinery, electrical machinery, defence equipment, railway tracks, railway engines, bridges, farms, workshops, automobiles, houses and a host of other industrial and consumer goods. In fact, the quantity of steel produced and its per capita consumption reflects the level of industrialisation and economic development of a country.

The art of steel making was known to Indians since ancient times as is evident from the famous iron pillar in Delhi, which dates back to the Gupta period. The first attempt to produce iron and steel on modern lines, was made in 1830 at Porto Novo (Tamil Nadu). But this mill was closed down in 1866. The first unit, which was able to produce pig iron successfully was started at Kulti in 1874 and was named the Bengal Iron Work Company. However, the setting up of the Tata Iron and Steel Company at Sakchi (now in Jamshedpur) by Jamshedji Tata in 1907 marked a turning point in the history of iron and steel production in India. Today, India is the fifth largest crude steel producing country in the world.

Raw Materials

The main raw materials used in iron and steel industry are iron ore, coal, manganese, limestone, silica, chromate, feldspar, scrap iron, flux and fuel. Manganese is used for hardening of steel and also for removing impurities. Steel products need to be galvanised to make them rust free. This is done by galvanising iron with chromium, nickel and tungsten.

Steel Making

Iron ore is always found with some impurities like sulphur, silica, phosphorus, lime, *etc.* So the impurities have to be removed to get pure iron ore that is used for making steel. The following process is used for converting iron ore into steel:

1. Ore Reduction: The process of ore reduction is carried out in a blast furnace where the ore and coal put in a blast furnace. Small quantities of limestone and dolomite are also added as flux to help combine the impurities in the ore as slag. This slag floats on the molten iron and can be easily separated from it. Molten iron is collected at the base of the furnace at regular intervals. The product so obtained is known as pig iron. This pig iron can be converted into wrought iron, steel and cast iron.

2. Steel Melting Furnaces: The pig iron obtained after reducing the ore contains upto 5 per cent of carbon and other impurities. To convert pig iron into steel, impurities are removed through deoxidation. Hardening

materials including carbon are added to get the desired quality.

3. Rolling Mills: The steel is then cast into ingots and rolled into different sizes.

Large Integrated Iron and Steel Plants

An integrated steel plant is the one in which all the processes from providing raw materials, basic fuels, water supply, *etc.*, to the conversion to steel, rolling, *etc.*, are all done in one place. On the contrary, the mini steel plants have electric furnaces and do not have all the facilities at one place and require separate units for completing the process of steel manufacturing.

Major Iron and Steel Plants

Steel Authority of India (SAIL) is the largest steel making company in the Public Sector. It produces iron and steel at five integrated plants at ~~Bhilai,~~ Durgapur, Rourkela, Bokaro and Burnpur and three special steel plants at Salem, Durgapur and Bhadravati. It also owns a Ferro Alloy plant at Chandrapur in Maharashtra. Besides, there are integrated steel plants in the private sector as well, the largest being Tata Iron and Steel plant at Jamshedpur.

1. TATA IRON AND STEEL COMPANY

Tata Iron and Steel Company (TISCO) is one of the largest manufacturing plants in Asia. It is situated at Sakchi, (now called Jamshedpur). It is the oldest steel plant in the country. It was established by Jamsetji Tata in 1907 and its production started in 1911. The following factors were responsible for the plant being located at Jamshedpur.

1. Location: The TISCO plant is situated at Jamshedpur in the Singhbhum district. Jamshedpur is most ideally located with respect to iron ore, fuel and flux supplies which are obtained from within 175 km of it.

2. Availability of Raw Materials: The plant obtains its requirements of iron ore from Gurumahisani mines in Mayurbhanj district of Odisha and from the Noamundi mines in Singhbhum district of Jharkhand. These ore deposits are rich, containing over 60 per cent iron. It receives Manganese from Joda in Keonjhar district and limestone, dolomite and fire-clay from Sundargarh district of Odisha. Coal is obtained from the Jharia and Bokaro coalfields.

3. Power Supply: Coal is the main source of power for this plant. The supply of coal comes from Jharia and Bokaro coalfields located at a distance of about 177 km.

4. Water Supply: The two rivers Kharkai and Subarnarekha, which never run dry throughout the year, supply a continuous stream of water for cooling purposes.

5. Labour Force: The labour force for the plant is recruited from the densely populated valley of Ganga, mostly from the States of Bihar, West Bengal, Jharkhand, Chhattisgarh and Uttar Pradesh.

6. Market: The plant is located at a distance of 240 km from Kolkata which is not only an important market for the consumption of iron and steel goods but also has facilities for export of finished goods.

7. Transport Facilities: Jamshedpur is well connected with roads and railways to the other parts of the country. The movement of raw materials and finished products is facilitated by the Eastern Railways. It is also connected with the Kolkata port for exporting of finished steel.

Products

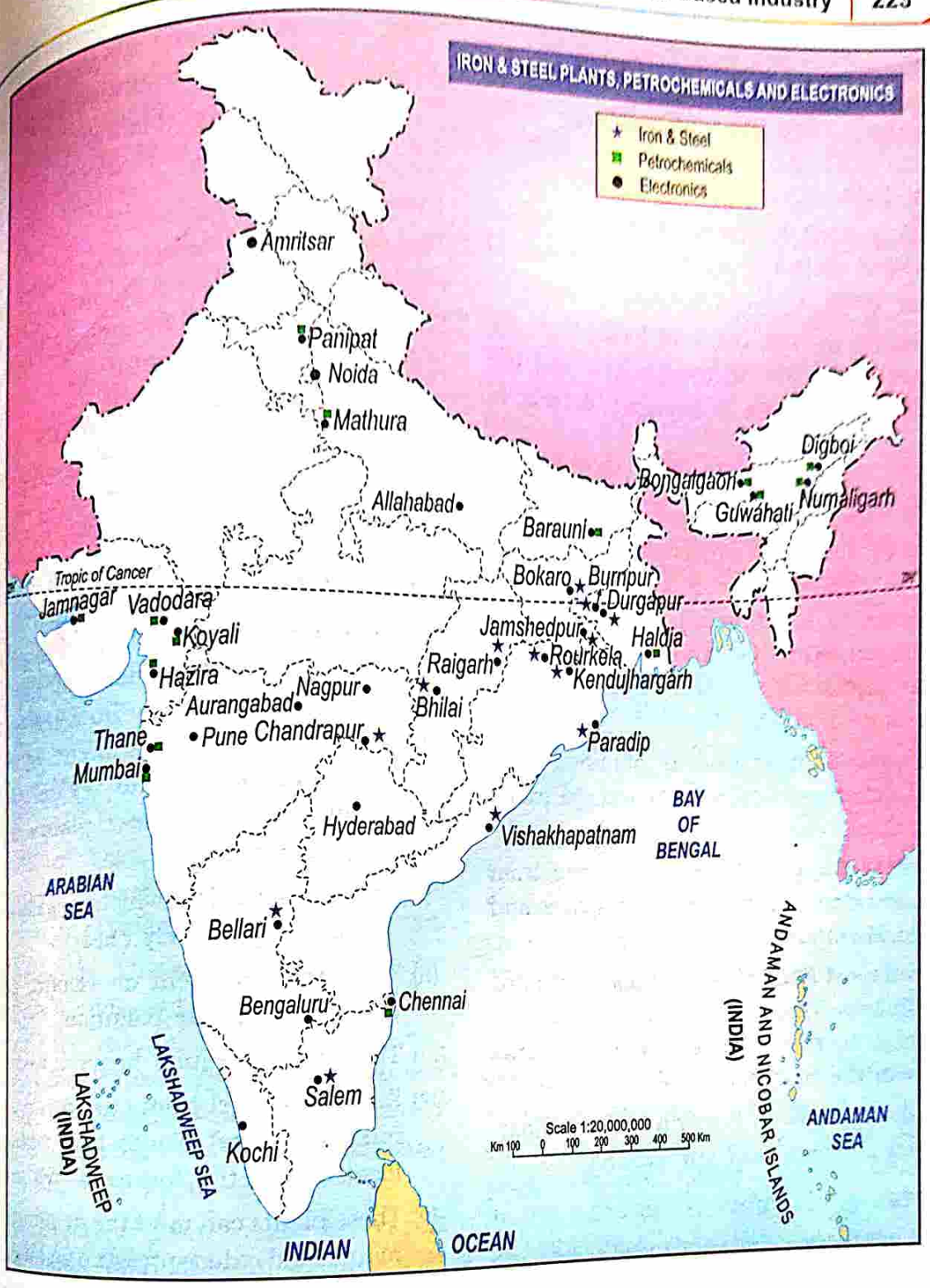
It produces high grade *carbon steel* used in structural fittings and tin plates, *acid steel* for making railway wheels, axles, bars, rods, sheets, *etc.* It also produces special alloy steel used for making bulletproof armour plates, *etc.*

2. BHILAI IRON AND STEEL PLANT

Bhilai Steel Plant was established at Bhilai in 1953 in collaboration with the (then) USSR Government.

1. Location: It is located in Durg district of Chhattisgarh.

2. Availability of Raw Materials: The plant gets its raw material from the following sources: Large iron ore deposits are supplied from Dalli Rajhara mines, about 80 km away from the plant. Limestone is drawn from the quarries developed in Nandini, 19 km from Bhilai.



Iron & Steel Plants, Petrochemicals, Electronics

manese is obtained from the neighbouring strict of Balaghat.

3. Power Supply: Coal is obtained fr... karo, Kargati, and Jharia fields in Jharkhand ... Korba in Chhattisgarh. The main sour... power is the thermal station at Korba.

4. Water Supply: The plant gets water ... a system of reservoirs at Tendula.

5. Transport Facility: The Bhilai Steel Plant lies on the Mumbai-Nagpur-Kolkata rail line which links the plant to the major ma...ets.

6. Labour Force: The labour for the plant ... recruited from the nearby states of Bihar, J...rkhand and Madhya Pradesh.

PRODUCTS

The plant produces heavy rails, structurals, beams, billets and rolled wire. It produces plates

for shipbuilding industry. The plant also produces by-products like ammonium sulphate, benzol, coal tar and sulphate acid.

3. ROURKELA STEEL PLANT

The Rourkela Steel Plant was built with technical cooperation from the German firm, Krupps and Demag in 1959.

1. Location: The plant is located at the confluence of two rivers, the Sankha and the Koel (Brahmani) in the Sundargarh district of Odisha.

2. Raw Materials: The plant is situated within 80 km of the high-grade iron ore reserves of the Sundargarh and Keonjhar district in Odisha. Manganese is obtained from Barajmda (Jharkhand), limestone from Bhirmitrapur (Odisha) and dolomite from Baradwar (Chhattisgarh), all situated within a short distance from the plant.

3. Power Supply: Coal is obtained from Jharia, Talcher and Korba fields and electricity from Hirakud Project.

4. Water Supply: Water is obtained from the Mandira dam across the Sankha river and also from Mahanadi.

5. Transport Facilities: Rourkela is situated on the Kolkata-Nagpur rail line. This provides easy access to raw material producing areas and also to the markets.

6. Labour Force: It is recruited from Bihar, West Bengal, Jharkhand and Odisha.

Products

Its major products include hot-rolled sheets and strips, cold-rolled sheets, galvanised sheets and electrical steel plates. It also produces large quantity of nitrogen as a by-product which is used for the manufacture of fertilizers and various chemicals.

4. VISHAKHAPATNAM STEEL PLANT

1. Location: It is the first shore based steel plant in India located at the port city of Visakhapatnam in Andhra Pradesh.

2. Raw Materials: The plant obtains iron ore from Bailadila in Chhattisgarh. It gets limestone, dolomite and manganese from the mines of Andhra Pradesh and Odisha.

3. Power Supply: It is well connected with the coalfields of the Damodar Valley.

Products

The plant produces liquid steel and saleable steel. The quality of steel produced in this plant is as per the global standards and is exported to China and South East Asia.

MINI STEEL PLANTS

These plants generally use ferrous scrap, pig iron or sponge iron as their raw material. They work through electric furnaces and have a capacity from 10,000 tonnes to about 5 lakh tonnes per year. Further, their period of construction and gestation is also short. These mini plants are distributed in different parts of the country particularly in areas away from the integrated steel plants. The Government of India is promoting and planning to set up more mini steel plants because these plants have the following advantages:

(i) They use scrap iron which is easily available and is comparatively cheap.

(ii) They are dependent on electric power so they do not cause pollution.

(iii) They do not require heavy investment.

(iv) Since mini steel plants use scrap iron from integrated steel plants they need not be located near the source of raw material.

(v) These plants can meet the demands of local market and reduce pressure on large plants. Some of the mini steel plants are located at Kanpur, Jaipur, Hyderabad, Delhi, Pune and Ranchi.

Problems of Iron and Steel Industry

Although India is an important Iron and Steel producing country in the world, yet it is not able to perform to its full potential due to the following problems:

(i) Capital Intensive: Iron and Steel Industry is a capital intensive industry, i.e., it requires huge amount of capital. Besides, iron and steel plants have a long gestation period.

(ii) **Obsolete Technology:** Iron and steel plants established after India attained independence, are not working to their full potential as the machinery being used is outdated. Consequently, the iron and steel industry is lacking behind the advanced countries in terms of new technological inputs.

(iii) **Limited Availability of Coking Coal:** Though India has huge deposits of high grade iron ore, her coal reserves, especially high grade coking coal, used for smelting iron ore are limited. Consequently, many steel plants are forced to import coking coal. For example, steel plant at Vishakhapatnam has to import coal from Australia.

(iv) **Sick Industrial Units:** Due to the inadequate supply of power and sharp increase in the cost of raw materials, many small iron and steel plants are either experiencing sickness or have been closed down.

(v) **Control of Prices:** The government has fixed price for iron and steel which leaves little margin of profit for the manufacturers.

(vi) **Inefficiently Managed Public Sector:** Many iron and steel plants in the Public Sector are facing strikes, lockouts, energy crisis caused by heavy investment on social overheads, poor labour relations, inefficient management and underutilisation of capacity.

(vii) **Heavy Demand:** Even at low per capita consumption rate, demand for iron and steel is increasing rapidly. To meet this increasing demand, large quantity of iron and steel has to be imported.

ELECTRONICS

The electronics industry developed in India in the 1950s. It began with radio manufacturing and at present has diversified into new areas like space exploration, defence equipments, medical diagnosis, communication, information technology, computer systems. Indian hardware and software is in great demand world wide.

The electronic industry requires large number of skilled workers. It is a fast growing tertiary occupation and has a larger concentration in the Southern States.

1. The Indian Telephone Industries (ITI): It was the first government undertaking to be set up after Independence near Bengaluru in 1950. It produces equipment to meet the needs of the post and telegraph departments, railways, defence, overseas communication services and electricity boards. Among other items, it manufactures automatic telephone switching systems and teleprinter exchanges and long distance transmission systems.

The ITI has now seven manufacturing units all over the country: two at Bengaluru and one each at Naini, Rae Bareli, Mankapur, Palakkad and Srinagar (J&K).

2. The Electronics Corporation of India Ltd. (ECIL): It is an indigenous unit. It was set up in Hyderabad in 1970. It has a well equipped laboratory where tests are carried out. Among its products are: transistorised modular systems for nuclear applications and for use in medical, agricultural and industrial fields. Components like metal oxide resistors, analog computers and online digital process control computers are also produced.

