CHAPTER 2

Maps & Cartography

Learning Objectives

By the end of this chapter students would be able:

2.1 To know about maps and there importance

2.2 To know about scales of maps and their types

2.3 To know about types of maps

2.4 To understand elements of maps and indexing

2.5 To understand map coordinate systems.

2.6 To interpret the satellite images

2.1 What are Maps and what's their Importance?

1. Map Concepts

The word *'mapi'* comes from the Latin word *'mappai'* and means napkin, cloth or sheet. The first map to represent the known world was created by Anaximander, a Greek philosopher in the 6 th century B.C. Globe is a three dimensional model of whole earth whereas map is a two-dimensional graphical representation of the earth or a specific area.

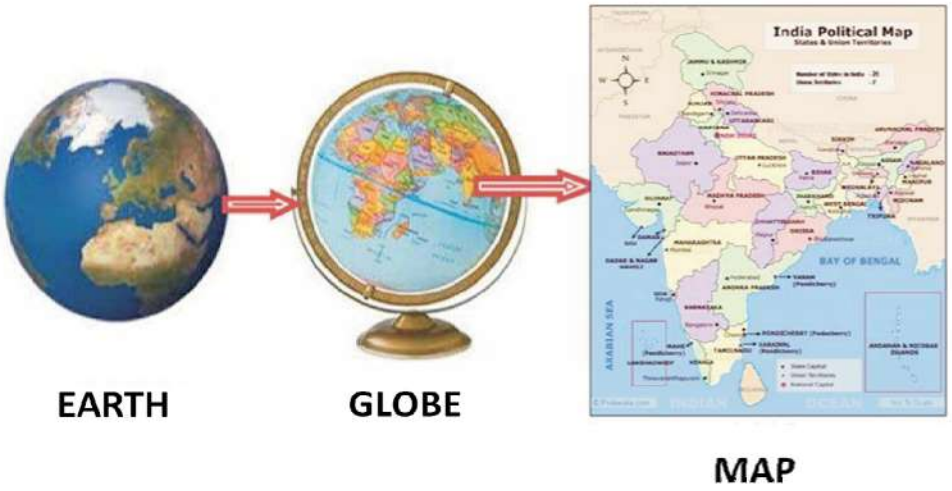


Fig. 10

2. What is Map?

Map is a two dimensional graphical representation of the earth to provide the information of the location and distance between the ground features, such as populated places and routes of travel and communication. The primary purpose of a map is to convey information or "get across" a geographical concept or relationship between the features. It also indicates variations in terrain, heights of natural features, and the extent of vegetation cover. It communicates locational and descriptive information. For easy understanding, features must be represented by conventional signs and symbols. Maps help us to understand directions, landmarks, distances and heights.

What is Map?

A map is a graphical two-dimensional representation of a portion of the earth's surface drawn to scale & uses colors, symbols and labels to represent features found on the ground.

3. Importance of Map

(a) Location

Maps identify what is at a location, where you are. For example, If you want to locate house, school, religious places, museum etc., how would you guide people to locate these places? One option is that you can draw the direction and route map showing different landmarks on a piece of paper like temple, park, school etc. This drawing guides your friend to reach his destination using the landmarks and directions. We use the knowledge of the area, landmarks and direction to locate any place. These landmarks are represented on the map through symbols.

Fig. 11

(b) Navigation:

When you are travelling in an unknown place, maps guide you the proper path. For example, If you want to visit city museum then you need to look into the city map & find out possible routes to reach the destination. Maps also provide distance information so that we can select the shortest path for our travel.

(c) Planning

Along with the location information maps also shows us the important landmarks nearer to that location which help us for planning. For example if administrative department wants to construct a new road then before starting the job they can visualize the area, how much buildings are existing in that area, what are the measuring acts that need to be taken to evacuate the place etc, These types of plans can easily be done by the help of proper maps

(d) Map Features:

