Indira Gandhi National
Open University
School of Sciences

BGGCT-133
GENERAL CARTOGRAPHY

Block

5

REPRESENTATION OF DATA

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BGGCT- 133

GENERAL CARTOGRAPHY

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BLOCK 5: REPRESENTATION OF DATA

There are certain methods and methodologies which provide a base for every domain of scientific knowledge. Geography is no exception, as it is also endowed with a rich repertoire of such knowledge base embedded in its core subject matter of cartography. To generate and further advance the knowledge base, after collecting the huge amounts of data from different sources, a geographer firstly employs certain techniques to segregate the irrelevant nature of data into relevant ones. Afterwards, he/she employs definite methods in the form of maps, graphs and diagrams that helps to see the nature and trend of distribution and spatial variations etc. Many Government agencies regularly prepares diverse kinds of maps to deal with different aspects like weather monitoring and forecasting, identifying and locating a mineral resource, planning the distribution of food grains, preparing maps for natural disasters and so on.

Over the years, with the advent of web resources like, for example Google Earth and Bhuvan portal, almost everyone whosoever is interested in maps has started acquiring mapping skills. With the help of satellite imageries and sophisticated mapping software's, the importance of maps and map making profession has grown manifold. A map made on different aspects definitely helps not only to devise a plan but also to manage the both set of natural and human resources spread on surface of the planet earth. The prime aim is to judiciously and consciously utilize the bounties of both nature and cultural landscape in a coherent and logical sense to keep these safe for the use of future generations also.

In order to portray the vast amount of data, geographers employ such methods and techniques suitably as per the need of the theme under investigation.

This last block introduces you to the representation of geographical data distributed into two units.

Unit 14 Graphs and Diagrams:

This unit will provide you the understanding of various kinds of graphs and diagrams used to represent the geographical data. These are one dimensional, two dimensional and three dimensional diagrams etc. You will come to know that which particular method may be used to represent different data types related to various aspects of both human and physical geography.

Unit 15 Maps:

You have already studied maps and its types in general in Unit 1 of Block 1 of this course. The final unit also deals with the maps with a detailed focus on thematic maps and its types along with techniques of their construction. There are mainly three kinds of techniques to represent diverse array of geographical data in its various forms.

We hope that after studying this block, you will be able to better understand and appreciate the graphs and diagrams and their types with usages and thematic maps, its types along with techniques of making such maps in particular.

Our best wishes are always with you in this endeavour.

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UNIT 14

GRAPHS AND DIAGRAMS

Structure

14.1 INTRODUCTION

In Unit 12, you have already learnt about representation of climatic data. If you remember we have discussed climograph, hythergraph, ergograph and wind rose. We have also discussed about the construction of these diagrams with the help of an example. You are now familiar with the representation of data. The only difference is that in Unit 12, we have discussed it exclusively in the context of climatic data. When we say geographical data, it includes data related to physical, environmental, social and economic aspects that explains the geographical phenomena. For example, when we want to explain themes related to population geography, we heavily rely on the census data. Similarly, when we discuss about economic geography, we take the help of economic surveys conducted by the different agencies of Government of India and state

governments and so on. Till now, you might have got an idea about wide array of data used in explaining several subject matters in geography. You might have also observed that these data are supported and visually represented by diagrams. You will agree that such diagrammatic representation of data brings more clarity and makes it easily comprehensible.

In this Unit, we will discuss about various dimension related to representation of geographical data through diagrams. In Section 14.2, we will describe general rules related to representation of geographical data through diagrams and in Section 14.3, we have explained categorization of these diagrams into various types. In the next three Sections, i.e., 14.4, 14.5 and 14.6, we will discuss some of the popular and extensively used types of one dimensional, two dimensional and three dimensional diagrams, respectively. In all the three Sections, we will describe general rules for construction of all of these diagrams supported by solving one exercise each.

Today, you can easily draw most of these diagrams with the help of computer assisted softwares. However, we will advise you to draw these diagrams manually to learn the processes of construction. Later on, you can try it in computer also.

Expected Learning Outcomes

After completing this unit, you should be able to:

- describe general rules for representation of geographical data through diagrams;
- state various types of diagrams used for the representation of geographical data;
- identify appropriate diagrams for representing the varied nature of geographical data; and
- analyze strengths and weaknesses of each diagram.

14.2 GENERAL RULES FOR DATA REPRESENTATION THROUGH DIAGRAMS

Before discussing in detail about various diagrams for representation of geographical data, let us know some general rules that are followed while constructing a diagram. We will also discuss about classification of major types of diagram. Some of the major rules for data representation are as follows:

1. **Selection of an Appropriate Method:** This is the first and foremost consideration we take into account while representing geographical data. As you know, geographical data are collected from various sources and represent various themes such as temperature, rainfall, growth of population, production, distribution and trade of different commodities, etc. These characteristics of the data need to be suitably represented by an appropriate graphical method. For example, data related to the temperature or growth of population between different periods of time and

for different countries/states may best be represented using line graphs. Similarly, bar diagrams are best suited for showing rainfall or the production of commodities. There are certain data which is best represented by combined line and bar diagrams. The data represented through this diagram is representation of temperature and rainfall of a particular place. You will learn more about it when we will discuss about various types of diagrams in subsequent sections of this Unit.