3. The Bharat Electronics Ltd. (BEL): It was set up in the Public Sector in 1956 in Bengaluru to fulfill the needs of the electronics in defence services. It also caters to the needs of the All India Radio and the Meteorological Department. BEL makes important contribution in the fields of communications, radar, fire, control system for tanks and various kinds of optical system.

Space Technology

Our Space Technology is supported by the electronics Industry. We have successfully launched indigenously built satellites such as the Apple and INSAT series. The Indian Space Research Organisation (ISRO) at Bengaluru; the Satellite launching Station at Sriharikota and the National Remote Sensing Agency at Hyderabad are landmarks in Space technology. India is among the six nations of the world to possess the capability to launch satellites into

Geosynchronous Transfer Orbit (GTO). ISRO has developed two rockets: the polar satellite launch vehicle (PSLV) for putting satellites into polar orbits and the Geosynchronous Satellite Launch Vehicle (GSLV) for placing satellites into geostationary orbits. These rockets have launched numerous communication satellites, earth observation satellites. India has become the first country in the world to reach Mars on its first attempt in September 2014. *The Mars Orbiter Mission*, also called *Mangalyaan* was a space probe orbiting Mars. It was India's first interplanetary mission, which made India the fourth space agency to reach Mars, after *Roscosmos*, *NASA*, and the *European Space Agency*.

Chandrayaan-I, India's first Scientific Mission to moon was launched in 2008 and Chandrayaan-II was launched in 2019.

Software Industry

The software industry has emerged as one of the fastest growing sectors in electronics in India. The Department of Electronics has adopted a proactive role to further enhance competitiveness of India in IT and has initiated a number of programmes for manpower development, quality upgradation and stimulation of software engineering and research.

India has achieved capability of designing and building supercomputers. Bengaluru and Hyderabad are leading centres of software industries.

Television and Audio

The television and audio industries bloomed in the 1990s as a result of the progress made by the electronics industry. The audio industry can be broadly classified as mono players, stereo players, midi systems, CD based systems and car audio systems. The main centres of production are Mumbai, Kolkata, Chennai and Pune.

PETROCHEMICAL INDUSTRY

Petrochemicals are important organic chemicals, derived from petroleum products, LPG and coal.

This industry is normally located near an oil refinery which can supply its basic requirements of Naphtha or Ethylene and Benzene. These chemicals are used for manufacturing a large variety of articles such as synthetic fibres, synthetic rubber, ferrous and non ferrous metals, plastics, dyestuffs, drugs and pharmaceuticals. The products are widely used today in domestic, industrial and agricultural fields. In particular, this industry produces:

(i) Fertilizers and insecticides.

(ii) Resins, adhesives for industries.

(iii) Plastic sheets, plastic foam, bowls and baskets, paints and furniture coverings for household items.

(iv) Carbon black is used in printing inks, paints, carbon paper and gramophone records.

Advantages of Petrochemicals Products

Petrochemicals are cost-effective, economically stable, cheaper as they are produced on a mass scale. Its raw material is easily available, not dependent on agricultural raw material as in the case of jute. Therefore, traditional raw materials like wood, glass and metals are being replaced by petrochemical products. For example:

Natural Material	Petrochemical Product
1. Leather footwear	Plastic chappals and Synthetic footwear.
2. Natural Rubber	Synthetic rubber.
3. Jute fibre	Synthetic fibre.
4. Steel pipes	PVC.
5. Steel Utensils	Plasticware/containers.
6. Cloth and Jute bags	Polythene bags.

Production Units

1. Herdillia Chemicals Ltd.: It was set up at Chennai in collaboration with the Distillers Co. Ltd. of UK, and Hercules Power Co. of the USA. It manufactures a number of heavy organic chemicals like phenol, acetone, diacetone alcohol, and their derivatives — by-products co-products and compounds.

2. National Organic Chemicals Industries Ltd.: It is the biggest unit in India which was sponsored by Mafatlals in the Thane-Belapur area near Mumbai. It is also the first integrated plant in India which is based on the latest technology in petrochemical field. The plant produces naptha to produce ethylene, benzene, PVC, etc.

3. Petrofils Cooperative Limited (PCL): It is a joint venture of the Government of India and Weavers' Cooperative Societies. It has three plants located at Vadodara and Naldhari in Gujarat. It manufactures yarn used for making

swim suits, undergarments, polyster filament yarn and nylon chips.

4. Indian Petrochemical Corporation Ltd.: It is located at Jawaharnagar near Vadodara. It manufactures a number of petrochemicals like polymers, synthetic organic chemicals and fibres.

5. The Bongaigaon Petrochemicals Ltd.: It is located at Bongaigaon in Assam. It draws its raw materials from the Bongaigaon and Noonmati refineries.

6. The Reliance Industries: It is located at Hazira in Gujarat.

7. Haldia Petrochemicals Ltd.: It is a modern naptha based Petrochemical complex located at Haldia in West Bengal. It manufactures wide range of polyolefins and chemicals like benzene, butadiene, cyclo-pentane.

8. The Indian Oil Corporation: It has set up three world class mega petrochemical plants:

(i) Linear Alkyl Benzene (CAB) plant, Gujarat

(ii) Paxaxylene/Purified Terepthalic Acid (PX/PTA), Panipat

(iii) Naptha Cracker Plant, Panipat.

Major Industries in India

Industry	States and Main Centres of Production
1. Iron and Steel	1. **Tata Iron and Steel Company (TISCO)** — Jamshedpur, Jharkhand 2. **Bhilai Iron and Steel Plant** — Durg, Chhattisgarh. 3. **Rourkela Steel Plant** — Sundargarh, Odisha. 4. **Vishakhapatnam Steel Plant** — Vishakhapatnam, Andhra Pradesh. 5. **Bokaro Steel Plant** — Hazaribagh, Jharkhand. 6. **Durgapur Steel Plant** — Burdwan, West Bengal. 7. **Indian Iron and Steel Company (IISCO)** — IISCO Plants are located at Burnpur, Hirapur and Kulti, near Asansol, West Bengal. 8. **Vishvesvaraya Iron and Steel Limited** — Shimoga, Karnataka. 9. **Vijayanagar Steel Plant** — Bellary, Karnataka. 10. **Salem Steel Plant** — Salem, Tamil Nadu.
2. Petrochemical Industry	1. **Herdillia Chemicals Ltd.** — Chennai, Tamil Nadu. 2. **National Organic Chemicals Industries Ltd.** — Mumbai, Maharashtra. 3. **Petrofils Cooperative Limited (PCL)** — Three plants located at Vadodara and Naldhari in Gujarat. 4. **Indian Petrochemical Corporation Ltd.** — Vadodara, Gujarat. 5. **The Bongaigaon Petrochemicals Ltd.** — Bongaigaon, Assam. 6. **The Reliance Industries:** Hazira, Gujarat. 7. **Haldia Petrochemicals Ltd.:** Haldia, West Bengal. 8. **The Indian Oil Corporation:** Three plants in Gujarat and Panipat.
3. Electronics	1. **The Indian Telephone Industries (ITI)** — Bengaluru, Karnataka; 2. **The Electronics Corporation of India Ltd. (ECIL)** — Hyderabad, Andhra Pradesh; 3. **The Bharat Electronics Ltd. (BEL)** — Bengaluru, Karnataka.
4. Space Technology	1. **The Indian Space Research Organisation (ISRO),** — Bengaluru, Karnataka. 2. **Satellite Launching Station** — Sriharikota, Andhra Pradesh. 3. **National Remote Sensing Agency** — Hyderabad, Andhra Pradesh. 4. **Chandrayaan-I** — India's First Scientific Mission to Moon. 5. **Chandrayaan-II** — India's Second Scientific Mission to Moon.
5. Software Industry	Bengaluru and Hyderabad.
6. Entertainment	Mumbai, Kolkata, Chennai and Pune

EXERCISES

I. Answer the following questions:

Q.1 (a) Which is the largest mineral-based industry in India? Why is it called the backbone of all industries?

(b) What is an integrated steel plant? Give one example.

(c) State any three factors which affect the location of an integrated steel plant.

(d) How is it advantageous for a mini steel plant:

(i) to use electric furnaces; and

(ii) to be located far from the source of the raw material?

Q.2 (a) Name two major steel plants in the Public Sector. Name one steel plants that was set up with Russian collaboration.

(b) What are mini steel plants?

(c) Mention three factors which have helped Jamshedpur to develop into India's major centre of steel production.

(d) Name the steel plant located in Andhra Pradesh. What two advantages this steel plant have over the other steel plants in the public sector?

Q.3 (a) What are petrochemicals?

(b) Why are traditional raw materials being replaced by petrochemical products?

or

Why are petrochemical products growing in popularity?

(c) (i) Name any two products made from petrochemicals.

(ii) Why is a petrochemical industry usually located near an oil refinery?

(d) The electronic industry has made an impact on both media and education. Give reasons to support your answer.

Q.4 (a) Name two industrial towns which are connected with the production of iron and steel.

(b) Mini steel plants cause less pollution than integrated steel plants. Give reasons.

(c) State the difficulties experienced by the iron and steel industry in India.

(d) Give three reasons why the iron and steel industry is concentrated largely in the Chota Nagpur belt.

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Chapter 21 Transport

Syllabus

Transport

Importance and Modes — Roadways, Railways, Airways and Waterways — Advantages and disadvantages.

Transport system is like the arteries and veins in the human body. It helps in connecting one part of the country with the other; it facilitates, the movement of raw materials, fuel, machinery, to the points of production and finished goods to the points of marketing and consumption.

IMPORTANCE

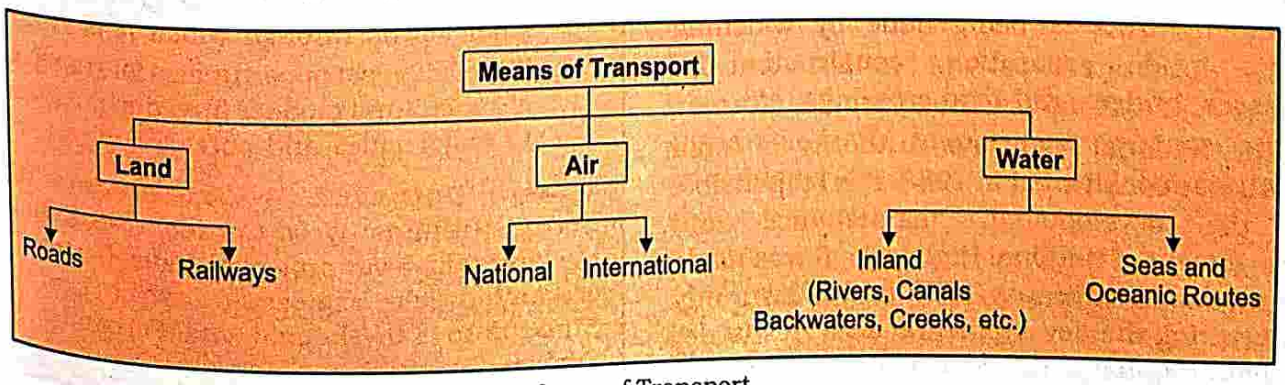
- Transportation helps in the better utilisation of the resources of the backward areas by linking them with the more advanced areas.
- It aids in the process of industrialisation and urbanisation.
- It removes scarcity of goods during any crisis.
- It helps in minimising the effects of natural disasters.
- It brings in homogeneity and National integration in thought and culture through easy movement of people and bringing them in contact with one another.

India, being a vast country, needs an efficient and cheap transport system. It has every mode of modern transport system: by land, air and water.

ROADS

India had paved roads from ancient times as is evident from the ruins of Mohenjo-daro and Harappa. The earlier emperors connected their capitals with other parts of their territories. The Mughal rulers were noted for building roads. Sher Shah Suri built the famous Grand Trunk (GT) road to strengthen and consolidate his empire. This road connected Kolkata and Peshawar. However, road transport in its modern sense was quite limited in India before the Second World War.

After India attained Independence, a 20-year road plan to improve the conditions of roads was initiated in 1961. Since then the road network has expanded manifold in India. According to National Highways Authority of



Means of Transport

Freeways are the highest class of controlled access highways and are designed for high speed vehicular traffic. NHAI has only two freeways in India; Eastern Freeway and Western Freeway (or Coastal Freeway); to reduce traffic congestion in the island city of Mumbai. Only cars and public buses are allowed on these. Bandra Worli Sea Link, a part of Western Freeway, is the longest bridge above water in India.

India (NHAI), India has a huge network of roads, making it the second largest road network in the world. This network, which includes both paved and unpaved roads, is categorised as *National Highways*, *Expressways*, *State Highways*, major *District* roads, *Rural* and *Other* roads. However, about 40 per cent of the villages in India still lack access to all weather roads and remain isolated during the monsoon season.

National Highways

The main roads which are constructed and maintained by the Central Government are known as the *National Highways*. These are main highways running through the length and breadth of the country connecting every major city and are the backbone of road infrastructure. National Highways in India are designated as NH followed by the State highway numbers. The longest NH is NH7 (about 7,770 km).

The National Highways represent only 1.7 per cent of the total network length but they handle about 40 per cent of the total road traffic.

The traffic on National Highways has been growing due to industrialisation in the country. The Government is taking steps to utilise latest technologies and improved management techniques to provide hindrance-free traffic movement. This is being done by widening roads, grade separation, construction of bypasses, bridges, rail-road crossings, *etc.*

The National Highways Authority of India (NHAI) was constituted in 1988. It is responsible for the development, maintenance and management of National Highways. It was made operational in February 1995 and is currently undertaking the developmental activities under *National Highways Development Project* (NHDP) in phases. All the phases combined together are aimed at improvement of more than 25,000 km of arterial routes of National Highway Network to international standards.

Expressways

Expressways constitute the most significant features of land transportation. Expressways are highways planned for high-speed traffic, having few intersections, limited points of access or exit and a divider between lanes for traffic moving in opposite directions. They usually have six to eight lanes. So, the major difference between a Highway and Expressway is the access control. In expressways, roads are not multiples. There is a controlled access where a vehicle can enter through a limited place and no further. But in the case of highways, multiple roads are there which merge with or cross the highways at many places. Besides, the expressways have several facilities like access ramps, lane dividers, telephone booths, CCTV cameras and mobile radars.