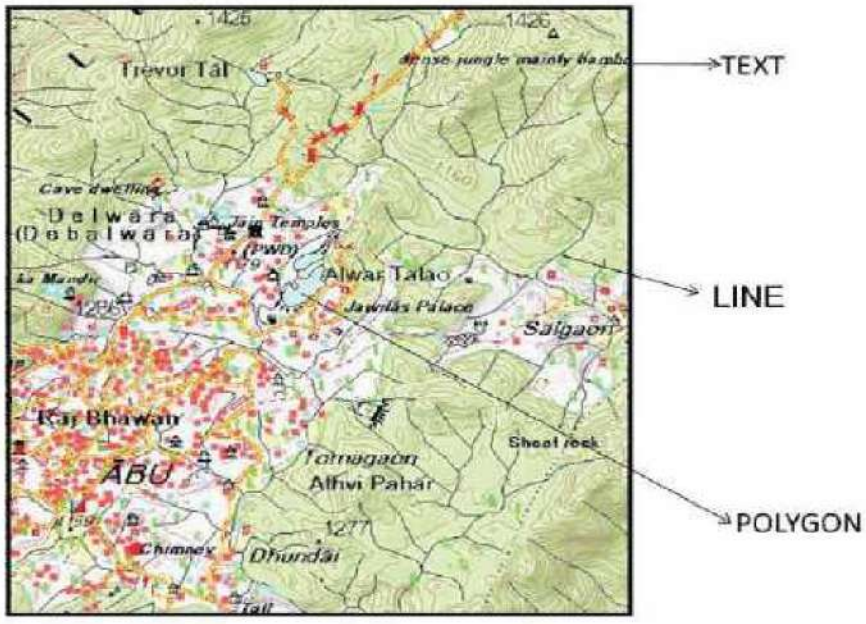
Look at any map you will find different shapes and symbols used to illustrate maps. There are four types of symbols used to depict different features types. i.e. points, lines, polygons and text.

(i) **Points:** Points define discrete locations of geographic features which are too small to be depicted as lines or areas, such as locations of wells, telephone poles, or buildings. etc.

(ii) **Lines:** Lines represent the shape of geographic objects too narrow to depict as areas, such as streets and streams, or linear features that have length but no area, such as elevation contours, roads and pipelines.

(iii) **Polygons/ Areas:** Areas are closed features that represent the shape and location of homogenous, real-world features such as states, cities, parcels, soil types, or land use zones.

(iv) **Text:** Text provides brief descriptions of different features. For example: names of landmarks, roads, rivers etc.



Map with Map Features

Fig. 12

4. Map Directions

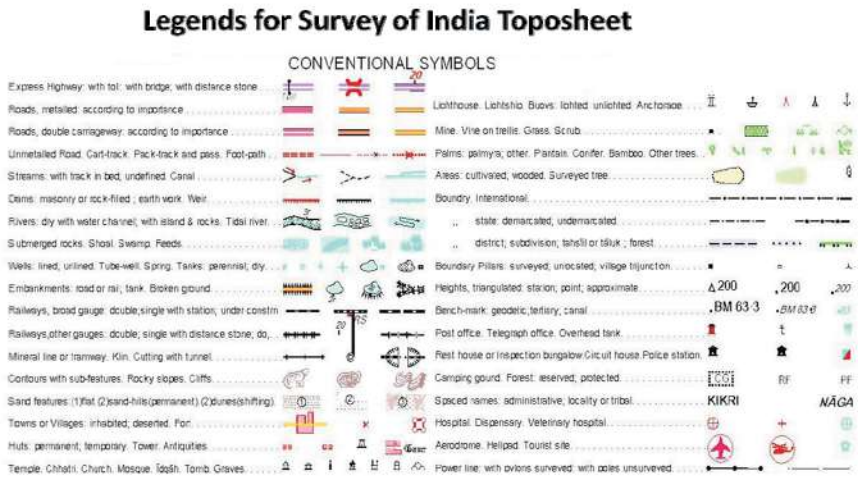
Map direction is usually indicated on a map by a North-South line with north represented by an arrowhead. A short line perpendicular to this is drawn to show the east and west directions. North, South, East and West are main directions. Northeast lies between North and East. In the same way, we have directions like Southeast, Southwest and Northwest.

Fig. 13

5. Map Symbols

Map symbols are used to represent the real world objects. Without symbols, we wouldn't have maps. Survey of India (SOI) is an organization that regularly draws and updates different types of maps in India. Map uses a lot of symbols to represent different features. How will you know which features are located at which place? To solve this, maps have a key at a corner that explains the symbols. If you find a symbol on the map that you do not know, simply look for it in the key.

Both shapes and colors can be used for symbols on maps. Map Legend is a key to all the symbols used on a map. It is like a dictionary through which we are can understand the meanings of various symbols used in the map.



Map Legends from SOI Toposheet

Fig. 14

6. What is Cartography?

Cartography comes from two Greek words, '*chartis*' meaning map, and *graphos*', meaning to draw or write. Cartography is the art and science of map making, practiced by cartographers. Humans have been drawing maps to understand their environment. In ancient times, cartographers drew maps manually with limited information and indicating location information in relation to something else, nowadays cartographers have the advantage of GIS tools to assist them, making their maps more precise using geographical coordinates such as latitude and longitude to orient their features

What is Cartography?