2. **Selection of Suitable Scale:** Once we decided about the methods of representation of geographical data, the next step is to select a suitable scale for measurement of data. As you have already learnt about it in Unit 3, Block 1 that scale is used as unit of measurement of the data for representation in the form of map or diagram in a piece of paper. Therefore, the selection of suitable scale for the given data sets should be carefully made and must take into consideration the entire data. You should try to choose a scale which is neither too large nor too small.

3. **Appropriate Design**: We know that design is an important aspect of cartographic work. It refers to the arrangement of diagram and its associated attributes. It includes title, legend and scale. In the case of map, the other factor which is taken into consideration is direction. Let us discuss these aspects of design one by one.

   (i) Title: The title of the diagram indicates the name of the area, reference year of the data used and the theme of the diagram. These components are represented using words of the paper and numbers of different font sizes and thickness. Normally, title, subtitle and the corresponding year are shown in the centre at the top of the map/diagram. We cannot describe this as a rule, but it is a matter of practice.

   (ii) Legend or Index: This is also another essential part of a diagram. It explains the colours, shades, symbols and signs used in the diagram. It must correspond to the contents of the diagram. Though, there are no set rules related to placing of legend or index, but normally it is placed either at the lower left or lower right side of the sheet in a map or diagram.

   (iii) Scale: Like legend, there is no set rules related to placing of scale also. To give presentation a balanced look, it is placed just opposite side of the legend at the lower side of the sheet if space permits. For example, if legend is placed at the lower right side of the sheet, then the scale is placed at the lower left side of the sheet and vice-versa.

14.3 Types of Diagrams

After discussing general rules for representation of data, let us discuss about types of diagrams prepared based on the nature of data. If we look at varieties of diagrams prepared based on diverse kinds of data, the diagrams can broadly be grouped into the following types:

(i) **One-dimensional diagrams:** It includes line diagram and bar diagram. These diagrams can further be sub-divided on the basis of its various

forms. For example, line diagram can be further sub-divided as simple line diagram, multiple line diagrams and band diagram etc. As the name suggests, it represents one dimension only.

(ii) **Two-dimensional diagrams:** These are basically those diagrams which represent data expressed in terms of area. As you know, area has two dimensions i.e., length and breadth. Examples of such type of diagrams are circular diagram, square diagram and rectangular diagram.

(iii) **Three-dimensional diagrams:** These are basically volumetric diagrams and have three dimensions namely length, breadth and depth. Cube and spherical diagrams are examples of three dimensional diagrams.

SAQ 1

i) Name the various aspects that are taken into consideration while designing representation of data through diagrams.

ii) State any one example each from one dimensional, two dimensional and three dimensional diagrams.

14.4 ONE DIMENSIONAL DIAGRAMS

As mentioned in the previous section, these diagrams have only one dimension which is length. Bar and line diagrams are the best example of one dimensional diagram. In this section, we will describe various types of bar and line diagram.

14.4.1 Bar Diagrams

These diagrams are also known as columnar diagrams. It consists of a series of columns or bars that are proportional in length to the quantities they represent. Bar diagrams are widely used because of their simplicity in terms of construction and comparison. The bars can either be vertical or horizontal. Vertical bars are drawn when data is to be shown with reference to time. For example, vertical bars are more suitable when we want to show population of India from 1911 to 2011 or rainfall distribution in 12 months of the year. On the other hand, horizontal bars are used when comparisons with reference to time are not required e.g., population of different states of India in 2011.

Rules for Drawing Bar Diagrams: Following points should be kept in mind while drawing the bar diagrams:

(i) All the bars should have equal width. However, there are no fixed rules regarding the width of the bars. But care should be taken that the bars should neither be very wide nor very narrow. The width of the bars should be determined keeping in view the number of bars to be constructed and the size of the paper in which these diagrams are presented.

(ii) The bars should be equally spaced. The spaces separating the bars should not be more than the width of the bars.

(iii) A suitable scale is selected to draw the bars keeping in view the maximum and minimum values as well as the size of the paper. The scale should neither be too large so that the longest bar is not accommodated on the paper nor it should be too small so that the smallest bar loses its identity.

(iv) If the data to be shown pertains to a specific time, it should be arranged in ascending or descending order. Otherwise, there is no need for such an arrangement.

(v) The unit of the quantities such as persons, degrees and kilometers etc., is written along the scale. As far as possible, the counting on the scale should start from 'zero'.

(vi) The heading should include the elements to be shown i.e., population, food grains, road lengths and temperature etc., along with reference year/s and place/s.

(vii) In order to make the presentation of bars attractive, it is necessary to colour them or give them some appropriate shades.

Advantages and Disadvantages of Bar Diagrams: After discussing rules for drawing bar diagrams, let us learn about advantages and disadvantages of bar diagrams. **Major advantages** of bar diagrams are as follows:

- The construction of bars is very simple.
- Comparisons can easily be drawn by looking at the length of bars.
- Even a common man can understand bar diagrams easily.

Some of the **major disadvantages** of bar diagrams are as follows:

- It fails to show elements having continuity such as temperature and pressure etc.
- These diagrams are not much useful in the event of high range between the maximum and minimum values.
- They cover a lot of space and are not frequently used on maps.
- Bar diagrams are also not very useful when the time period and spatial distributions are large. For example, it is very inconvenient to show the yearly food grains production in India for thirty years.