Thus, the expressways provide high speed, greater safety, comfort and convenience for both

TWO MAJOR PROJECTS UNDERTAKEN BY NHAI

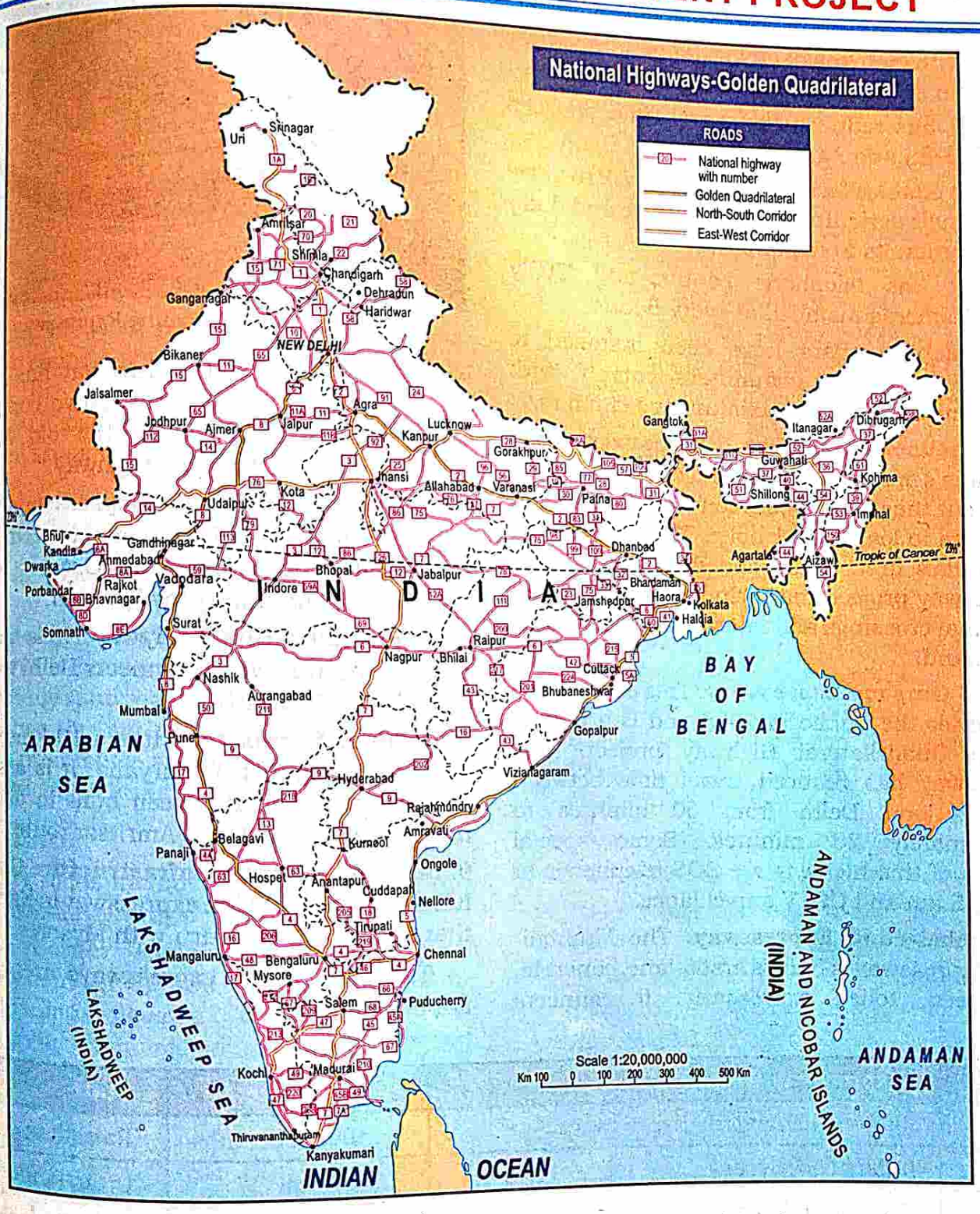
1. Golden Quadrilateral: The Golden Quadrilateral (GQ) is the largest express highway project in India. It connects India's four largest metropolies: Delhi, Mumbai, Kolkata and Chennai and thus, forms a quadrilateral of sorts. Bengaluru, Pune, Ahmedabad and Surat are also served by this network.

The main economic benefits of the Golden Quadrilateral Project are the following:

- This highway interconnects many major cities and ports;
- It provides an impetus to truck transport throughout India;
- It enables the industrial growth of all small towns through which it passes;
- It provides vast opportunities for transport of agricultural produce from the hinterland to major cities and ports for export.

2. North-South and East-West Corridors: The North-South-East-West Corridor (NS-EW) is the largest highway project in India. It consists of four/six lane expressways which connect Srinagar to Kanyakumari and Porbandar to Silchar.

NATIONAL HIGHWAYS DEVELOPMENT PROJECT



the drivers and passengers and lower vehicle operating costs. The major Expressways of India are the following:

1. **Agra-Lucknow Expressway:** It is a six-lane expressway built to reduce traffic in already congested roads and to reduce pollution. It has increased connectivity of towns and commercial centres north of the Yamuna.

The expressway has cut down the travel time between Agra and Lucknow to just 3.5 hours, from the 7 hours earlier. The Expressway has automatic traffic management systems aimed at reducing road accidents and helping even at the time of fog.

2. **Yamuna Expressway:** It is a six-lane, controlled-access expressway which connects Greater Noida with Agra. It was formally inaugurated in 2012. The main features

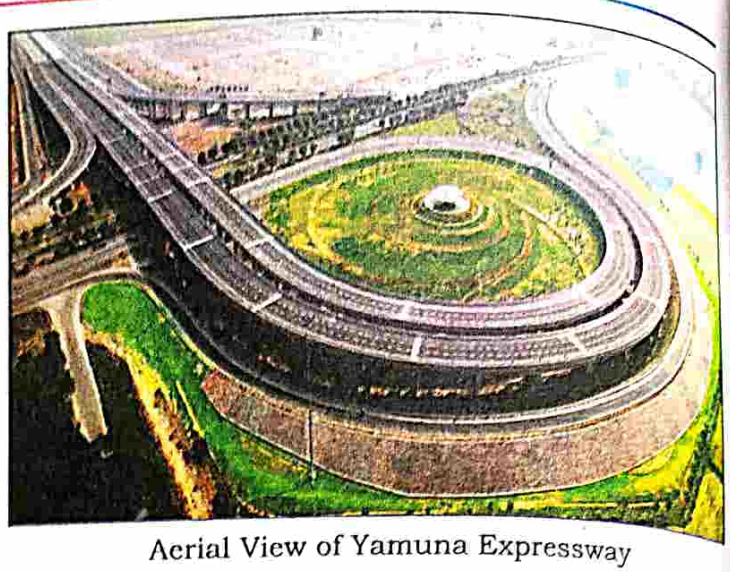
of Yamuna Expressway are the following:

- It provides a fast moving corridor to minimise the travel time and connects with main townships/commercial centres on the eastern side of Yamuna river.
- It has reduced the travel time between Delhi and Agra to two hours.
- It enables farmers in Western UP to move their agricultural, horticulture and dairy products to major cities.
- It has telephone booths and CCTV cameras installed at every 5 kms.
- Mobile radars have been installed to ensure that commuters comply with minimum and maximum speed limits.

3. **Ahmedabad-Vadodara Expressway:** This was India's first expressway that opened in 2001. It has cut the journey between Ahmedabad and Vadodara to less than 1 hour. This expressway was India's first 4-lane and dual carriageway expressway project and includes minor bridges and canal crossings and interchanges at Nadiad and Anand.

4. **Delhi-Gurgaon Expressway:** This expressway opened for the public in 2008 and is a part of Golden Quadrilateral Highway project. This expressway has reduced travel time between Gurgaon and Delhi from 60 minutes to approximately 20 minutes. Some special features of this highway are SOS telephones at every 1.5 km and CCTV surveillance.

5. **Mumbai-Pune Expressway:** The Mumbai-Pune Expressway is India's first 6-lane, concrete, high-speed, tolled expressway. It connects Mumbai with Pune. This highway has reduced the travel time between these two commercial cities from 4-5 hours on the old NH4, to 2-3 hours on the Express Highway.



Aerial View of Yamuna Expressway

6. **Noida-Greater Noida Expressway:** It is a six-lane highway which connects Noida, an industrial suburb area with Greater Noida a new suburb, both in Uttar Pradesh.

7. **Delhi-Noida Direct Flyway:** It is an eight-lane expressway which connects Delhi to Noida, an industrial suburb.

8. **Panipat Expressway:** It is a 10-km elevated highway at Panipat in Haryana. It is a six-lane expressway which has been built to decongest traffic on the busy Delhi-Amritsar route.

9. **Bengaluru-Mysore Infrastructure Corridor:** It is a 4 to 6 lane 111 km expressway in Karnataka that connects Bengaluru with Mysore.

The other major expressways are given in the table below:

S.No.	Expressway Name	Distance	State
1.	Jaipur-Kishangarh Expressway	90 km	Rajasthan
2.	Allahabad Bypass	86 km	Uttar Pradesh
3.	Durgapur Expressway	65 km	West Bengal
4.	Chennai Bypass	32 km	Tamil Nadu
5.	P V Narasimha Rao Elevated Expressway	11.6 km	Telangana
6.	Hosur Road Elevated Expressway	9.9 km	Karnataka
7.	Kona Expressway	08 km	West Bengal
8.	Nehru Outer Ring Road (Hyderabad)	158 km	Telangana
9.	Raipur-Bhilai-Durg Expressway	26 km	Chhattisgarh

State Highways

The State Highways are constructed and maintained by the State governments. These highways provide linkages with the National Highways, district headquarters, important towns, tourist centres and minor ports within the state. Besides, these arterial routes provide connectivity to important towns and cities as well as with National Highways or State Highways of the neighbouring states.

District Roads

These are important roads within a district connecting areas of production with markets. They also connect small towns with one another or with the State Highways and National Highways. It also connects Taluka headquarters and rural areas to District headquarters within the state.

Rural Roads

The rural roads in India form a substantial portion of the road network. These roads constitute about 80 per cent of the total road length in the country. Most of the rural roads were initially sand roads. They provide vital links by moving the agricultural produce and the finished products of small-scale industries from the producing centres to the marketing centres.

Other Roads

The other roads include the Border Roads and International Highways.

The Border Roads: The Border Road Organisation (BRO) was set up in 1960 for strengthening defence preparedness and accelerating economic development through improvement of roads along the northern and north-eastern boundary of the country. This organisation has constructed the world's highest road from Manali (Himachal Pradesh) to Leh (in Ladakh), at an average altitude of 4,270 metres. Apart from the construction and maintenance of roads in strategically sensitive areas, the BRO undertakes snow clearance in high altitude areas and construction of airfields, buildings and permanent bridges.

Class	Length in km
National Highways	96,260.72
State Highways	131,899
Other roads	30,71841
Total (approx)	**33 Lakh km**

Indian Road Network

Advantages of Roadways

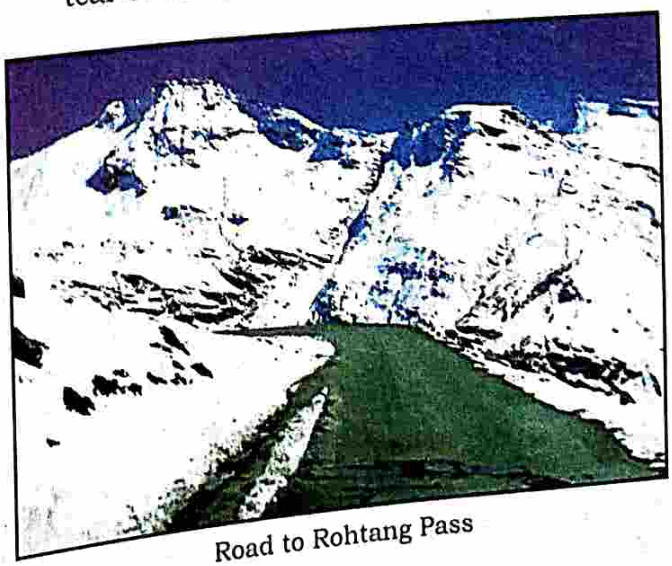
Roadways are the harbingers of economic development. The main advantages of using road transport are the following:

- It is through the roads that every village and hamlet can be reached.
- Construction cost of roads is much lower than that of the railway line.
- Roads can be constructed even in the areas of difficult terrain and where railway lines do not exist.
- Roads offer door to door service and thereby, reduce the cost of loading and unloading. Roads also help farmers to move their perishable products quickly to the markets.
- The movement of goods is safer through road transport as the chances of pilferage are lesser than in the railways.
- Road transport supplements the other modes of transportation. It provides link between railway stations and ports and their hinterlands.

Disadvantages of Roadways

Road transport has the following disadvantages:

- Many roads are unsurfaced and therefore, not suitable for regular vehicular traffic.
- Roads are not properly maintained. Poor road surfaces cause heavy loss in wear and tear of vehicles.



Road to Rohtang Pass

- There are multiple check-posts, toll tax and octroi duties collection points on the roads which bring down the speed of the traffic, waste time and cause irritation to the commuters.
- Many roads have inadequate capacity, weak pavement, unbridged level crossings and lack of wayside amenities and safety measures.
- The traffic on Indian roads, especially in cities, is too high. Further, same road is used by all types of vehicles — high speed cars, trucks, two-wheelers, animal driven carts, cyclists and even by animals. This increases traffic time and causes congestion, pollution and road accidents.

RAILWAYS

The Railways constitute the principal mode of transportation for freight and passengers. It brings together people from the farthest corners of the country for conducting business, sightseeing, pilgrimage, education, *etc.*

Railways were first introduced to India in 1853 when a line was constructed from Mumbai to Thane covering a distance of 34 km. Since then Indian Railways have grown into a vast network. By 1947, the year of India's independence, there were forty two rail systems. In 1951 the systems were nationalised as one unit, becoming one of the largest networks in the world. Indian Railways operate both long distance and suburban rail systems.

At present, it is one of the largest and busiest rail networks in the world, transporting over 18 million passengers and more than 2 million tonnes of freight daily. It is the world's largest employer, with more than 1.4 million employees. The railways traverse the length and breadth of the country, covering 7,137 stations over a total route length of more than 66,030 kilometres.