Cartography is the art and science of map making technique. The persons who prepare maps are called cartographers.

2.2 Map Scale and Types

1. What is Map Scale?

Map is a graphic representation of a portion of the earth's surface plotted on paper with some ratio. This ratio is known as representative fraction (R.F.). The scale of a map is defined as the ratio of a distance on the map to the corresponding distance on the ground. If we are drawing a map of India, we cannot draw a map as huge as India. The actual distance is shortened and represented in scale on the map. The explanation of the scale is given at one corner of map in a box called scale bar. Scale is represented in three different ways. Different countries measure the distances in different units such as miles, Kms. etc. As the denominator of the representative fraction gets larger and the ratio gets smaller, the scale of the map decreases

The scale of a map is defined as the ratio of a distance on the map to the corresponding distance on the ground.

(a) Statement such as 1 cm = 0.5 Km.

In the scale of 1:50,000

1 cm represents 0.5 km on the ground.

(b) Representative fraction (RF) like 1:10,000. Representative Fraction makes measurement in units. Unit can be millimeter, centimeter or a meter. For example if a village map has the representative Fraction 1:50,000 and the distance between the temple and school is 1 cm, the actual distance on ground is 500 meters. To calculate the scale, the following formula is used.

R.F. (Scale) = Map distance / Ground distance

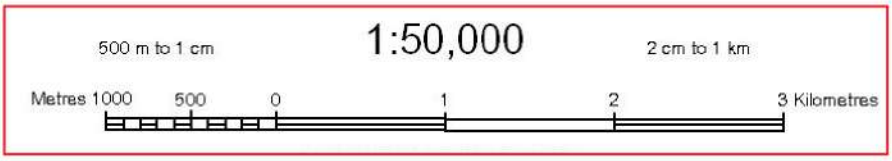


Fig. 15

If 2 cm. on the map represents 1 Km on the ground

The scale would be calculated 2 cm = 1Km

Distance on the map / Distance on the ground = 2 cm /10, 0000

Therefore scale = 1:50,000.

(c) Graphical or linear scale: The graphical scale or a linear scale is a line of convenient length divided in regular intervals and graduated in terms of distances on the ground. Using the linear scale the distance between any two points can be measured directly in terms of distances on the ground.

Using the linear scale, distance between any two points on the ground can be measured directly in terms of distance on the map.

2. Classification of Maps:

Maps are classified into two types of scales. Scale describes the details and amount of area covered by a map on the ground.

(a) Large Scale Map: Large-scale of 1:5,000 maps shows the greater details and represents the small area as compared to the scale of 1:10,000 of same area

(b) Small Scale Map: A small scale of 1:10,000 map shows lesser details and represents more area as compared to the scale of 1:5000 of same area

Large and small scale maps differ in area coverage and amount of information

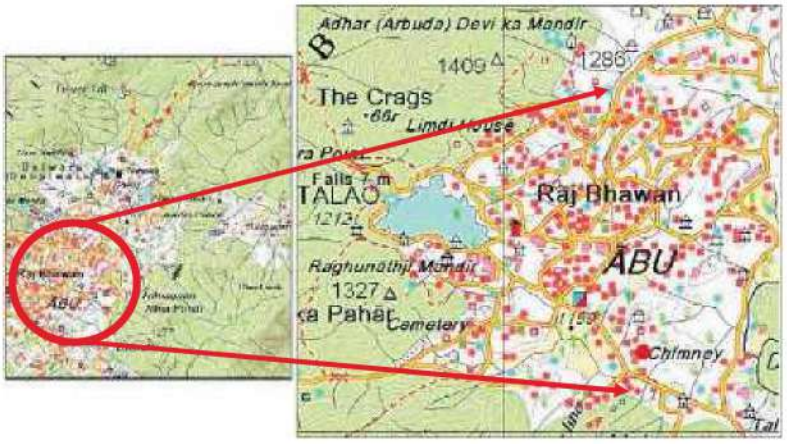


Fig. 16

2.3 Types of Maps

Why do you need different types of maps? Maps help you to understand the spatial patterns. Various types of maps are used for effective planning and management of resources. Some of the types of maps are discussed below:

(i) Topographic maps

Topographic maps are commonly called contour maps or topomaps. Topographic maps are prepared based on topographical surveys performed at large scales. Indian topographic sheets are prepared and managed by Survey of India (SOI).