Types of Bar Diagrams: Although, there are several types of bar diagrams. However, some of the widely used bar diagrams are as follows:

(i) Simple Bar Diagram - Horizontal and Vertical

(ii) Multiple or Comparative Bar Diagram

(iii) Compound or Sub-divided Bar Diagram

(iv) Duo-directional or Deviation Bar Diagram

(v) Pyramid or Paired Bar Diagram

In this unit, we will describe the first three types along with one example each. We will also explain steps involved in the construction of each type of bar diagram.

(i) Simple Bar Diagram

As the name indicates, it consists of a series of bars drawn on a common base and scale. Each bar shows total value of only one variable. For example, this diagram is effectively used to show the production, consumption, export and import of different products for a particular time or of a particular area with respect to time. This diagram has the advantage of easy comparison because the length of each bar inside is proportional to the quantity shown by it. It is very simple to draw and understand this diagram.

Let us learn the entire process of construction with the help of the below given example.

Example 1: Draw a Vertical Bar diagram representing the below given data in table.

Table 1: Total Population of India 1951-2011.

Census Year	Total Population (in Crores)
1951	36.11
1961	43.92
1971	54.82
1981	68.33
1991	84.34
2001	102.70
2011	121.08

Steps involved in the construction of vertical bar diagrams are as follows:

(i) In this example, total population of India for the last seven census years is given. These data are concerned with time and are to be shown by vertical bars. Since the data are with reference to time and arranged sequentially, there is no need to arrange these data in ascending or descending order.

(ii) Draw a horizontal line in the lower part of a graph paper. This will be the base line OX. Draw another line perpendicular to the base line at its left end as OY. This line will work as the scale to show the variations in total population over the last seven census years.

(iii) Mark seven census years at appropriate equal distance along the base line.

(iv) Select a suitable scale keeping in view the maximum and minimum values of population. In this case, we have selected 1 cm = 10 crores as scale. Calculate the length of all seven bars. For example, if 1 cm length on the graph paper represents 10 crores of population, then 36.11 crores

population in 1951 will be shown by 3.61 cm length of the bar on the graph paper. Similarly, calculate values in case of rest of six census years and draw the six bars accordingly.

Once you complete the construction, your bar diagram will be similar to the figure as given below (Fig. 14.1).

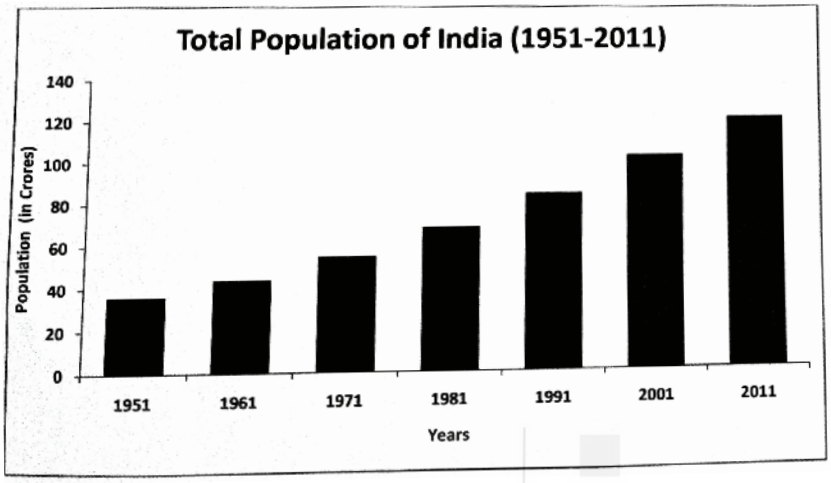

Fig. 14.1: Vertical bar diagram showing total population of India, 1951-2011.

(ii) Comparative or Multiple Bar Diagram

The multiple bar diagrams are used to show two or more than two sets of data of the same category with respect to time or space. These data are shown by a set of bars drawn adjacent to each other. The sets of bars are separated from one another by equal space. The length of each bar is in proportion to the quantity represented by it. Thus, data concerning rural and urban population, males and females, literates and illiterates, production of different agricultural crops, industrial products etc., are shown by multiple bar diagrams. Such diagrams are best suited for drawing comparisons and hence are also known as comparative bar diagrams. Different bars showing similar data are given different shades to distinguish them from one another. These shades are made clear by drawing a legend or index at the bottom or at one side of the diagram as explained in previous Section.

Example 2: Draw a multiple bar diagram representing the below given data in table.

Table 14.2: Total Population in India, 1971-2011.

Census Year	Total Population (in Crores)	Rural Population (in Crores)	Urban Population (in Crores)
1971	54.8	43.9	10.9
1981	68.3	52.4	15.9
1991	84.7	62.9	21.8
2001	102.9	74.3	28.6
2011	121.0	83.3	37.7

Steps involved in the construction of multiple bar diagrams are as follows:

(i) Table 14.2 shows rural, urban and total population of India for five census years. This data has to be shown by multiple bar diagrams. The construction of multiple bar diagram is similar to that of simple bar diagrams.

(ii) Like the previous example of simple bar diagram, draw base line and decide the scale. In this case also, we have selected 1 cm = 10 crores as scale.

(iii) It shows rural, urban and total population for each census year by set of three adjacent bars. Each set of three bars representing one census year should be separated from another census year at appropriate equal distance along the base line.

(iv) Give different shades to these bars to differentiate one from the other and draw the index. Thus, your diagram is complete as shown in Fig. 14.2.