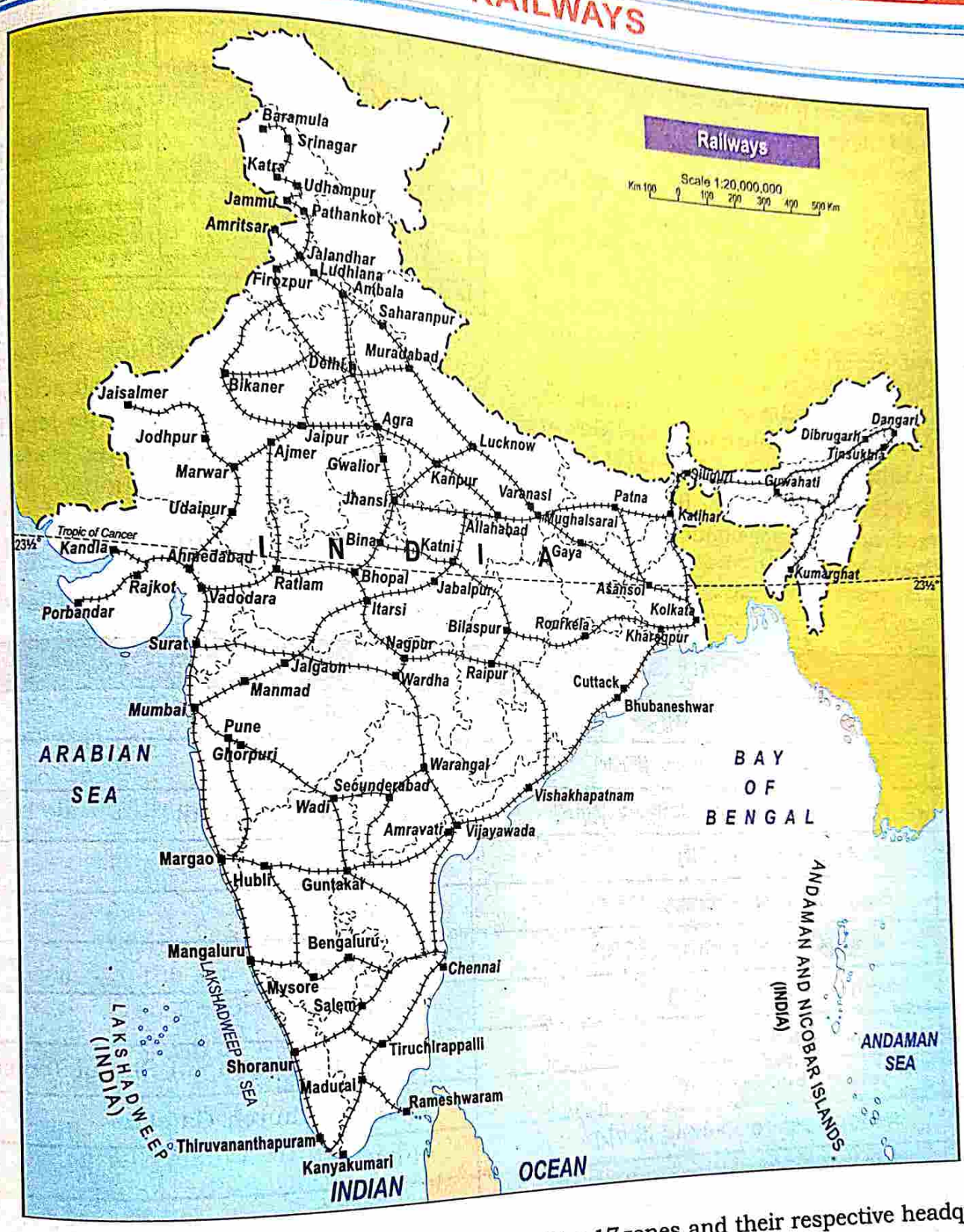
Many cities have their own suburban networks to cater to commuters. Currently, suburban networks operate in Mumbai, Chennai, Kolkata, Delhi, Hyderabad, Pune and Lucknow. The last three cities do not have suburban tracks but share the tracks with long distance trains. New Delhi, Kolkata, Chennai and Mumbai have their own Metro networks.

Suburban trains that handle commuter traffic are mostly *Electric Multiple Units* (EMUs). They usually have nine coaches or sometimes twelve to handle rush hour traffic.

Indian Railways carry a huge variety of goods ranging from mineral ores, fertilizers, petro-chemicals, agricultural produce, iron and steel. Ports and major urban areas have their own

Indian Railways

INDIA—RAILWAYS



freight lines. Thus, railways help in accelerating the development of industry and agriculture.

The growth of Indian Railways in the past 150 years has been phenomenal. Its huge size has put pressure on the centralised management system. Therefore, to ease this pressure, the railway system has been divided into 17 zones. These divisions are the basic operating units. The 17 zones and their respective headquarters are given on Page No. 236.

Track System

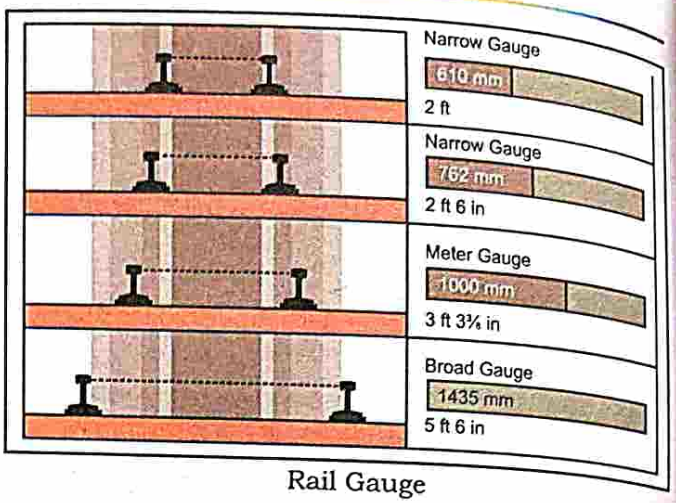
Based on the width of the track, the Indian Railways are divided into three categories:

Broad Gauge: The distance between rails is 1.676 metre. The total route length of broad gauge accounts for about 85 per cent of the total length

of rail route in the country. Almost all the main routes are broad gauge. Broad gauge system links major ports of India with the interior towns and industrial centres and handles 85 per cent of the total goods traffic in terms of tonnes-km. It is also called India gauge.

Broad gauge railway line on the west coastal lowland known as the *Konkan Railway Line*, is an engineering marvel of the Indian Railways. It is 760 km long rail route connecting Roha in Maharashtra to Mangalore in Karnataka. It crosses 146 rivers, streams, nearly 2000 bridges and 91 tunnels. It also passes through 6.5 km long tunnel which is Asia's largest tunnel. The States of Maharashtra, Karnataka and Goa are partners in this project.

Metre Gauge: The distance between rails is one metre. It accounts for about 11 per cent of the total route length.



Rail Gauge

Narrow Gauge: The distance between rails is 0.762 metre and 0.610 metre. It accounts for about 4 per cent of the total route length. It is mainly confined to the hilly areas.

Advantages of Railways

- Railways constitute one of the most

RAILWAY ZONES

S.No.	Name	Headquarters
1.	Northern Railway (NR)	New Delhi
2.	North Eastern Railway (NER)	Gorakhpur
3.	Northeast Frontier Railway (NFR)	Maligaon (Guwahati)
4.	Eastern Railway (ER)	Kolkata
5.	South Eastern Railway (SER)	Kolkata
6.	South Central Railway (SCR)	Secunderabad
7.	Southern Railway (SR)	Chennai
8.	Central Railway (CR)	Mumbai (Chhatrapati Shivaji Terminus)
9.	Western Railway (WR)	Mumbai (Church Gate)
10.	South Western Railway (SWR)	Hubli
11.	North Western Railway (NWR)	Jaipur
12.	West Central Railway (WCR)	Jabalpur
13.	North Central Railway (NCR)	Allahabad
14.	South East Central Railway (SECR)	Bilaspur (Chhattisgarh)
15.	East Coast Railway (ECoR)	Bhubaneshwar
16.	East Central Railway (ECR)	Hajipur
17.	Kolkata Metro	Kolkata

efficient and cost-effective forms of transportation. Railways help in the easy movement of bulky goods and perishable commodities to distant places.

- Railways transport raw materials to the production units and finished goods to the markets.
- Railways have brought the villages closer to the cities and have helped to transfer new ideas and innovations to the rural areas.
- Railways help in reducing sufferings during natural calamities.
- Railways act as an integrating force, knitting the whole country into one whole with its huge network running throughout the country.
- Railways facilitate easy movement of police, troops and defence equipment.
- Railways provide comfortable journey as the trains have enough space to stretch legs and move in the corridors. At night, one can sleep comfortably on the berths provided in the trains.
- Rail travel is safer and comfortable for families with babies and elders.

Disadvantages of Railways

- Rail transport lacks flexibility of routes. Train tracks cannot be laid in every region of the country like in the hilly areas or remote forested areas.
- Train travel can be very long and tedious, especially when compared to air travel.
- Train tracks cannot be laid in every industrial region and trains have to travel to a station, where the cargo is loaded from one form of transportation to another. Most industrial locations have roads leading to them, but not all of them have train tracks leading to them.
- The trains which run on coal produce lot of air and noise pollution.
- Trains cannot cross the oceans. They are limited to land travel and cannot normally haul products from one continent to another.

AIR TRANSPORT

Air transport in India started with a 10-km airmail operation between Allahabad and Naini in 1911. However, air transport made its progress only after India attained Independence. At present, India has both domestic and international airlines. They carry passengers, freight and mail.

The Airports Authority of India came into existence on April 1, 1995 with the merger of the then two authorities — National Airports Authority and International Airports Authority of India. It is the nodal agency responsible for creating, upgrading, maintaining and managing civil aviation infrastructure and providing safe, efficient Air Traffic Services and aeronautical communication services in the country.

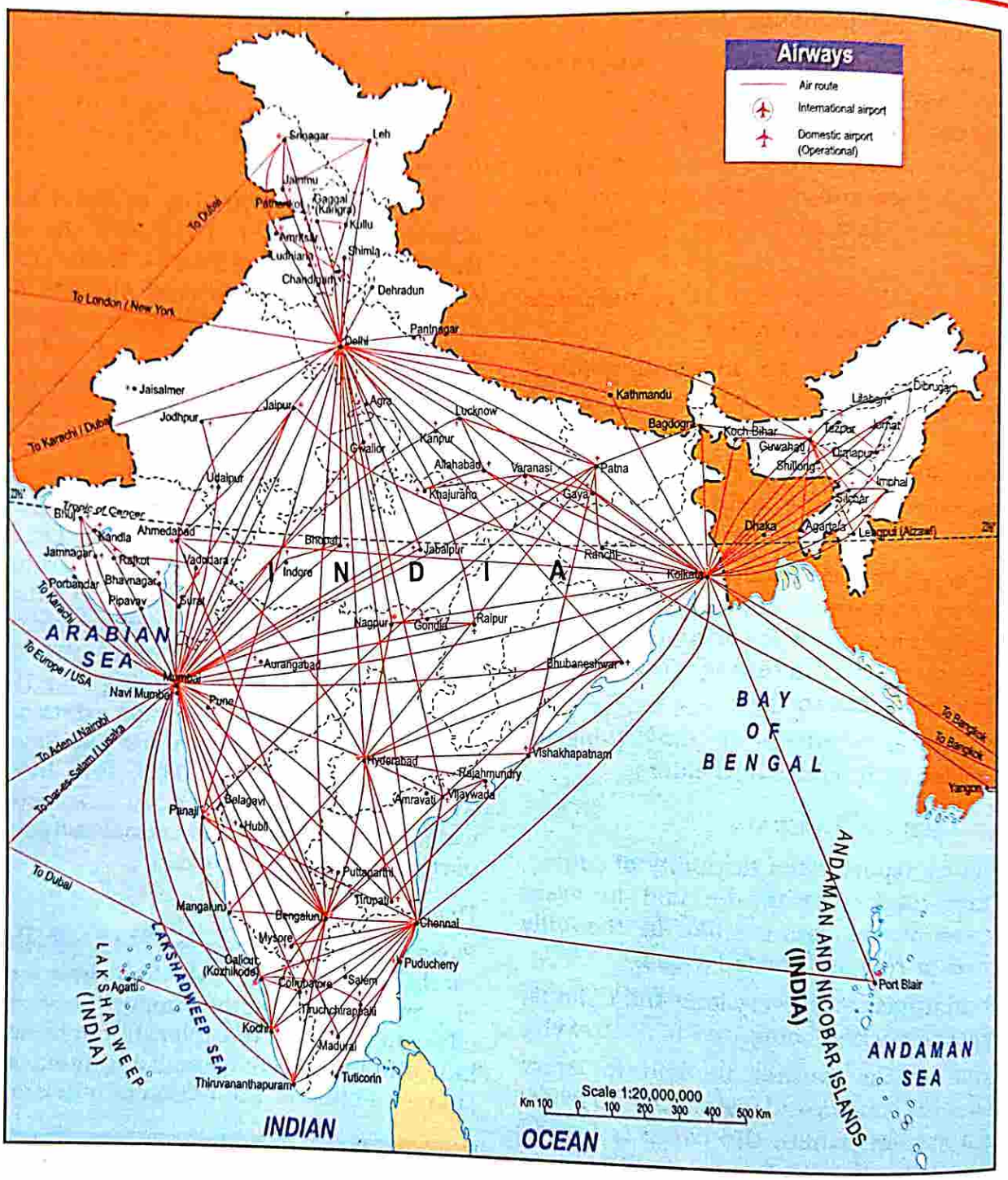
The air transport in India was managed by two corporations — Air India and Indian Airlines. However, the two entities, *i.e.*, Air India and Indian Airlines were merged into one in 2007 and is called *Air India*. With this merger, Air India has become the 16th largest airline in Asia, serving 50 domestic destinations and 39 international routes and serving over 100 cities. Apart from Air India there also exists a number of private scheduled operators, like Spicejet Ltd, Go Airlines (India) Pvt. Ltd., and Inter Globe Aviation Ltd. (Indigo) and Vistara, providing a wide choice of flights and connectivity to various parts of India and abroad.

Pawan Hans

Pawan Hans Helicopters Ltd. (PHHL) was established in 1985 with the primary objective of providing helicopter support services to the oil sector in offshore exploration, operate in the hilly and inaccessible areas and make available charter flights for promotion of tourism.

Indian Airlines A320 Airbus

INDIA—AIR ROUTES



Advantages of Airways

- Air transport is particularly significant for a country like India in which owing to her vast size long distances have to be covered between important cities.
- It is the fastest and comfortable mode of transport. It connects the far flung and remote areas of the country.
- The speed and ease with which aeroplanes can cross mountain barriers, sandy deserts, large expanses of water or forests make the air transport indispensable.
- Air transport is of particular importance during natural calamities. It is used to air-lift people from the affected areas and to air-drop food, medicines and other

necessary things to calamity affected people.

Disadvantages of Airways

- Air transport is costly.
- It depends on weather conditions. Flights are often delayed due to bad weather.
- Air transport is run on petroleum which is a non-renewable source of energy.
- Air transport can carry small tonnage but it has high freight charges.

WATER TRANSPORT

India is endowed with an extensive network of waterways in the form of rivers, canals, backwaters, creeks and a long coastline accessible through the seas and the oceans. Water transport can be divided into two categories— (a) Inland Waterways and (b) Oceanic Waterways.

Inland Waterways

Inland waterways include rivers, canals, backwaters and creeks which are deep enough to allow the ships and boats to navigate safely. These waterways must also be free of barriers such as waterfalls and rapids. However, the rivers of Peninsular India are not ideal for navigation. First, these rivers are seasonal as they are rain-fed. Second, these rivers are comparatively shorter than the rivers of northern India. Third, these rivers are marked by a number of waterfalls.

India has 14,500 km of navigable waterways out of which about 3700 km of river and 4300 km of canals are navigable by mechanised flat bottom vessels. Freight transportation by waterways is highly underutilised in India compared to other large countries like United States, China and European Union. Cargo transportation in an organised manner is confined to a few waterways in Goa, West Bengal, Assam and Kerala. Inland Waterways Authority of India (IWAI) is the statutory authority in charge of the waterways in India. It does the function of building the necessary infrastructure in these waterways, surveying the economic feasibility of new projects and also administration and regulation. According to the Inland Waterways Authority there are six inland waterways called National Waterways. These are:

1. **National Waterway No. 1 (NW-1):** It comprises Ganga-Bhagirathi-Hooghly River System which connects Haldia-Kolkata-Farakka-Munger-Patna-Varanasi-Allahabad.