Topographic Map

Fig. 17

They are published as map series and are made up of two or more map sheets that cover a village or district depending on scale. A topographic map is on scale.

A topographic map is a detailed and accurate graphic representation of Natural and Man-made features on the ground. These maps usually include elevation, relief, major geographical features, contour lines and other information

Contour lines showing changes in elevation

Fig. 18

Contour is an imaginary line drawn on maps joining the places that have same heights. This method of showing heights through contours is perhaps most accurate, common and popular. Contours are drawn on the basis of an actual survey conducted in the field. A map showing contours is called a contour map. Contours are numbered to indicate their height above Mean Sea Level (MSL). Contour which is CLOSE indicates STEEP terrain whereas, contours which are OPEN indicate FLAT terrain.

(a) Benefits of Topographic Maps

Topographic maps provide a wide range of information which is used for residential and commercial planning, engineering, energy exploration, environmental management, public works design, natural resource conservation, and outdoor activities such as fishing, camping, hiking. etc.

(b) What type of information should be collected from a topographic map?

A topographic map identifies numerous cultural and natural ground features, which can be divided into the following categories: roads, buildings, boundaries, railways, power transmission lines; water bodies, lakes, rivers, streams, mountains, valleys, slopes, depressions; and forests, names of places, names of water features, names of highways. All these features can be identified in the legend from the corresponding symbols.

(c) Topographic Map Elements and Interpretation:

The various features shown on the map are represented by conventional signs or symbols. Maps use significant colors to indentify the features for example, blue often means water, green means forests, and white means bare land. Colors can be used to indicate classification of roads. These signs are usually explained in the legend of the map, or on a separately published characteristic sheet. The title of the topomap is printed in the upper and lower right corners of the map. Adjacent topomaps names are displayed in Index to Sheets which helps to find out the neighboring maps.

Every map has a scale which reads distance on the map with respect to the ground. Topomaps also show the information about the Grids as latitude and longitude which are used to indentify exact location of any point on the earth. Along with this information, Contour intervals & Projection information are displayed in degrees and minutes. In topomaps North is at the top, South at the bottom, West to the left and East to the right.