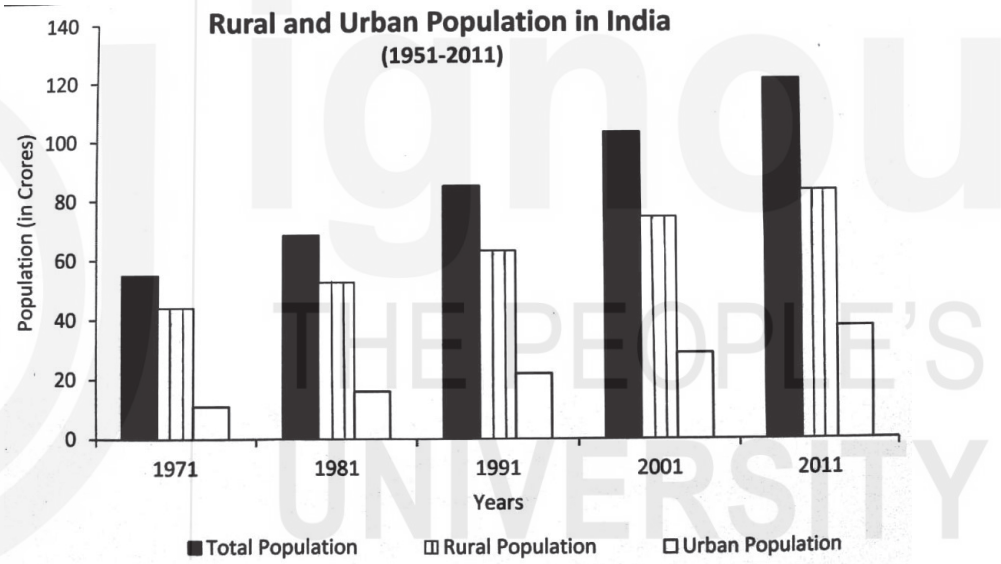

Fig. 14.2: Comparative bar diagram showing rural, urban and total population of India, 1971-2011.

(iii) Compound or Sub-divided Bar Diagram

A simple bar shows only the total values but a compound bar is capable of showing the constituents as well as the total value in the same bar. For example, a simple bar can show only the total production of food grains while a compound bar can show different types of food grains such as wheat, rice, maize, jowar, bajra and barley etc., by sub-dividing the same bar according to the scale. Similarly, a compound bar can show total population as well as population falling in different age groups while a simple bar can show only the total population.

First of all, a simple bar is drawn to show the total value. Then, the bar is divided according to the quantity of the constituents. Each division is given a different shade or colour for identification and comparison. Care should be taken to keep the same sequence of shades or colours in all the bars to

facilitate easy comparisons. Index to shades or colours is invariably given at the bottom of the diagram. It should however, be noted that this diagram can be drawn only if the units of the total and the constituents are same. If there is only column, the components are arranged in descending order for a better visual impact. It is worth noting that the comparison of the components becomes unintelligible when the number of the components is rather too large. The number of components should not exceed 5-6 in the interest of case of drawing and good comparison.

Example 3: Draw a compound bar diagram representing the below given data in table.

Table 14.3: Consumption of Electricity by Sectors in India 2012-17 (in thousand giga watt hour).

Year	Industry	Agriculture	Domestic	Commercial	Railways	Others	Total
2012-13	36.60	14.75	18.37	7.28	1.41	4.03	82.4
2013-14	38.44	15.27	19.98	7.42	1.55	4.74	87.4
2014-15	41.83	16.89	21.74	7.84	1,62	4.93	94.85
2015-16	42.35	17.32	23.89	8.60	1.66	6.23	100.1
2016-17	44.02	19.12	25.58	8.98	1.57	6.85	106.1

Steps involved in the construction of sub-divided bar diagrams are as follows:

(i) The given data can be effectively shown by a compound bar diagram. First of all, draw a bar showing the total consumption of electricity by different sectors in India.

(ii) For this purpose, take a graph paper and select a scale according to the quantity to be shown and size of the graph paper and draw a horizontal straight line. Supposing 1 cm length of the line shows 10,000 giga watt per hour, then the length of the bar showing different years will be as follows:

82.4/10 =8.24 cm for 2012-13; 87.4/10=8.74 cm for 2013-14; 94.85/10=9.48 cm for 2014-15; 100.1/10=10.01 cm for 2015-16 and 106.1/10=10.61 cm for 2016-17.

In similar manner, calculate the values for different sectors for all the five years.

(iii) Arrange the consumption of electricity in descending order for a better visual impact. The sequence of sectors in descending order is industry, domestic, agriculture, commercial, other sources and railway.

(iv) Draw five bars of 8.2 cm, 8.7 cm, 9.5 cm, 10.0 cm and 10.6 cm long to show the total electricity consumption by different sectors in India for the

above said five years. Divide 8.2 cm into 3.7 cm, 1.8 cm, 1.5 cm, 0.7 cm, 0.4 cm and 0.1 cm lengths of this bar to show the proportion of contribution by industry, domestic, agriculture, commercial, other sources and railway sector for the year 2012-13. Similarly, calculate for the other four years and subdivide the bars accordingly.

Once you complete the construction, your bar diagram will be similar to the figure as given below (Fig. 14.3).