   It stretches to more than 1620 kms of potentially navigable waterways. It is navigable by mechanised boats up to Patna and by ordinary boats up to Haridwar.
2. **National Waterway No. 2 (NW-2):** The river Brahmaputra connecting Dhubri-Pandu (Guwahati)-Tezpur-Neamati-Dibrugarh-Sadiya stretching to about 891 kms was declared a National Waterway in 1988. The NW-2 connects the North East region with Kolkata and Haldia ports through Bangladesh and Sunderbans waterways.
3. **National Waterway No. 3 (NW-3):** It runs from Kollam to Kottapuram. It comprises 168 km of west coast canal along with Champakara canal and Udyogmandal canal. It was declared a National Waterway in 1993. It is one of the most navigable and tourism potential area in India and has much to offer to the potential tourists.
4. **National Waterway No. 4 (NW-4):** It connects the States of Andhra Pradesh, Tamil Nadu and the Union Territory of Puducherry. It comprises Kakinada-Puducherry stretch of Canals and Kalurelly Tank, stretches of river Godavari and Krishna (1028 km).

The river Ganga is navigable from its mouth right upto Allahabad because:

(i) Ganga is a perennial river fed by monsoon rains in the rainy season and melting of snow on the lofty mountains during dry season.

(ii) It is joined by Yamuna, Son, Ramaganga, Gomti, Ghagra, Gandak and Kosi which increase the depth of water in Ganga, which is more than 10 metres up to Allahabad.

(iii) The slope of the Ganga is gradual and the river bed is free from stones and silt.

5. **National Waterway No. 5 (NW-5):** It comprises Talcher-Dhamra stretch of river Brahmani, Geonkhali-Charbatia stretch of East Coast Canal, Charbatia-Dhamra stretch of Matai river along with Mahanadi delta river system (585 km). It was declared a National Waterway in 2008.
6. **National Waterway No. 16 (NW-16):** It is a waterway between Lakhipur and Bhanga of the Barak River. It integrates the waterways in the northeast and helps cargo transport through Assam, Nagaland, Mizoram, Manipur, Tripura and Arunachal Pradesh.

Oceanic Waterways

India has a long coastline of 7,517 kilometres forming one of the biggest peninsulas in the world. It has 12 Major ports and 187 notified Minor and Intermediate ports.

Oceanic waterways constitute an important role in the transport sector of India's economy. Ocean routes handle 95 per cent of India's foreign trade by volume and about 70 per cent by value. Besides international trade, these routes are also used for transportation between the islands and the rest of the country.

Ports

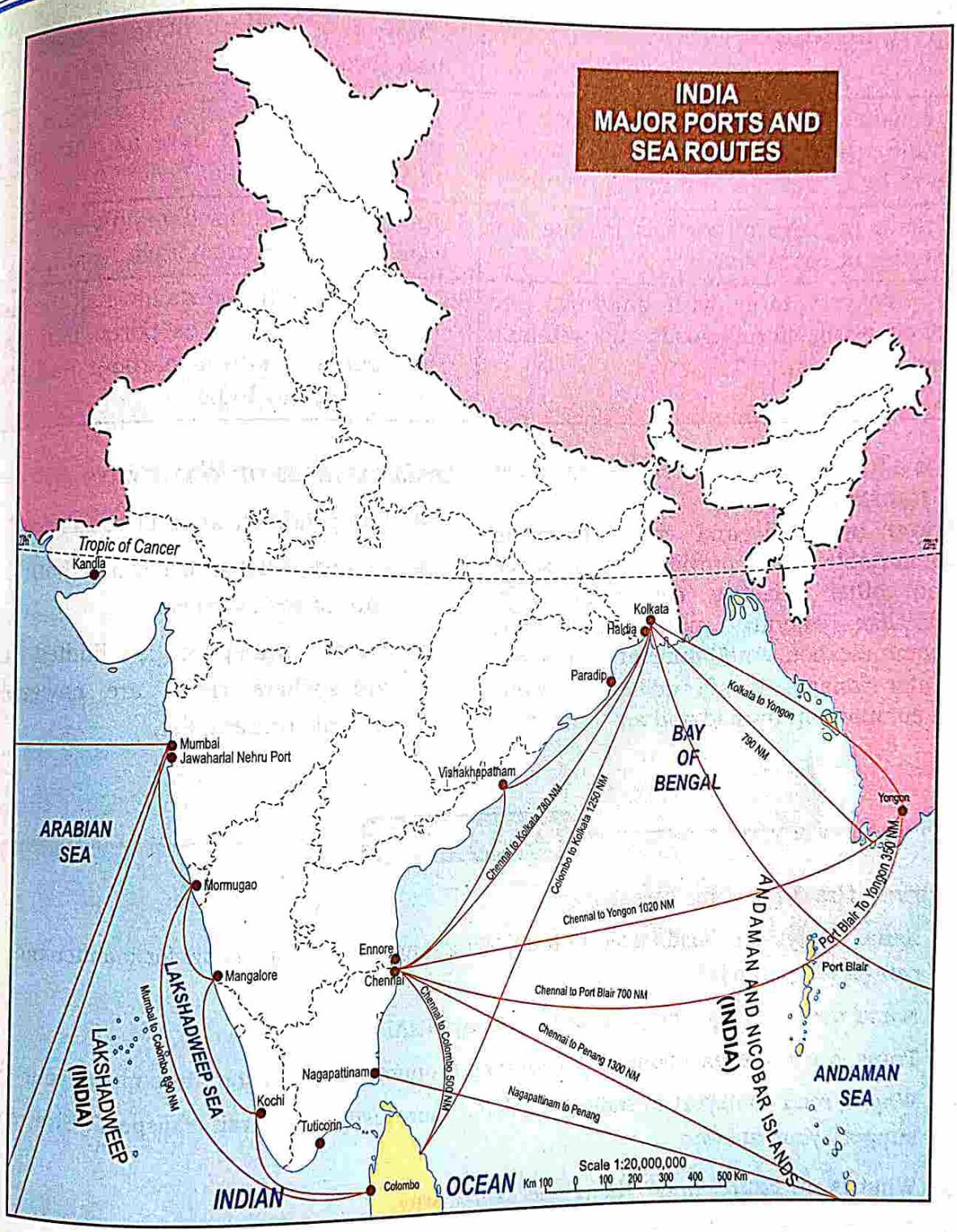
Major ports handle over 80% of all cargo traffic. These ports have been classified into Major, Minor and Intermediate type.

Major Ports

1. **Kolkata (West Bengal):** It is a riverine port located on the bank of the Hooghly River. It handles diversified commodities, coming from S.E. Asian countries, Australia and New Zealand.
2. **Haldia (West Bengal):** This port has been developed on the river Hooghly to relieve pressure on Kolkata.
3. **Paradip (Odisha):** It is located on the coast of Odisha and handles iron ore and coal.
4. **Vishakhapatnam (Andhra Pradesh):** It is India's deepest landlocked port handling crude oil and petroleum products.
5. **Chennai (Tamil Nadu):** It is the second largest port in terms of volume of traffic handled and is the oldest artificial harbour on the east coast of India. It handles petroleum products, crude oil, fertilisers, iron ore and dry cargo.
6. **Tuticorin (Tamil Nadu):** This port is located on the east coast of India. It handles mainly coal, salt, edible oil, dry cargo and petroleum products.
7. **Kandla (Gujarat):** It is a Tidal port and a free trade zone located at the eastern end of Rann of Kutch. It handles crude oil, petroleum products, edible oil, food grains, salt, cotton, *etc.*
8. **Mumbai (Maharashtra):** It is a natural harbour on the west coast and is also the biggest port of India. It handles maximum traffic (over the fifth of total traffic of ports) which include mineral oil and dry cargo.
9. **Jawaharlal Nehru (Nava Sheva) Port near Mumbai:** It is the biggest ultra-modern seaport off Mumbai. It is equipped with modern facilities having mechanised container berths for handling dry cargo and service berths.
10. **Mormugao (Goa):** It is a natural harbour, situated at the entrance of the Zuari estuary, in Goa. It occupies fifth position in terms of total traffic handled.
11. **New Mangalore (Karnataka):** It is located on the west coast of India. It handles the export of iron ore of Kudremukh and imports of petroleum products, fertilisers, edible oils, *etc.*

Passenger Cruiseliner

INDIA—MAJOR PORTS



12. **Kochi (Kerala):** It is a natural harbour. It handles the export of tea, coffee and spices and imports of petroleum oil and fertilizers.
13. **Ennore Port:** It is located about 24 km north of Chennai Port. It is the first port in India which is a public company. It is a corporate entity (Ennore Port Ltd.) and not a Port Trust like other major ports of India. It is a satellite port meant to decongest and improve the environmental quality at the busy Chennai Port.

Advantages of Waterways

- It is the cheapest means of transport.
- It is most suitable for carrying heavy and bulky material.

Difference between a Port and a Harbour

Port	Harbour
1. Ports are man-made commercial places built along the coastline.	1. Harbours are natural or created places, connecting a piece of land with a large waterbody, which serve as ports.
2. The location of ports is chosen along the coastline where water is navigable and is close to land facilities and infrastructure.	2. Natural harbours are surrounded by land on most sides but have an entrance point to the sea.
3. The main purpose of ports is loading and unloading of cargo ships.	3. Harbours are utilised mainly for providing safe parking or anchorage to ships.
4. Ports are very large with buildings and warehouses for storing goods and well-built transport system.	4. When natural harbours have all the facilities of ports they serve as ports. For example, Mumbai is a natural harbour and also the biggest port in India.

- It is a fuel-efficient and eco-friendly mode of transport.
- Travel by ships and cruise liners is comfortable as it provides lot of space and other facilities concerning daily life like catering, medicines, doctors, communication, entertainment, sports, *etc.*
- Water transport is safe and has less traffic in comparison to road and air transport.

Disadvantages of Waterways

- It depends on weather conditions.
- It needs long travelling hours which causes sea sickness.
- Water transport is limited to the areas where rivers are navigable and oceanic routes exist.

EXERCISES

I. Answer the following questions:

Q.1 (a) Name the types of roads used in India. Which agency is responsible for maintenance of each category separately?

(b) Name the two major projects developed by NHAI.

(c) Transport is the backbone of a country's economy. Give reasons to support your answer.

(d) Why is road transport in India considered more useful than rail transport? Give reasons to support your answer.

Q.2 (a) What is an Expressway? Name one expressway.

(b) Give two points of difference between Highways and Expressways.

(c) Give two advantages and one disadvantage of railways.

(d) Mention any three problems being faced by the Indian Railways.

Q.3 (a) What are National Highways?

(b) What is the Golden Quadrilateral Project?

(c) Give three economic benefits of the Golden Quadrilateral Project.

(d) Give three points to explain the role of roads in the economic development of the country.

Q.4 (a) What is the significance of an efficient transport system?

(b) Name the types of gauges of railways used in India.

(c) How is the Indian rail network one of the largest and busiest networks in the world?

(d) Give a geographical reason for each of the following:

(i) Railways bind the economic and cultural life of the country.

(ii) Railways are not common in North East India.

(iii) North India is better suited for railways and roadways.

Q.5 (a) Name the regulatory body looking after air transport in India. State any two of its functions.

(b) Discuss the contribution of Air India in the air transport of India.

(c) List two advantages and one disadvantage of air transport in India.

(d) Give two advantages and one disadvantage of helicopter services over aeroplane services.

Q.6 (a) Explain why India has an extensive network of waterways.

(b) Explain the role of oceanic waterways in the transport sector of India's economy.

(c) Give two advantages and one disadvantage of water transport.

(d) Give a geographical reason for each of the following:

(i) The Ganga is navigable from its mouth right upto Allahabad.

(ii) The Peninsular rivers are not ideal for inland water transport.

(iii) Mumbai is a harbour and a port.

Q.7 (a) What are the two prerequisites of waterways to be navigable?

(b) Give two points of difference between Inland Waterways and Oceanic Waterways.

(c) (i) Give two points of difference between a Port and a Harbour.

(ii) On which river and between which two places does the National Waterway No.2 lie?

(d) Give a geographical reason for each of the following:

(i) Nearly 70 per cent of Indians do not use air transport.

(ii) A well-developed transport network is important for industrial progress.

(iii) Airways are quite useful during natural calamity.

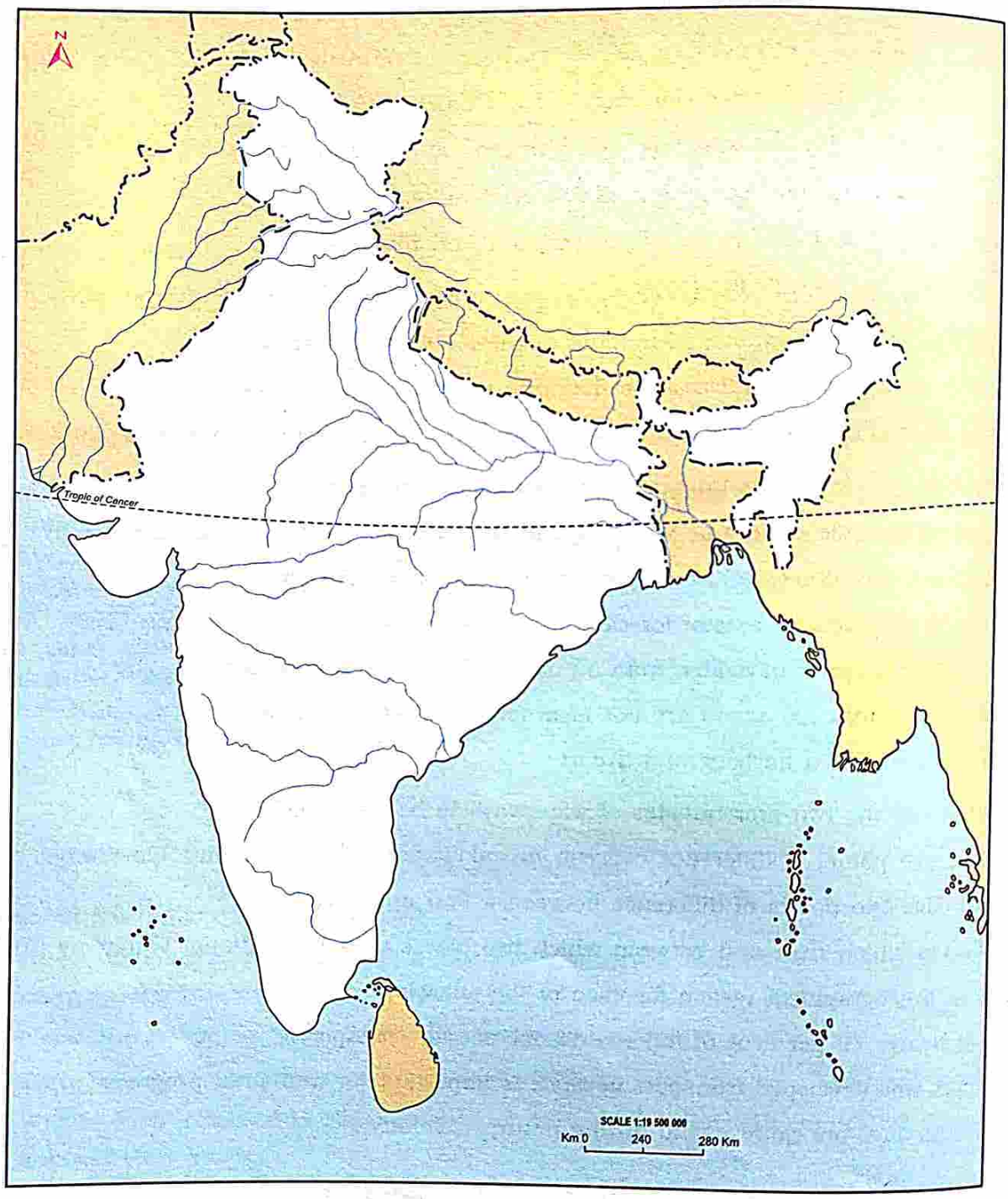
II. Map Work

On the outline map of India mark the following:

(a) The four metropolitan cities connected by the Golden Quadrilateral.