INDEX OF TOPOSHEETS

Fig. 19

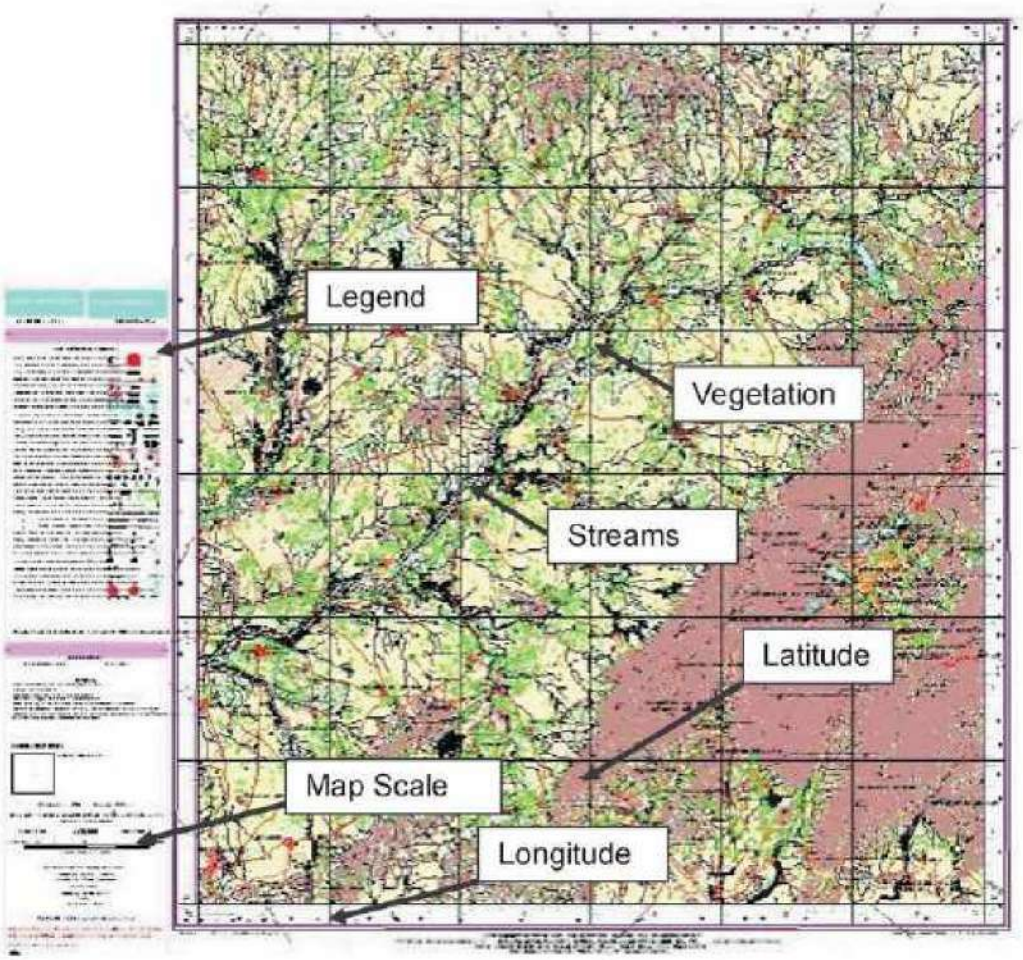
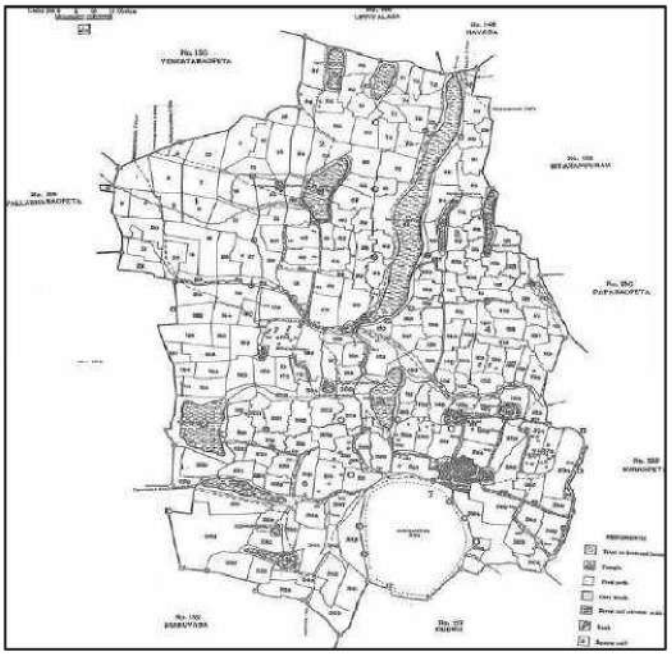


Fig. 20

(ii) Cadastral Maps

Cadastral maps are village maps which show individual plots. These maps show the boundaries of properties owned by different people. These maps are the basis for maintaining revenue records of villages and towns.



Cadastral Map

Fig. 21

(iii) Physical Maps

Physical maps illustrate the physical features of an area such as mountains, rivers and lakes. The maps use lines, shading, tints, spot elevations, and different colors to show elevation and distinguish the mountains from the lowlands. Colors are used to show relief differences in land elevations. Green is typically used for lower elevations and orange or brown indicate higher elevations. This kind of map often has some road, city and cultural information but mostly functions as a view of the land surface.

Physical Map
(Survey of India)

Fig. 22

(iv) Political Maps

Political maps show boundaries that divide one political entity from another, such as townships, counties, cities and states. Some maps emphasize the boundaries by printing the areas of each political division in different colors, for example world maps usually show each country in a different color. A political map can be created for a country, state, district, village, block, municipality.

Political Map (Survey of India)

Fig. 23

(v) Thematic Maps

Thematic maps are grouped according to the subject; these maps can portray physical, social, political, cultural, economic, agricultural, or any other aspects of a city, state, region, nation, or continent. For example, if you draw a map showing ponds, wells and water bodies of the village it will be named thematic map of the water resources of your village. Similarly if a map is drawn based on state wise population of India, it is called a demographic map of India. A thematic map can be created based on population density, as shown below: (Fig. 24)