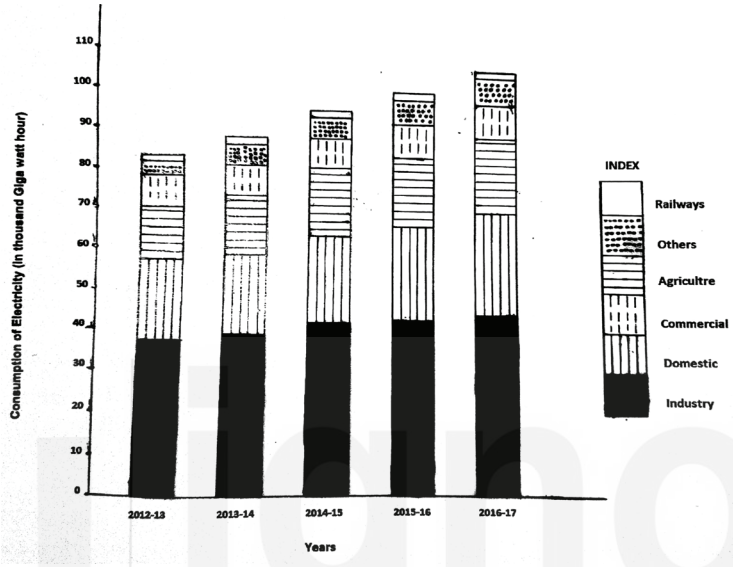

Fig. 14.3: Compound bar diagram showing total and sector-wise consumption of electricity in India 2012-17.

SAQ 2

Fill in the blanks with suitable words.

(i) Bar diagrams are also known as _____-_____.

(ii) Multiple bar diagram is also known as_____.

(iii) The number of components in sub-divided bar diagram should not exceed 5-6 in the interest of case of _____and _____.

14.4.2 LINE DIAGRAMS

This is a simple and extensively used diagram in which the data are shown with the help of a line or lines. This line is drawn with reference to two co-ordinates, one is the horizontal direction and is called X-axis. The other is in the vertical direction and is called y-axis. The point at which the X-axis and the Y-axis originates serves as 'zero' or 'starting point'. The measurement along the X-axis and Y-axis are called abscissa and ordinate respectively. The X-axis shows independent variables such as months, years, states and countries etc. while Y-axis shows dependent variables such as temperature, population and production etc.

With this basic background, let us learn the basic points to be kept in mind while constructing line graphs.

Points to be considered for drawing Line Graphs

Following points are to be considered while drawing a line graph:

- Scale is selected considering the maximum and minimum values of the given data as well as the size of the paper.
- Variation over time or area is shown along the X-axis and data are shown along the Y-axis.
- The graph should be properly labeled. In order to facilitate reading, labeling should be done in a horizontal direction as far as possible.
- Different design of lines should be used when more than one line is to be drawn on a single graph. For example, if four lines are to be drawn, they can be simple line, broken line, dotted line and broken lines with a dot in between the broken line.

Types of Line Graphs: There are several types of line graphs. But, following line graphs are more popular and are widely used for showing statistical data:

(i) Simple Line Graph

(ii) Combined Line and Bar Graph

(iii) Polygraph or Multiple Line Graph

(iv) Compound Line Graph or Band Graph

(i) Simple Line Graph

As its name suggests, this is a simple graph in which there is only one line showing only one element. This is one of the simplest to understand, easiest to make and most widely used.

Example 4: Draw a line graph representing the below given data in table.

Table 14.4: Mean Monthly Temperature of Jodhpur (in Degree Celsius).

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
17	19	25	30	34	34	31	29	29	27	22	18

Steps involved in the construction of line diagrams are as follows:

(i) Draw lines along X and Y-axis as OX and OY respectively. Mark the independent variable i.e., months in this example on the X axis and the dependent variable i.e., mean monthly temperature on Y axis at an equal interval.

(ii) Select an appropriate scale and mark it on Y-axis. In this case, we have selected 1 cm = 3^0 Celsius. Calculate the remaining values accordingly.

(iii) Plot all the twelve months data to depict month-wise values of mean monthly temperatures according to the selected scale on Y-axis. Mark the location of the plotted values by a dot and join these dots by a free hand drawn line and complete the diagram.

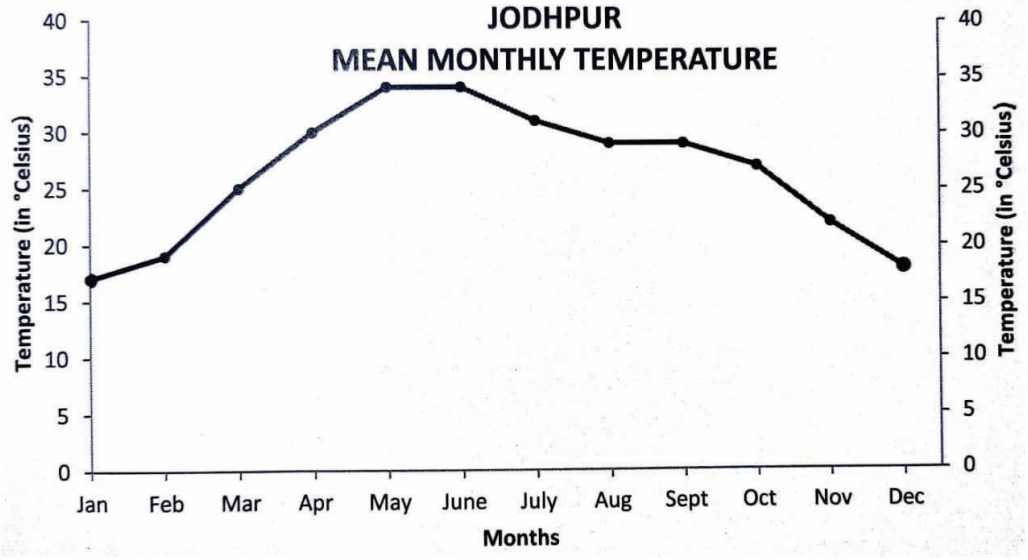

Fig. 14.4: Line graph.