(b) One National and one International Airport.

(c) (i) Tidal port; (ii) Riverine port; (iii) Biggest ultra-modern port.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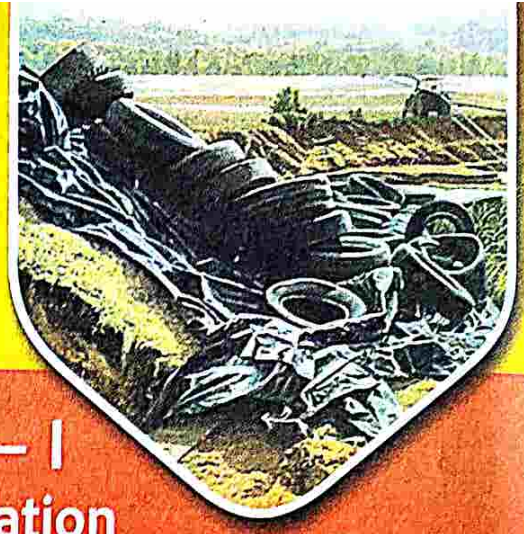


Chapter 22 Waste Management — I
Impact of Waste Accumulation

Syllabus

Waste Management

Impact of waste accumulation—spoilage of landscape, pollution, health hazards, effect on terrestrial, aquatic (fresh water and marine) life.

Waste is a general term used to describe any material that is discarded because it has served its purpose and is no longer useful. Waste can also be any material that remains at the end of a process and has no further use and so it is thrown away.

In modern times waste is being generated at an alarming rate both in complexity and quantity.

As our knowledge of science and technology increases, we continue to exploit natural resources for our own benefit. In this process, the amount of waste we produce also increases.

SOURCES OF WASTE

Depending on their source of origin, wastes are classified into the following broad categories:

1. Domestic Waste

Wastes generated due to domestic activities are called domestic waste. Food leftovers, fruits and vegetable peels, bits of paper, packets, polythene bags, bottles, small metal and aluminium cans, scrap metal, glass pieces, cotton, rags, discarded clothes, ashes from burning coal, sewage from toilets, batteries, expired medicines, chemicals, etc., are some of the examples of domestic wastes.

2. Industrial Waste

Wastes from various types of small and large scale industries are called industrial wastes. Industrial wastes include any material that is rendered useless during or left over in a manufacturing process. For example, a textile industry generates toxic wastes in the form of chemicals used for dyeing, synthetic fibres, etc. Industrial wastes include chemicals (lead, mercury, arsenic, etc) paints, sand, paper, paper products, fly ash, industrial by-products, metals, etc.

Industry uses a great deal of energy that produces waste gases and other materials. Sulphur dioxide, nitrogen oxides emitted from power stations cause health hazards because of their link with acid rain.

3. Agricultural Waste

Agricultural wastes mainly include crop residue, husks and straws, wood waste, sawdust, molasses, tobacco waste, coconut waste products, rubber waste, nut shells, fruit and vegetable peels, manure, etc. Most of the agricultural waste is recycled, used for gobar gas and as manure.

Agricultural wastes can cause environmental problems, if they are not disposed of properly. They become breeding ground for harmful insects and rodents. Burning of wheat or rice stubble gives rise to smoke which pollutes the environment. The waste spread along the roads or near the residential houses has a nuisance value.

4. Commercial Waste

Wastes from commercial houses, stores, godowns, hospitals and offices are known as

commercial wastes. These wastes co...aste paper, torn out gunny bags, w...e pa...g materials like straw, broken cr...kery, glass, food wastes, packing mate...s, wood pieces and cans. Hospital waste ...mprises syringes, needles, plastic bottles, bandage, gloves and dead human tissues.

5. Construction Waste

Wastes generated at construction sites, mainly due to demolition and construction rubble is called construction waste. It includes bricks, pipes, plastic, roofing, and insulating materials, asbestos pieces, etc.

6. Mining Waste

Wastes generated during mining operations, excavations, etc. are called mining wastes. They include tailings, slag heaps, debris, etc. Some mining processes use large volumes of chemicals or liquids, which add to the waste generated. These can be toxic or hazardous.

The *use and throw* concept, i.e., the practice of discarding things after using them once, is one of the significant reasons for waste accumulation. One can see heaps of solid wastes accumulated in street corners, around hospitals, school backyards and even near water bodies. Dumping of solid wastes not only gives an ugly look and foul smell, but also causes serious health hazards. Sometimes, the outbreak of epidemics takes place due to the accumulation of wastes, particularly near water bodies.

During rains, rainwater may take the decomposed waste along with pathogens (disease causing germs) to our wate...bodies (rivers, ponds, wells, *etc.*) and cause ...er pollutio... All this leads to outbreak of ep...mics ...nd other health hazards.

7. Electronic Waste or E-Was...

Electronic waste refers to va...us forms ...f electric and electronic equip...ent that have ceased to be of any value to its users because they have exhausted their utility value due to redundancy, replacement or breakage. These include refrigerators, televisions, washing machines, microwaves, computers and mobile phones. With advancement in Information Technology, new electronic goods are being produced at a fast rate and this results in an increase in volume of obsolete electronic products. In fact, e-waste is one of the fastest growing waste, constituting more than five per cent of all municipal solid waste.

E-waste is valuable as a source for secondary raw material but hazardous if treated and discarded improperly. Uncontrolled burning and disposal of e-waste cause environmental problems. It is of concern largely due to the toxicity of some of the substances like lead, mercury, cadmium, etc. A computer monitor may contain more than six per cent lead by weight. Up to 36 separate chemical elements are incorporated into e-waste items.

E-waste presents difficulties for recycling due to the complexity of each item and lack of viable recycling systems. Many of the plastics used in electronic equipment contain flame retardants. These are generally halogens added to the plastic resin, which make it difficult to recycle plastic.

8. Toxic and Non-Toxic Waste

Certain wastes are classified as toxic wastes because they pose a serious threat to human health and the environment. These wastes result from industrial processes and products. They also include chemicals used in modern agriculture and medical waste from hospitals. The use of chemicals has increased causing health hazards to living beings. They produce toxic wastes during their manufacture. If allowed into the environment, these toxic wastes can contaminate soil, pollute water and enter the food chain, harming plants, animals and human beings. Most of the pesticides sprayed on the crops fall on the soil as waste and enter the local water supply system when this soil drains away into the rivers and lakes.

Some of the commercial toxic wastes are arsenic, cyanide, lead, cadmium, nickel, beryllium, uranium and mercury and their compounds, chlorinated solvents, asbestos, photographic wastes, plating sludges, pesticide residues, waste paints and lubricants. Burning produces oxides of sulphur and nitrogen which become toxic at high concentration.

Some of the solid wastes are generated due to domestic activities such as food-leftovers,

fruit and vegetable peelings, bits of paper and other rubbish often stored in dustbins. The waste produced by shops, offices, restaurants and schools do not pose a serious problem to the animals, plants or to the environment. Such wastes are called *Non-toxic Wastes.*

Non-toxic wastes are mostly biodegradable and after decomposition become a part of nature.

SPOILAGE OF LANDSCAPE

Spoilage of landscape refers to the accumulation of heaps of garbage and waste that is simply dumped onto vacant land and left to decompose. Open dumps not only ruin the natural beauty of the land but also provide a home to rats and other disease carrying organisms. Both open dumps and landfills may contain poisonous substances that seep into the groundwater or flow into streams and lakes. These open dumps not only emanate foul smell but also spoil the visual appeal of a place.

POLLUTION

The word 'pollute' means to degrade or to contaminate. Pollution is thus, an unfavourable modification of the natural world caused entirely or partly due to direct or indirect actions of human beings.

Pollution is caused by human activities like addition of toxic chemicals through the atmosphere into the biosphere. It is also caused by other substances which may not be particularly dangerous to the organisms directly, but have adverse influence on the environment.

Effects of Toxic Particulate Materials

1. **Lead:** Affects blood system, causes behavioural disorders and can also cause death.
2. **Cadmium:** Causes cardiovascular diseases and hypertension, kidney damage.
3. **Nickel:** Causes respiratory problems, lung cancer.
4. **Mercury:** Causes nerve and brain damage, kidney damage.
5. **Beryllium:** Causes berylliosis. Affects mucus membrane of eyes and lungs. Causes shortness of breath, weight loss, lung cancer and affects heart.
6. **Asbestos:** Causes asbestosis, shortness of breath and lung cancer.

Accumulation of waste is probably the most visible form of pollution. Every year human beings dispose of billions of metric tonnes of solid waste.

The handling of solid wastes is a problem because most disposal methods cause harm to the environment. Both open dumps and landfills may contain toxins that seep into the soil and the water bodies and cause soil and water pollution respectively. The uncontrolled burning of accumulated waste creates smoke and other air pollutants that release toxic substances into the environment and cause air pollution. Scavengers and stray animals invade the open garbage dumps and spread the waste over large

Sources of Pollution

Air Pollution	Water Pollution	Soil Pollution	Radioactive Pollution
Automobiles	Domestic Effluents	Industrial Wastes	Nuclear Weapons
Chemical Industry	Sewage	Commercial Wastes	Atomic Reactors and Nuclear Fuel
Metallurgy	Industrial Effluents	Domestic Wastes	Radioactive Isotopes
Pesticides	Agricultural Effluents	Chemical Fertilizers	Radiations from X-rays
Refineries	Radioactive Wastes	Biomedical Waste	
Forest Fires	Thermal Pollution	Pesticides	
Burning of Garbage	Offshore Drilling and Oil Spills	Insecticides	
Energy Production			
Construction Material			

area, thereby, spreading germs and diseases as well as destroying the beauty of the place.

Industrial waste contains harmful chemicals, particulate matter (small particles) and toxic heavy metals such as lead and mercury. These toxic chemicals and heavy metals get deposited in animal tissues and harm living things along the food chain. For example, grass gets some toxic chemicals from the soil. Animals eat such grass and get affected by toxins. These animals directly or indirectly pass on these toxins to the human beings through their dairy products or meat.

As accumulated waste decomposes, it produces a large quantity of methane gas. This is highly inflamable, and can cause an explosion if not managed properly.

Water pollution occurs when people discharge large amount of waste into water bodies, and the natural cleansing process in the water bodies cannot function properly.

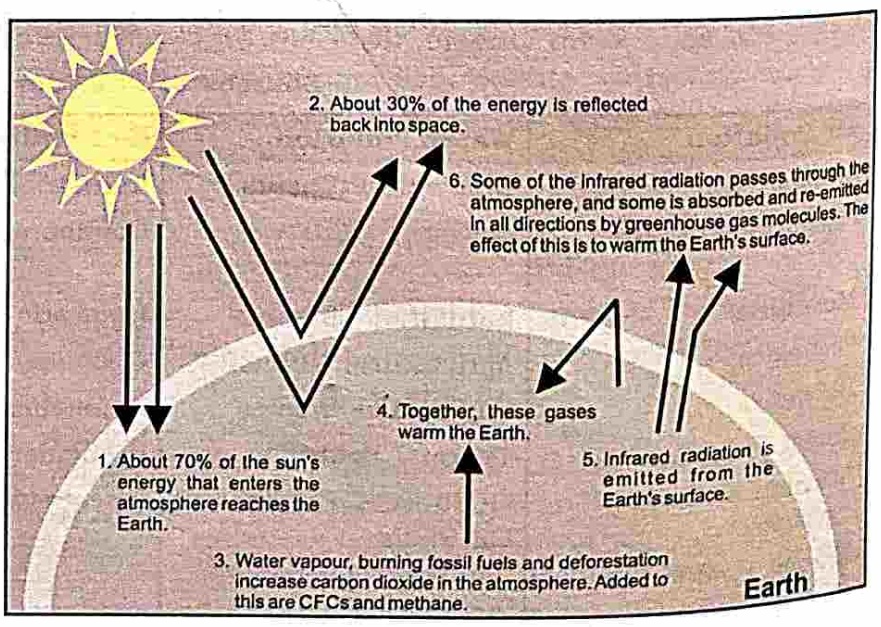
Eutrophication is the process of depletion of oxygen from water bodies occurring either naturally or due to human activities. The process of eutrophication takes place due to introduction of nutrients and chemicals through discharge of domestic sewage, industrial effluents and fertilizers from agricultural fields. Under normal conditions, algae and phytoplankton use carbon dioxide, inorganic nitrogen and phosphate from the water as food. They serve as food for microscopic animals (zooplankton). Small fish feed on these zooplankton and large fish in turn consume these small fish. When nutrients become abundant due to waste accumulation, the growth of phytoplankton and algae increases. They reduce the penetration of oxygen, light and heat into the water body. As a result acquatic plants are unable to carry on photosynthesis reducing the oxygen content of water. This causes death of most of the aquatic organisms, draining water of all its oxygen.

Waste Accumulation and Global Problems

The problem with waste is that it remains in our environment. We move waste from one place to another but never get rid of it completely. Nature has recycled waste materials for millions of years. However, human population has increased so rapidly during the last century that the environment is now threatened by our activities and the wastes they produce. Much damage is done to the environment by the pollution of air, degradation of soils and contamination of water sources such as rivers, lakes, *etc.* Accumulation of waste and its disposal causes number of problems which affect human beings and the environment globally.

Global Warming: When organic waste decomposes, carbondioxide and methane gas is produced. Both carbon dioxide and methane are Greenhouse gases, which contribute to global warming and climate change.

The rate of absorption of solar radiation by earth and its emission back into space as infrared waves balances the heat on the earth. This phenomenon plays a very important role in maintaining surface temperature of the earth. The carbon dioxide and other gases form a blanket around the globe which prevents the passage of infrared waves from the earth back into space. Concentration of solar radiation produces much heat, making the earth a very warm place. This phenomenon is similar to that of a greenhouse in which the glass enclosed area gets heated up due to the insulation from the rest of the environment. The warming up of the atmosphere is due to the greenhouse effect. Hence, Global Warming is also known as *Greenhouse Effect.*



Greenhouse Effect

Our future is in danger if we do not arrest global warming by controlling emissions into the atmosphere. The following are the effects of Global Warming:

1. Global temperature is likely to rise by 2°C to 5°C during the next century.
2. Due to rise in temperature by 2°C to 5°C there is a chance of melting of ice caps at the Earth's poles. This melting of ice will result in the rise of the sea level. Large stretches of low lying areas will submerge and many island countries will face deep encroachment by seawater. Some may disappear altogether.
3. Due to an increase in temperature there will be serious climatic changes. This will bring various changes in wind and rain pattern.
4. Higher temperature will cause rise in transpiration, which in turn, will affect the groundwater table.
5. Insects and pests will increase in the warmer climatic conditions. Thus, pathogenic diseases will multiply.