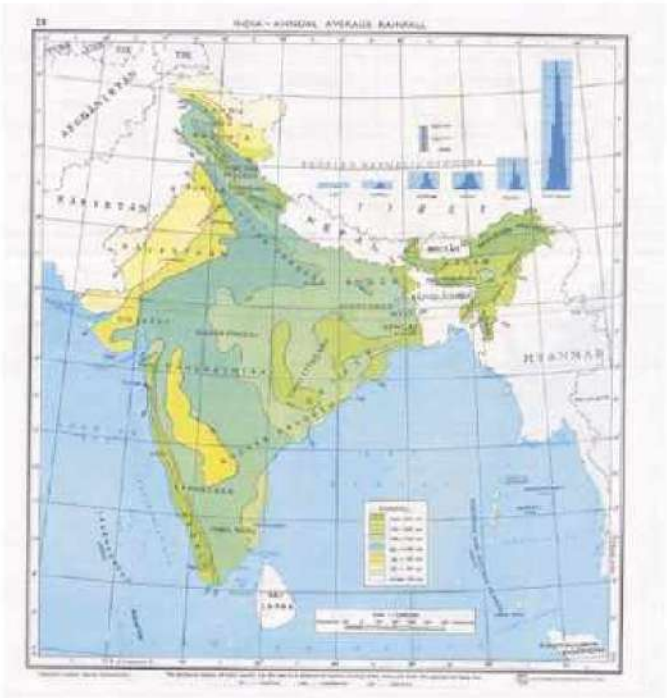
Purpose of Thematic Map

Thematic maps serve three primary purposes. First, they provide specific information about particular locations. Second, they provide general information about spatial patterns. Third, they can be used to compare patterns on two or more maps.

Population Density map of India (Survey of India)

Fig. 24

(vi) Meteorological Map A meteorological map shows different climatic parameters like rainfall, wind velocity, direction etc.



Metrological map of India (Survey of India)

Fig. 25

2.4 Elements of Maps & Indexing

Maps enable us to depict spatial phenomenon on paper. There are conventions used in cartography which allow a map to be read efficiently and quickly.

(a) Legend

A good map will have a legend or key which will describe the map features with different symbols. For instance, a square with a flag on top usually represents a school and roads are represented by a variety of widths and combinations of lines.

(b) Scale

Scale represents ratio between map distances to ground distance.

(c) North Arrow

It depicts the true north. Without a north arrow, it is difficult to determine the orientation of a map. With a north arrow (pointing in the correct direction), a user can determine direction.

(d) Neat line

It is the border of a map. It helps to define the edge of the map area and obviously keeps things looking "neat."

(e) Projections

Since the map is a flat representation of the curved surface of the earth, all maps are inherently inaccurate. There are a variety of projections which have been formulated for different uses.

(f) Source

The map source shows the details about the source of information of the contents of the map.

(g) Title

The title represents the theme of the map. A map's title provides important clues about the cartographer's intentions and goals.

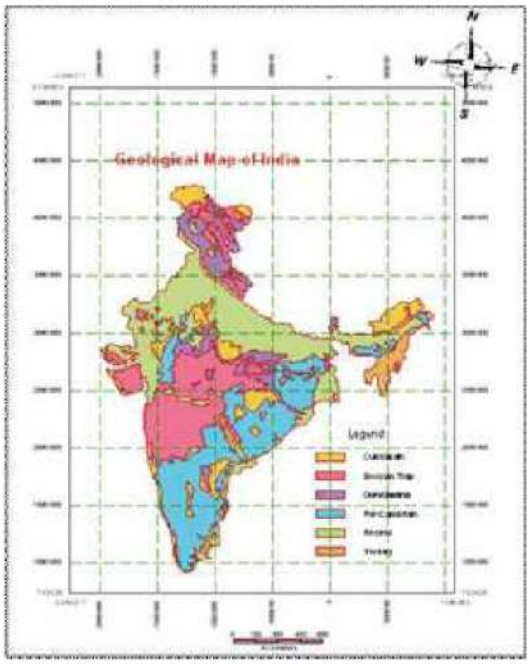


Fig. 26

2.5 Map Coordinate System

How can you locate yourself on earth? There should be some system which can calculate the location information by some known referencing point. That system is called Coordinate system. The coordinates systems are of two types viz. Geographic coordinate system and projected coordinate system. In this chapter we will be discussing the Geographic coordinate system. Projected coordinate systems will be discussed in Class-XII

(1) Geographic Coordinate System: The use of Geographic Coordinate System is very common. It uses degrees of latitude and longitude and Sometimes also a height value to describe a location on the earth's surface.