(ii) Polygraph or Multiple Line Graph

The literal meaning of polygraph is 'many graphs'. Thus, a polygraph consists of two or more lines drawn on the same graph. These lines show two or more inter-related variables. This diagram is used to show inter-related variables of one area over a period of time or of different areas over the same time period. For example, mean, maximum and minimum monthly temperature of a place, birth rates and death rates, male-female, literate-illiterate components of population, imports and exports, as well as agricultural products, industrial products and minerals and power resources etc.

The greatest advantage of a polygraph is that it helps in drawing comparisons. But it loses its utility, if a large number of curves are drawn on the same graph. In such an event, several graphs will cut and merge with one another. For the purpose of identification and comparison, different lines are indicated differently from each other. These lines can also be drawn in different colours. An index is prepared to identify different curves.

Steps involved in the construction of multiple line diagrams are similar to simple line graphs**.** Let us draw a multiple line diagram with the help of below given data.

Example 5: Draw a multiple line graph representing the below given data in table.

Table 14.5: Mean Monthly Temperature of Shillong, Pune and Chennai (in Degree Celsius).

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Shillong	10	11	16	19	19	21	21	21	20	17	13	10
Pune	21	23	26	29	30	28	25	25	25	26	23	21
Chennai	25	26	28	31	33	33	31	31	30	28	26	25

Once you complete the steps of construction, your polygraph or multiple line graph will be similar to the figure as shown in Fig. 14.5.

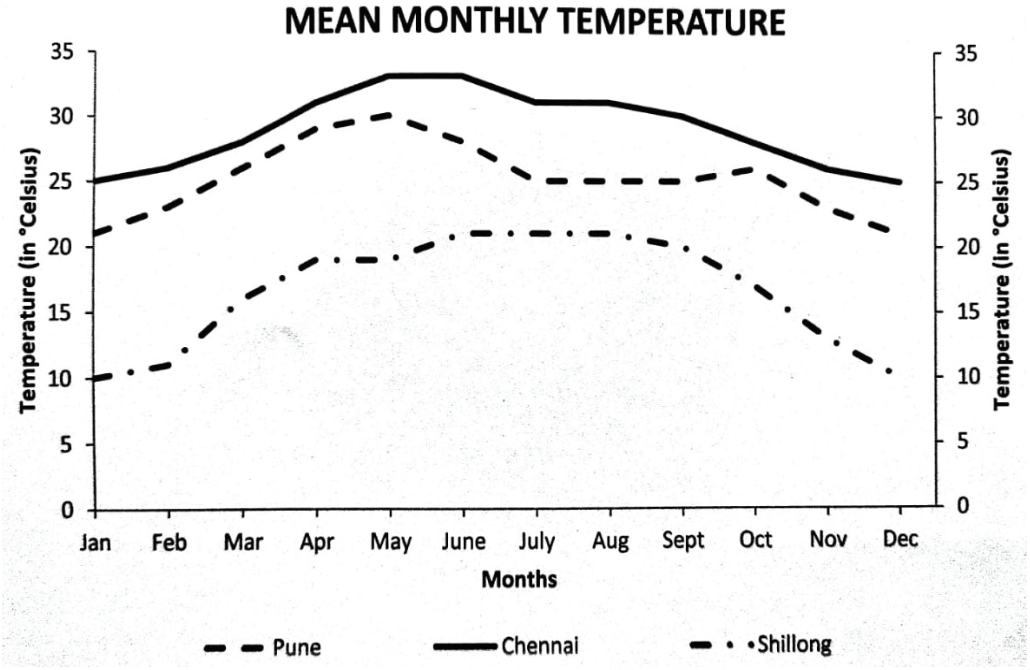

Fig. 14.5: Multiple line graph.

(iii) Combined Line and Bar Graph

This is a special type of diagram in which a line graph is combined with a bar graph and both are drawn within the same frame. This diagram is mainly drawn to show temperature and rainfall of a place for all the 12 months of the year. Temperature exists at all the times and changes regularly. Therefore, rainfall is shown by bar graph.

Example 6: Draw a Combined Line and Bar diagram representing the below given data in table.

Table 14.6: Mean Monthly Temperature and Rainfall of Delhi

Months	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Temperature (^{0}Celsius)	14	17	23	29	34	35	31	30	29	21	20	15
Rainfall (in Millimeters)	21	24	13	10	10	68	186	170	125	14	2	9

(i) Draw lines along X and Y-axis as OX and OY respectively. Divide X-axis into 12 parts at an equal interval to show the twelve months in a year.

(ii) Select suitable scales for both temperature and rainfall. In this case, we have selected scale for temperature as 1 CM = 5° C. This data is represented on the Y-axis and is marked on right side of the Y-axis.