Ozone Layer Depletion

In the second layer of the atmosphere, *i.e.,* the Stratosphere which lies at the height of 20 km to 50 km from the Earth's surface, lies the Ozone layer. In spite of its low density, the Ozone layer plays an important role in our life.

Due to the presence of Ozone layer, ultraviolet rays and infrared rays from the sun cannot reach Earth directly. Ozone layer absorbs the harmful ultraviolet rays from the sun and protects the life on Earth from their harmful effects.

It has been revealed from different researches that when the Oxides of Nitrogen (NO and NO_2) come in contact with Ozone (O_3), their chemical reaction destroys Ozone layer. Besides this, supersonic aeroplanes move through the stratosphere and emit huge amount of Nitrogen gas which depletes the Ozone layer. Another important causative factor of Ozone layer depletion is Chlorofluorocarbons (CFCs), which have strong power to damage the Ozone layer.

All the developed and developing countries are using CFCs-type chemicals as refrigerants in aerosol, paints, plastics, foam and thermal insulating materials in spray and packaging industries. During the use of such materials, a lot of CFCs ultimately get dispersed into the atmosphere.

A hole has been observed in the Ozone layer in the Stratosphere near Antarctica. This hole allows the ultraviolet rays of the sun to reach the Earth directly without any obstacle or filtration. These ultraviolet rays cause many disease like skin cancer and cataract. The ultraviolet rays cause genetic disorders which ultimately affect heredity.

Increased concentration of ultraviolet rays disturb ecological balance in marine ecosystem. Green algae, fish and other animals on continental shelves get affected by ultraviolet rays. Young cells and larvae of organisms living in aquatic ecosystems get destroyed.

Acid Rain

Acid Rain means the presence of excessive acids in rainwater. Burning of coal, wood or petroleum produce sulphur and nitrogen. These two react with oxygen and are converted into their respective oxides—sulphur dioxide and nitrogen dioxide, which are soluble in water. During rain, these oxides react with large quantities of water vapour in the atmosphere to form acids like sulphuric acid, sulphurous acid, nitric acid and nitrous acid. These acids, when they precipitate together with rain or snow form *acid rain.*

Effects of Acid Rain

(i) Acid rain increases acidity in the soil and destroys forests and crops.

(ii) It corrodes buildings, monuments, statues, bridges, fences and railings. For example, acid rain produced by the pollutants from the Mathura oil refinery has been turning the white marble surface of the Taj Mahal into yellow.

(iii) It poses a serious threat to human health, since it contaminates air and water.

(iv) It affects the human nervous system by causing neurological diseases.

(v) Aquatic species are affected due to acid rain.

(vi) Acid rain affects the plant growth. Plant leaves get burnt and dry.

HEALTH HAZARDS

Spread of Disease Through Contamination

Several incidents around the world have demonstrated the potential hazard of accumulation of waste on human health. Waste that is not properly managed is a serious health hazard. Unattended waste dumped in the open attracts flies, rats and other creatures that act as vectors of the diseases and spread them among human beings. Domestic waste poses a serious threat since it is organic in nature, it undergoes fermentation and creates conditions favourable for the survival and growth of pathogens (disease-causing).

Flies, insects, rodents, *etc.*, live in the accumulated waste heaps and carry germs of various diseases to human habitations. Decomposition of wastes produces harmful gases that pollute the air around us.

Waste dumped near a water source percolates through the soil into the water bodies and contaminates the water. Direct dumping of untreated waste in rivers, seas and lakes results in the accumulation of toxic substances in the water bodies and further in the food chain through plants and animals that feed on it (biomagnification). Choking of drains and gully pits by the solid wastes results in water logging, especially during the rainy season. The water logging results in breeding of mosquitoes in the stagnant water which spread diseases like malaria and chikungunya.

Hazardous wastes are toxic substances which cause an increase in death rate and serious irreversible or incapacitating reversible illness. Lead is a harmful toxin and it can affect the development of a child's brain. Asbestos can cause a respiratory disease known as *asbestosis*, as well as chest and lung cancer. Mercury is a highly toxic chemical which attacks the nervous system, causing brain damage and even death. Arsenic is another chemical that has been shown to cause cancer.

Radioactive waste produced by nuclear reactors and weapon factories causes a potentially serious environmental problem. Radioactive waste, although present in small quantities, remains extremely harmful to human health for many years.

EFFECT ON TERRESTRIAL LIFE

Terrestrial life includes all the organisms that live on land — human beings, plants and animals.

Effect on Human Beings: Accumulation of solid waste looks ugly, smells foul, attracts insects, rats and other animals that spread diseases. Burning of waste in the open dumpyards causes smoke and foul smelling gases. In addition, rainwater can drain through refuse and carry harmful substances to different places.

Sanitary landfills are not fit for human settlements because methane and carbon dioxide gases are released in the first two years. These gases are produced when solid wastes start decomposing underground.

Effect on Plants: Waste accumulation has dangerous effect on plant life. Plant life is affected either by direct deposition of harmful toxins from wastes or indirectly through soil. The toxins cause:

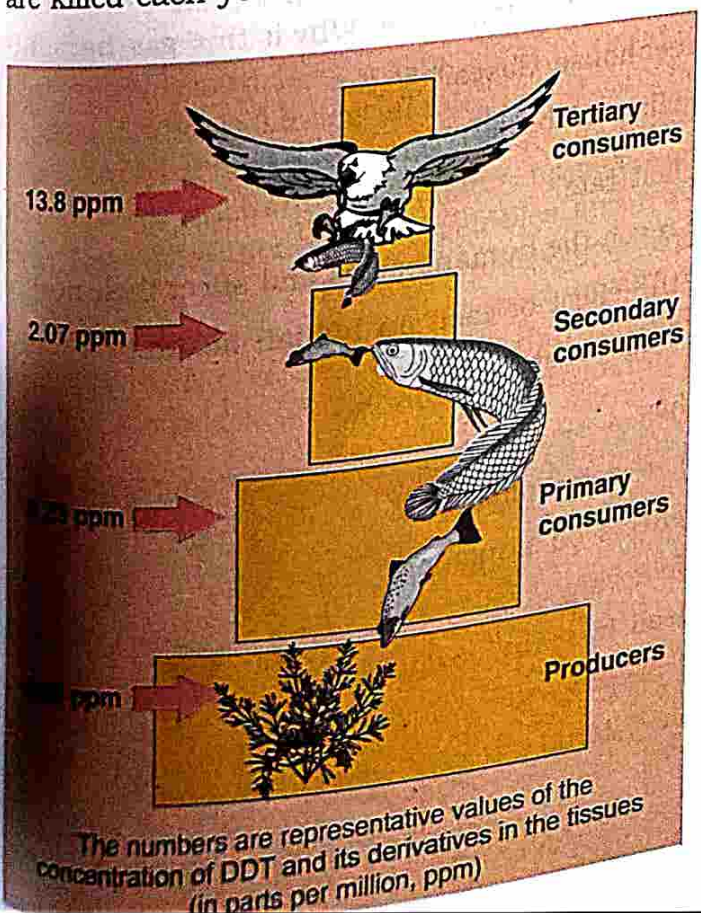
(i) different types of leaf injuries.
(ii) premature leaf fall.
(iii) decrease in transpiration.
(iv) reduction in the rate of photosynthesis.
(v) reduction in biological nitrogen fixation.
(vi) dust deposited on leaves block the stomata of plants. These decrease the rate of transpiration and inhibit the absorption of nutrients from soil.
(vii) smoke emitted by burning of waste causes reduction in root and shoot lengths, number of leaves and number of grains per spike in case of crops like wheat.

Effects of Radioactive Waste

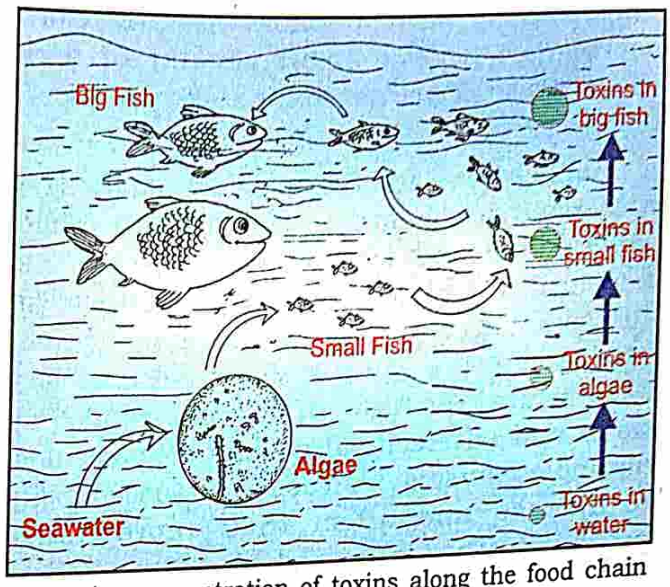
Effect on Animals and Birds: Scavangers and stray animals like dogs, rats, pigs and cows are directly affected by waste when they feed on the waste for food. Some[illegible]es these an[illegible]als consume toxins or non-degradab[illegible] subst[illegible]ces like plastic carry bags present in the [illegible]e and die due to choking. The wastes cons[illegible]d by animals also lead to many diseases [illegible]nd othe[illegible]problems. For example, according[illegible] a study, m[illegible] that were fed on high levels of toxins had difficulty in reproducing and so did their offspring. These offspring also had higher rates of birth defects and lower body weights. Similarly, birds too are adversely affected due to feeding on waste. Birds feeding on agricultural waste suffer from defective egg shells and increased mortality.

EFFECT ON AQUATIC LIFE

Waste accumulation can cause significant damage to aquatic life, both fr[illegible]h water and [illegible]arine. Two categories of waste that [illegible]ause [illegible]eatest damage to aquatic life are — *pest[illegible]es*, which run off agricultural lands and *i[illegible]s[illegible]ial and domestic wastes* that are imp[illegible]perly d[illegible]posed of into water bodies, Over [illegible]e million m[illegible]ine animals including mammals, turtles, fish, sharks, etc. are killed each year due to plastic debris in the oceans. The plastic waste is washed out from our beaches, streets and highways into rivers and streams and finally into the oceans. After sometime, this p[illegible]tic waste breaks down into smaller pieces, which [illegible]re easily ing[illegible]d by marine animals causing blocka[illegible]s in th[illegible] digestive tracts and eventually death. M[illegible] turtles are more susceptible to the effect[illegible]nsuming marine debris because they h[illegible] down[illegible]rd facing spines which prevent th[illegible]possibility o[illegible]egurgitation. Drilling for oil also causes harm t[illegible]he marine animals in the form of pollution from oil spills.



The numbers are representative values of the concentration of DDT and its derivatives in the tissues (in parts per million, ppm)



Increasing concentration of toxins along the food chain

Toxins present in the wastes can kill aquatic organisms directly by sufficiently changing the pH of water, covering the water surface and causing a reduction in dissolved oxygen. The aquatic organisms are also affected by a phenomenon, known as biomagnification.

Biomagnification: The term *Biomagnification* means increasing the concentration of various toxic substances along the food chain. Toxic substances at the level of primary producers get concentrated at each trophic level as they move up the food [illegible]hain. The ph[illegible]nomenon of concentrated tox[illegible] deposit[illegible]t the higher trophic level is kno[illegible] as [illegible]*-accumulation*. A small amount of tox[illegible]onstituent which is neither excreted nor [illegible]ised, gets increased as the food chain [illegible]ves upw[illegible] from one trophic level to the n[illegible] and the to[illegible] constituents become concentrated. For examp[illegible], if there are traces of toxic chemicals in water, then their concentration in algae will be much higher. When fish eat the algae, the concentration of toxins will increase further. It will increase still further

when big fish will eat smaller fish. The[illegible], accumulation of a small amount [illegible] toxic chemicals in water can have a serious impact on the fish that live in it.

Carelessness and the deliberate dumping of wastes and oil spills in the seas and oceans pollute water and damage beaches. Marine pollution is a great threat to sea-life (plants and animals). Oil spills decrease the penetration of light and hamper the photosynthesis process. They also retard the rate of oxygen uptake by water and adversely affect the development of marine organisms, increase their susceptibility to disease and affect their reproductive processes. They also lead to gastrointestinal irritation, liver and kidney problems and damage the nervous system of marine mammals.

Mercury in water can affect marine animals adversely. Mercury contamination in sea on a coastal town in Japan caused illness in some fishermen because of consuming fishes caught from the Minamata Bay. It also killed different sea bird species feeding on fishes. This epidemic in Minamata is known as 'Minamata Disease'.

Mercury contamination also results from wastes of other industries like paper and pulp industry, chlorine industry, pesticide industry *etc.* Pesticides with mercury add a considerable proportion of mercury to natural water bodies.

EXERCISES

I. Answer the following questions:

Q.1 (a) What is waste? Name two sources of waste.

(b) How is the 'use and throw' concept responsible for the increase in waste generation?

(c) What is acid rain? State its impact on the environment.

(d) What is meant by Ozone layer depletion? How is it harmful?

Q.2 (a) Why is the handling of solid wastes a major problem?

(b) Name the gas produced by the decomposition of accumulated waste. Why is this gas harmful?

(c) What is Global Warming? Name any two Greenhouse Gases?

(d) How does accumulation of waste affect animals and birds?

Q.3 (a) What is E-waste? Why is it increasing at a fast rate?

(b) Explain briefly how does the industrial waste reach the human beings and affect their health.

(c) Name two toxic particulate materials. State the effect of each on human health.

(d) Give two differences between toxic and non toxic waste.

Q.4 (a) Explain how eutrophication affects aquatic life.

(b) What harm is done by dumping of waste near waterbodies?

(c) What is biomagnification? What can be its effects on humans?

(d) Give a geographical reason for each of the following:

(i) Marine animals and turtles are found dead in many coastal areas.

(ii) Radioactive waste is more harmful than other waste.

(iii) Uncontrolled burning of waste causes air pollution.

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Chapter 23 Waste Management — II
Safe Disposal of Waste

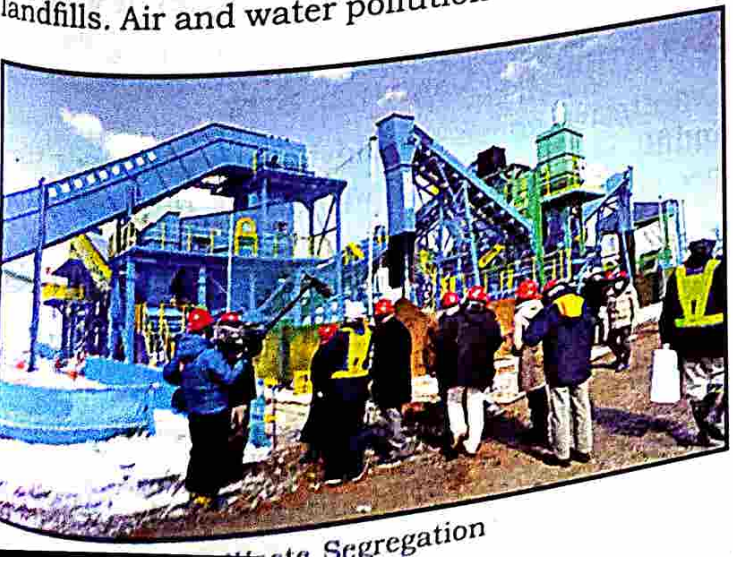
Syllabus

Methods of safe disposal of waste — segregation, dumping and composting.