On the spherical earth, geographers used imaginary vertical and horizontal lines and numbered them. Latitudes are horizontal lines and longitudes are vertical lines. Geographers have taken equator as a starting point for latitude and the prime meridian for longitude. In the same way lines to the right of prime meridians show the east and those to the left of prime meridian show the west. Any location on Earth is described by

two numbers, latitudes and longitude. If pilot or a ship's captain wants to specify position on a map, these are the "coordinates" they would use. Actually, these are two angles, measured in degrees, "minutes of arc" and "seconds of arc." These are denoted by the symbols (°, ', ") e.g. 35° 43' 9" means an angle of 35 degrees, 43 minutes and 9 seconds;

2. Latitude: Imaginary Line drawn from West to East. Latitude runs parallel to the equator and divides the earth into 180 equally spaceds sections from North to South (or South to North). Latitudes above the equator are in the northern hemisphere and those below the equator are in the southern hemisphere.

3. Longitude: Imaginary Lines drawn from North to South Pole. Longitude runs perpendicular to the equator and converges at the poles. Longitude covers 180 degrees for east and 180 degree for west.

4. Prime Meridian: The longitude which passes through Greenwich, England is called Prime Meridian or Greenwich Meridian. It is zero degree longitude (0°), used as a reference line to measure the longitudes.

5. Equator: The equator is referred to as zero degree Latitude (0°), as a reference line from where the latitude measurements begin.

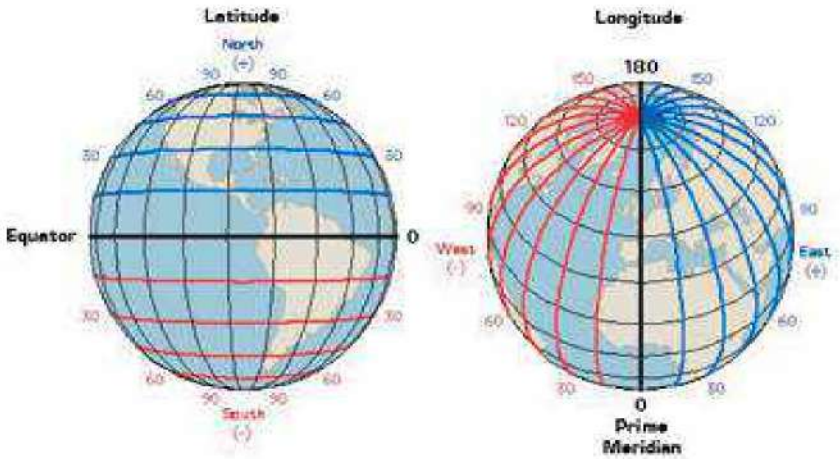


Fig. 27

2.6 Interpretation of Satellite Images

The act of examining Satellite Images for the purpose of identifying objects and judging their significance is called "Image Interpretation". The type and amount of information that can be extracted is based on the knowledge, skill and experience of the analyst.

Eight fundamental parameters are used in the interpretation of remote sensing images. In some cases, a single element alone is sufficient for successful identification; in others, the use of several different elements will be required. The following elements are used for interpretation of satellite image. The elements of image interpretation are location, size, shape, shadow, tone/color, texture, pattern, height/depth and site/situation/association.

Fig. 28

Elements of Image interpretation

In Landsat satellite image, given below (Fig. 29) many features are recognizable by color, shape and texture. The blue color shows river, the green areas are forest, the variations in green relating to tree species. The black indicates the water body. The reddish pink shows the forest burn area. White lines indicate the road network.