(iii) Similarly, we have selected scale for rainfall as 1 CM = 20 mm. This data is represented on the Y-axis and is marked on left side of the Y-axis.

(iv) Temperature data are plotted using line graph and the rainfall data are plotted using bar diagram as shown in Fig. 14.6.

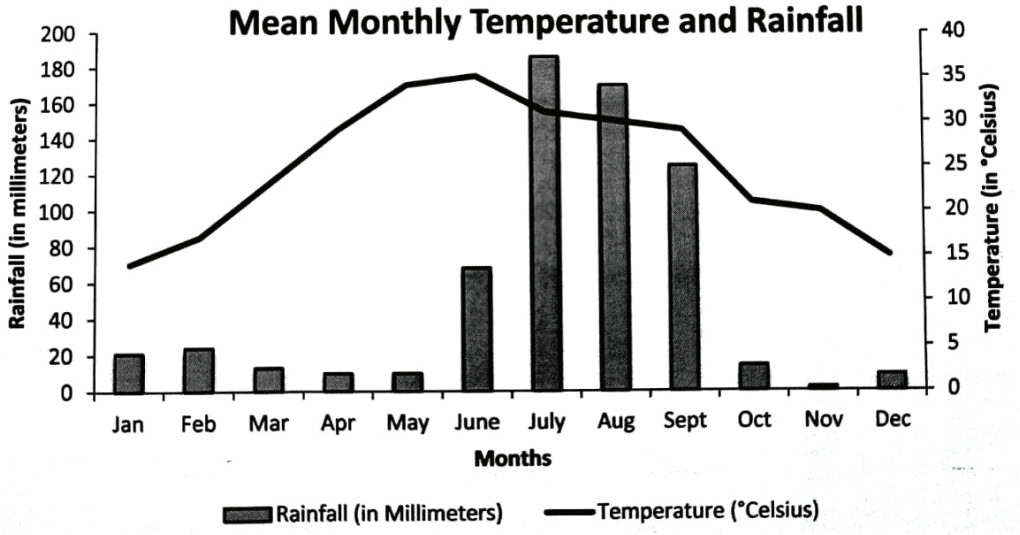

Fig. 14.6: Combined line and bar diagram.

SAQ 3

Match the two columns.

Type of Diagrams	Nature of Data
A) Simple Line Graph	i) Temperature and rainfall of Mumbai
B) Bar Diagram	ii) Month-wise Temperature of Kolkata
C) Multiple Line Graph	iii) Month-wise Rainfall of Chennai
D) Combined Line and Bar Diagram	iv) Temperature and Humidity of Delhi

14.5 TWO DIMENSIONAL DIAGRAMS

The name itself suggests that these diagrams have two dimensions i.e., length and breadth. These are also known as area diagrams. The area of two dimensional diagrams is proportional to the quantity represented by them. Do you know the advantages of two dimensional diagrams over one dimensional diagram? The major advantage is that they cover comparatively less space and capable of showing greater variations of data. Although, these diagrams are free from many defects of one dimensional diagram, these diagrams are also not free from drawbacks. Some of the major drawbacks are as follows:

- The area represented by two dimensional diagrams is proportional to the quantities shown by these diagrams. As a result of which, it is difficult to make direct comparisons.
- It is comparatively more difficult to draw two dimensional diagrams as compared to one dimensional diagram.

Types of two dimensional diagrams: On the basis of geometrical shape, the following types of two dimensional diagrams are generally recognized.

- Unit square diagram
- Square block diagram

- Rectangular diagram
- Circular diagrams

In this unit, we will describe only circular diagram out of the four types of diagrams mentioned above.

14.5.1 Circular Diagrams

These diagrams are called circular diagrams because they represent data using circle. In this diagram, the area of the circle is proportional to the quantity shown. That is why these diagrams are also known as **'Area Diagrams'**. Out of all the two dimensional diagrams, circular diagrams are most popular and widely used. This is because of the fact that it is comparatively easy to construct. These diagrams cover less space and their size can be determined according to the requirement. They spread equally in all the directions and give a balanced appearance. Circular diagrams are broadly divided into the following three types:

(i) Pie or wheel diagram

(ii) Proportional circles

(iii) Ring diagram

Out of these three types, we will discuss pie or wheel diagram which is most widely used.

(i) Pie or Wheel Diagram

Do you know why this diagram is known as pie or wheel diagram? This diagram looks like a wheel, hence named as wheel diagram. What about pie? You might have read in school level mathematics that pie represents a constant for the measurement of area in a circle. Like other circular diagrams, pie diagram also represents the quantities that are shown by the area of the circle. The circle is divided into various sectors whose areas are proportional to the quantities represented by them. Hence, it is also known as divided circles diagrams or coin diagram. In this diagram, a circle of suitable radius is drawn to show the total quantity. This circle is further divided into different sectors to represent different components of the total quantity. For this purpose, we have to calculate the angle formed by each sector.

In the below given section, you will learn about the method of dividing the circle.

Method of Dividing the Circle: We know that there are 360^0 in a circle. This means that 360^0 shows the total quantity. Hence, to divide the circle into different sectors for showing different components of the total quantity, we have to apply the unitary method.