SEGREGATION

'Segregation of waste' means dividing the waste into different categories like dry and wet or biodegradable and non-biodegradable.

Dry waste consists of waste that does not decay and is non-biodegradable. It includes wood and related products like timber, sawdust, home and office furniture, household-junk; aluminium foils, tetra packs, plastic products, broken crockery, steel utensils and glass. *Wet waste* comprises waste that is organic in nature and is biodegradable, i.e., it can be decomposed or broken down by living organisms. It includes kitchen waste from homes and eating establishments like vegetables and fruit peels, stale food, rotten fruits and vegetables, etc. When waste is segregated, there occurs a reduction in the volume of waste that reaches landfills. Air and water pollution is considerably reduced and it becomes easier to apply different processes of waste disposal like composting, recycling and incineration. In fact, segregation of waste is the key to effective waste management.



Segregation

The waste is segregated before it is disposed of. In colonies various types of dustbins are used to segregate glass, metals, paper, cloth, *etc.*, and each type is handled separately by reusing it, recycling it or disposing it in any other accepted waste disposal method.

It should be the duty of each household to segregate domestic waste into different dustbins like *biodegradable* and *non-biodegradable* and then convert biodegradable ones into other useful products like compost or gobar gas. Urban residential colonies should undertake collective efforts for safe disposal of domestic waste as

Segregation of Waste

Waste can be segregated as

1. *Biodegradable;* and
2. *Non-biodegradable.*

Biodegradable waste includes organic waste, e.g. kitchen waste, vegetables, fruits, flowers, leaves from the garden, and paper.

Non-biodegradable waste can be further segregated into:

a) *Recyclable waste* – plastics, paper, glass, metal, etc.; and

b) *Toxic waste* – old medicines, paints, chemicals, bulbs, spray cans, fertilizers and pesticide containers, batteries, shoe polish.

c) *Soiled* – hospital waste such as cloth soiled with blood and other body fluids.

Toxic and soiled waste must be disposed of with utmost care.

well as sweepings from the gardens and public parks. These sweepings can be converted into compost and used for the maintenance of these gardens and parks.

Sorting out of the reusable material from heaps of waste may often involve much manual labour. In a country like India, the poor rag pickers make a living by sorting out reusable and recyclable items from discarded solids. In this way they do a good job by removing much of the waste from the garbage dumps. Pieces of metal, glass, rubber, plastics *etc.*, are removed to be recycled to get finished products.

DUMPING

Open Dumping: In this method, waste materials are dumped in open low lands far away from the city. This method is not environment friendly. However, this is the cheapest method and does not need much planning. The open pits spoil the sight of the area and become a breeding ground for mosquitoes, flies, insects, *etc.*, that are the carriers of harmful diseases. They give out foul odour. The burning of waste material in the open dumps pollutes the air. Another danger of open dumping is that rainwater could carry the harmful substances to the nearby streams, ponds or lakes and if the water seeps down it could pollute the groundwater.

Sanitary Landfill: In this method, the waste is packed and dumped daily at the site and is covered with earth to prevent insects or rodents from entering into the landfill. The waste then is subjected to bacterial decomposition. Physical, chemical and biological reactions take place generating different gases like carbon dioxide, methane, ammonia and hydrogen sulphide. These gases can be recovered and used to generate power.

Sanitary Landfill

Sanitary landfill is a way of disposing refuse on land without creating nuisances or hazards to public health or safety. The waste disposal is carried out with minimal environmental damage and in areas already spoiled or in need of restoration.

In a sanitary landfill biological method of disposing of waste is used.

The waste undergoes the following five phases:

(i) In the first phase of operation, aerobic bacteria depletes the available oxygen and causes the temperature to increase.

(ii) In the second phase, anaerobic conditions get established and lead to the evolution of hydrogen and carbon dioxide.

(iii) Phase three establishes population of bacteria and the beginning of methanogenic activity, *i.e.*, production of methane from the decomposition of organic matter.

(iv) In the fourth phase the methanogenic activity becomes stabilised.

(v) The fifth phase depletes the organic matter, and the system returns to aerobic state.

The advantages of sanitary landfill as opposed to open dumping are:

- It is free from air pollution from burning.
- The health problems are minimised since flies, rats and other pests cannot breed in the landfill because of the covered wastes.
- It is mostly free from fire hazards.

Plantation at Landfill Site

A vegetative cover should be provided over the landfill site in accordance with the following specifications:

(i) Locally adopted non-edible perennial plants that are resistant to drought and extreme temperatures should be planted.

(ii) The plants grown should be such that their roots do not penetrate more than 30 cms. This condition should apply till the landfill is stabilised.

(iii) Selected plants should have the ability to thrive on low-nutrient soil with minimum nutrient addition.

(iv) Plantation should be made in sufficient density to minimise soil erosion.

MUNICIPAL WASTE MANAGEMENT

1. Collection of Municipal Solid Wastes

To prohibit littering, the following steps should be taken by the municipal authorities:

(i) Organising house-to-house collection of municipal solid wastes.

(ii) Devising collection of waste from slums and squatter areas or localities including hotels, restaurants, office complexes and commercial areas.

(iii) Bio-medical wastes and industrial wastes should not be mixed with municipal solid wastes.

(iv) Horticultural and construction wastes should be separately collected and disposed of.

(v) The waste should be segregated into biodegradable and non-biodegradable.

(vi) Waste (garbage, dry leaves) should not be burnt.

(vii) Stray animals should not be allowed to move around waste storage facilities.

2. Storage of Municipal Solid Wastes

The following criteria should be taken into account while establishing and maintaining storage facilities:

(i) Storage facilities should be set up and established by taking into account quantities of waste generation in an area and its population density. The storage facility is to be so placed that it is accessible to users;

(ii) These facilities are to be so designed that wastes stored are not exposed to open atmosphere and are aesthetically acceptable and user-friendly;

(iii) Storage facilities or 'bins' should have 'easy to operate' design for handling, transfer and transportation of waste.

(iv) Manual handling of waste should be avoided.

3. Transportation of Municipal Solid Wastes

Vehicles used for transportation of wastes should be covered. This prevents the wastes from being scattered. Waste should not be visible to public, nor exposed to open environment.

4. Community Participation in Segregation of Municipal Solid Wastes

The municipal authorities should undertake phased programme to ensure community participation in waste segregation.

COMPOSTING

Composting of waste is an aerobic (in the presence of air) method of decomposing solid wastes. The organic wastes from households are made to undergo decomposition in such a way that bacteria and other micro-organisms break them down and produce a safe, clean and soil-like material called *compost.*

In India, both the manual as well as mechanical methods of composting are used. In the rural areas, layers of vegetable waste and night soils are alternated in a shallow hole dug in the ground. The mixture is turned regularly for about three months to provide air to the mixture. Then the compost is left for another month without turning for the process to take effect. This method of composting is known as the *Indore Method.*

In the mechanical process, used in Bengaluru and adopted by other cities in the country, the waste material is placed in layers about one metre deep. The material is not turned at all but it decomposes completely in about five months. This method of composting is known as the *Bengaluru Method.*

Composting

Advantages of Composting

The major benefits of composting are:

(i) It enhances soil nutrients and water retention capacity of soils.

(ii) It suppresses plant diseases.

(iii) It rejuvenates poor soils by adding humus.

(iv) It absorbs odours and degrades volatile organic compounds.

(v) It prevents pollution by preventing pollutants in storm water run-off from draining into water resources.

(vi) It checks soil erosion and silting on embankments.

(vii) It reduces cost as there is no need for excess water, fertilizers and pesticides.

INCINERATION

In cities, vacant areas for disposal sites are not very many; so incineration process is used for waste disposal by industries and municipalities. Incineration is the process of controlled high temperature oxidation of primarily organic compounds that release thermal energy and produce carbon dioxide and water. In short, incineration involves burning of wastes at a very high temperature. The waste to be burnt is fed into an incineration chamber (or kiln) and combustion consumes/destroys the organic component.

Incineration is a useful technology to deal with large quantities of organic hazardous wastes that have high calorific value and cannot be dealt with by other methods. By this method pathogenic organisms are killed and the volume of the waste is reduced upto 50 per cent. However, incineration process has its limitations — (i) it is quite expensive; (ii) it generates ash and combustion gases which have an adverse impact on human health and environment; (iii) incineration consumes significant amount of energy to achieve high temperature.

REDUCE-REUSE-RECYCLE WASTE

Waste can be effectively managed by using the following three R's of waste management:

(i) Reducing the Waste;

(ii) Reusing the Waste; and

(iii) Recycling the Waste.

Reducing the Waste

The waste can be reduced by making use of the following methods:

(a) *Change of Process*: In industries, changes can be made in the production process to reduce waste generation. This reduction can be achieved by either changing the material used to finish the product or by using more efficiently the input materials in the production process or both.

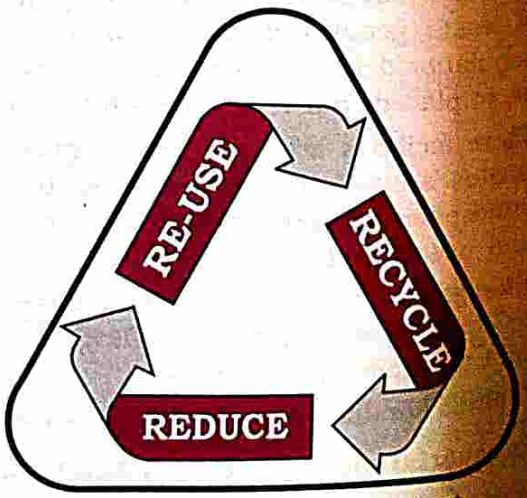
(b) *Waste Concentration*: By using scientific techniques such as precipitation and evaporation the amount of liquid waste can be reduced. Incineration can be used to get rid of inflammable wastes.

(c) *Segregation of Waste*: First of all, non-hazardous waste are separated from hazardous waste rather than dumping them together. Then the small amount of hazardous waste can be treated. We can dispose of a large amount of non-hazardous waste in the traditional ways.

REUSING THE WASTE

In our houses and in industries many materials are discarded as wastes. These materials have some value, for instance glass, metal pieces, rubber, wood fibre and paper products.

In developing countries like India, some of the waste materials like old glass bottles, steel tyres, tin cans are reused. For example, shoes or chappals are made from old tyres, water bags are made from leather, lamps are made from tin cans, *etc.* Many waste collectors (rag pickers) roam



Three R's of Waste Management

about in residential areas and industrial units to collect the solid wastes. They segregate them and supply them to specialised artisans who make utility articles from such material and make a living from their skill. For example, a beautiful garden (Rock Garden) has been created by Nek Chand in Chandigarh using waste products like tin cans, bottles, broken pieces of crockery, *etc.* Waste collectors, thus, help in making new production processes. Thus, they reduce the burden of waste disposal.

Some solid wastes from the industry can be utilised directly. Flyash from power plants is used as a substitute for cement. Bricks are made from flyash. Flyash is also used in making roads and filling up low-lying areas.

RECYCLING OF WASTE

Besides reusing the materials by using physical processes, we also use recycling process by treating the waste before it is used in a manufacturing process. In India, we have tonnes of bagasse from sugarcane during a particular season. Bagasse is used in the manufacture of paper pulp. This helps to save trees which are normally used for making paper pulp. Bagasse is also used for making packaging material for dairy products. Paper industry recycles pieces of wood from furniture industry, used and discarded cloth and used paper.

Plastics are recycled by plastic manufacturers. About 80 per cent of the plastic waste is recycled in India, which is about 0.75 million tonnes a year. Plastic is non-biodegradable. The bonds of carbon in plastic are impossible to break down through a physical or chemical process. They have to be incinerated, recycled or buried in landfills. The plastic bags which are extensively used in India are made from recycled plastic. The recycled plastic bags are harmful because the melting of plastic and plastic products breaks some polymer chains into smaller units which are harmful.

Roads from Plastic Waste

A Government of India Order in November 2015 made it mandatory for all road developers in the country to use waste plastic, along with bituminous mixes, for constructing the roads. This was done to overcome the growing problem

A Road made of Waste Plastic

of plastic waste disposal in the country. The technology for this was developed by the 'Plastic Man' of India, Prof. Rajagopalan Vasudevan, Professor of Chemistry at Thiagarajar College of Engineering, Madurai.

Prof. R Vasudevan first implemented the use of plastic waste on a road constructed inside the premises of his college in 2002. In 2006, the Thiagarajar College of Engineering received the patent for this technology.

The plastic waste items that can be used for road construction include plastic carrybags, plastic cups, plastic packaging for potato chips, biscuits, chocolates, etc.

For making roads, the plastic waste material is first shredded to a particular size using a shredding machine. The aggregate mix is heated at 165°c and transferred to the mixing chamber, and the bitumen is heated to 160°c to result in good binding.

The shredded plastic waste is then added to the aggregate. It gets coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look. The plastic waste coated aggregate is mixed with hot bitumen and the resulting mix is used for road construction.

The advantages of using waste plastics for road construction are the following:

- The process is easy and does not need any new machinery.
- For every kilo of stone, 50 gms of bitumen is used and 1/10th of this is plastic waste; this reduces the amount of bitumen being used.

- Plastic increases the aggregate impact value and improves the quality of flexible pavements. Wear and tear of the roads is also quite low.
- This road construction process is eco-friendly, with no toxic gases being released.
- Plastic waste helps increase the strength of the road, reducing road fatigue.
- These roads have better resistance towards rain water and cold weather.
- Since a large amount of plastic waste is required for a small stretch of road, the amount of waste plastic strewn around gets tremendously reduced.

If done in proper manner, waste management not only eliminates the surrounding wastes but also reduces the intensity of the greenhouse gases like methane, carbon monoxide which are emitted from the accumulated wastes. The depth of the existing landfills will be also curbed, thereby cutting down whatever is toxic to the environment. The number of fossil fuels will also get reduce in this manner, leading to a cleaner and a greener environment.

EXERCISES

I. Answer the following questions:

Q.1 (a) What do you mean by segregation of waste? How does it ensure safe waste disposal?

(b) What is meant by open dumping of waste? Why is open dumping not considered as an environment friendly method?

(c) (i) What is a sanitary landfill?

(ii) How is waste disposed of in a sanitary landfill?

(d) State the advantages of sanitary landfill as compared to open dumping.

Q.2 (a) What is biodegradable waste? Name two useful products which can be made from biodegradable domestic waste.

(b) What service is indirectly done by the rag-pickers for the disposal of waste?

(c) State three steps that should be taken by the municipal authorities for the safe disposal of solid waste.

(d) What is composting? Give two advantages of using compost.

Q.3 (a) What are the three R's of waste management?

(b) Explain how reusing waste can reduce the burden of waste disposal.

(c) What is meant by recycling of waste effectively? Give one example.

(d) Give a geographical reason for each of the following:

(i) Recycling of waste to produce paper can reduce deforestation.

(ii) Sugarcane waste can be recycled into useful products.

(iii) We should avoid using polythene carry bags.

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