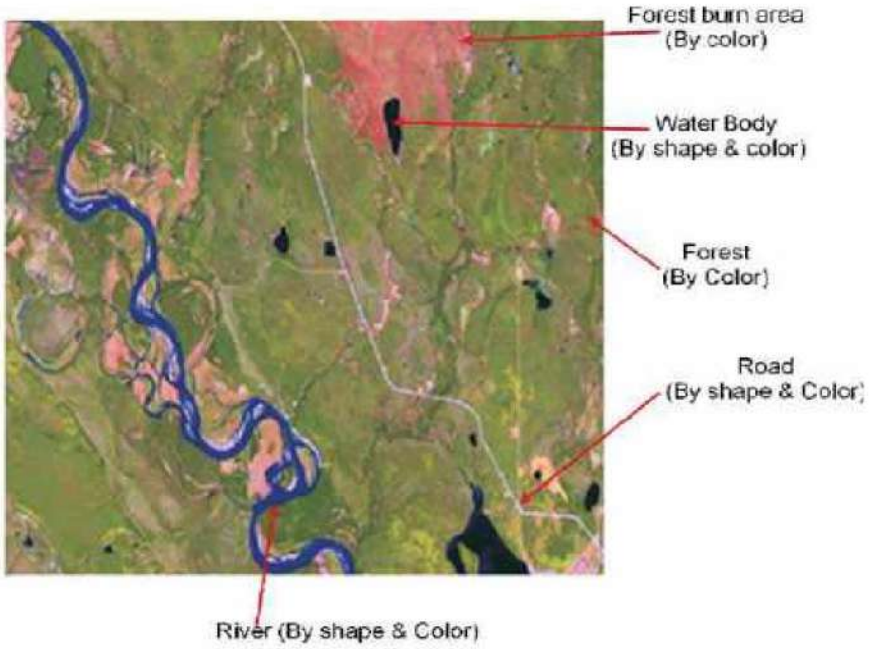


Fig. 29

Let us wrap up what we covered in this chapter

- Globe is a three dimensional model of whole earth.
- A map is a graphical & two dimensional representation of a portion of the earth's surface drawn to scale and uses colors, symbols, and labels to represent features found on the ground.
- A map provides information about the location distance between ground features, such as populated places & routes of travel and communication. It also indicates variations in terrain, heights of natural features, and the extent of vegetation cover.
- There are four types of elements used to depict different features i.e. Points, Lines, Polygons and Text.
- Maps are very important for planning, locating, navigating & getting knowledge of what else is there.

- Direction is usually indicated on a map by a North-South line with north represented by an arrowhead.
- Map symbols are used to represent the real world objects.
- Cartography is the art and science of map making, practiced by cartographers.
- The scale of a map is defined as the ratio of a distance between two points on the map to the corresponding distance on the ground.
- Scale is represented in three different ways: statement, representative fraction (R.F.) and graphical or linear scale
- Maps are classified into two categories like Large scale maps & Small scale maps
- Large-scale map shows greater details than small scale map of the same area
- Thematic maps are created according to the subject.
- Map elements are legend, scale, north arrow, neat line, projection, source and title.
- Geographic coordinate systems and projected coordinate systems are the two commonly used map coordinate systems
- Latitudes are imaginary Lines drawn from West to East. Equator is a zero degree latitude.
- Longitudes are imaginary Lines drawn from North to South Pole. Greenwich line or Prime Meridian is zero degree longitude line.
- A topographic map is a representation of both Natural and Manmade features on the ground.
- Contour is an imaginary line drawn on maps joining the places that have same heights.
- Contours which are CLOSE indicate STEEP terrain whereas contours which are OPEN indicate FLAT terrain.
- Eight parameters are used in the interpretation of remote sensing images such as location, size, shape, shadow, tone/color, texture, pattern, height/depth and site/situation/association

Review

Very Short Answer Questions

1. What is a globe?
2. What is cartography?
3. Why are directions used in a map?
4. A line of convenient length is divided into regular interval & graduated in terms of distances on the ground. True or False?
5. Small scale shows greater details. True or False?
6. Name types of maps used in planning and navigation?
7. Maps are classified into two scale maps. Name them.
8. Which latitude represents the zero degree latitude?
9. Where is the prime meridian?
10. Maps represent the earth three-dimensionally. True or false?
11. How are topographic maps prepared?
12. Indian toposheets are created by Survey of India. True or False?
13. As denominator of the representative fraction gets larger and ratio gets smaller the scale of the map decreases. True or False?
14. Cadastral maps represent both Natural and Manmade features. True or False?
15. By which map can you find the elevation of the terrain?
16. Name eight parameters used in the interpretation of satellite Images.

Short Answer Questions:

1. What is a Map?
2. What are the differences between globe and map?
3. What are the differences between point, line and Polygon?
4. What symbols would you use to represent a river, road, building and tree in a map?
5. Define Map scale.
6. Differentiate between large scale map and Small scale map.
7. What are contour lines?

8. How can you indentify steep and flat terrain?
9. What is a cadastral map?
10. Name the elements of Maps
11. Which map shows climatic parameters like rainfall, wind direction etc
12. Define in two lines

a) Latitude c) Prime meridian

b) Longitude d) Equator

Long Questions:

1. Explain the importance of maps
2. How do you locate yourself on the map?
3. The map scale is 1:25000. If distance between 2 points is 5cm then calculate actual distance on the ground. Explain the procedure.
4. Scale is represented in three different ways. Explain in detail
5. Explain the map features in detail
6. Explain the topographic map
7. What are the benefits of a topographic map?
8. What type of information can you collect from a topographic map?
9. What is a map legend?
10. Explain briefly about the thematic map
11. Describe the map elements
12. What is geographic coordinate system?