Total quantity is represented by 360^0

One unit of quantity is represented by $= \dfrac{360^0}{\text{Total quantity}}$

$$\text{Given quantity is represented by} = \frac{360^0 \text{ X Given quantity}}{\text{Total quantity}}$$

If the components or sub-divisions of the quantity are given in percentages, then the angle of the sector will be calculated as follows:

$$\frac{360^0 \text{ X Given quantity}}{\text{Total quantity}} = \frac{360^0 \text{ X Given quantity} = 3.6^0 \text{ X Given quantity}}{100}$$

Let us learn the entire process of construction with the help of below given example.

Example 7: Draw a pie diagram representing the below given data in table.

Table 14.7: Land Use Pattern in India, 2002-03.

Types of Land Use	Area Covered (%)
Forest	22.57
Barren and Wasteland	06.29
Non-agricultural land	07.92
Permanent pasture and grazing land	03.45
Tree, crops and grasses	01.10
Cultivable wasteland	04.41
Fallow other than current fallow	03.82
Current fallow	07.03
Net sown area	43.41

Points to be considered for drawing Pie Diagram:

(i) Arrange the given data in descending order and calculate the angle for each sector representing different land use.

(ii) The method of calculating the angles and dividing the circle has been explained earlier. These calculations are as follows:

$43.41 \times 3.6^0 = 156.27^0 = 156^0$ $22.57 \times 3.6^0 = 81.25^0 = 81^0$

$07.92 \times 3.6^0 = 28.51^0 = 29^0$ $07.03 \times 3.6^0 = 25.30^0 = 25^0$

$06.29 \times 3.6^0 = 22.64^0 = 23^0$ $04.41 \times 3.6^0 = 15.87^0 = 16^0$

$03.82 \times 3.6^0 = 13.75^0 = 14^0$ $03.45 \times 3.6^0 = 12.42^0 = 12^0$

$01.10 \times 3.6^0 = 3.96^0 = 4^0$

Note: Rounded off as the same value, if decimal value is below 0.5 and rounded off to the next higher number, if the decimal value is above 0.5.

(iii) Draw a circle of suitable radius preferably in the range of 3-5 cm. Draw the above calculated angles at the centre of this circle to show various forms of land uses. It is always convenient to draw and read the diagram by taking vertical radius as the reference line and sectors are drawn in a clock–wise direction.

(iv) Give different shades to the sectors and prepare an index below the

diagram accordingly. Complete the diagram by adding the title and sub-title.

(v) After completion of these steps, your diagram will appear as shown in Fig. 14.7 below.

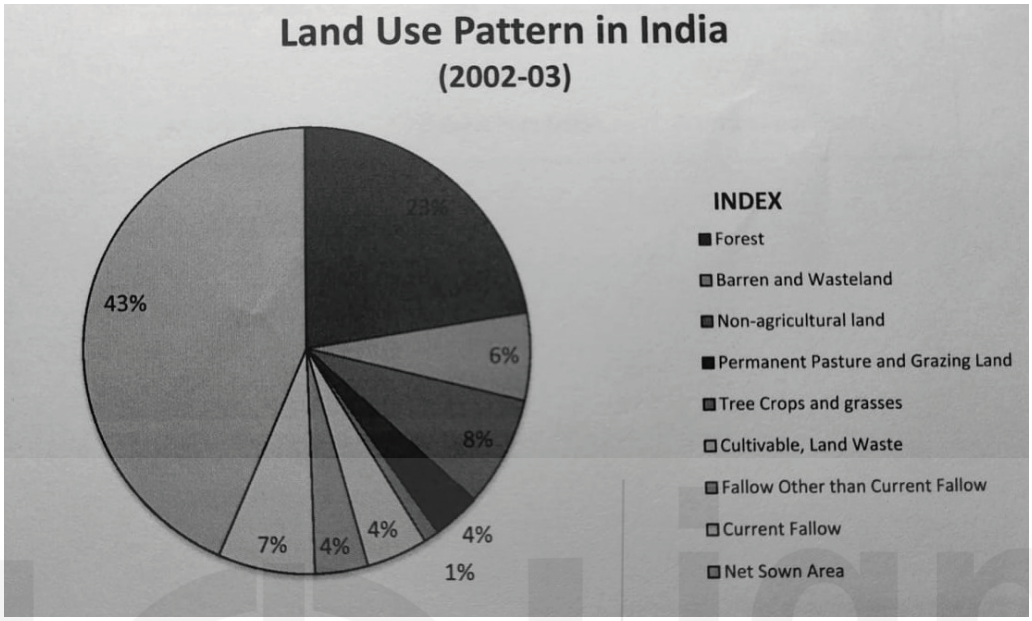

Fig. 14.7: Pie diagram showing land utilization in India.

SAQ 4

Which of the following statements are true and which are false.

(i) Proportional circles are one type of circular diagram.

(ii) Pie diagrams are also used as located diagrams.

(iii) It is always convenient to draw and read the diagram by taking horizontal radius as reference point and sectors are drawn in an anti-clockwise manner.

14.6 THREE DIMENSIONAL DIAGRAMS

As the name suggest, these diagrams have three dimensions viz., length, breadth and depth. Cubical and spherical diagrams are the main examples of three dimensional diagrams. The volume of three dimensional diagrams is proportional to the quantities they represent and as such they are also called volume diagrams. These diagrams occupy far less space as compared to two-dimensional diagrams. Thus, they are especially useful when the values of the given quantities vary greatly. These diagrams are also used as located diagrams on distribution maps.

14.6.1 Spherical Diagram

These are also known as proportional or graduated spheres. A sphere is that geometrical figure which has the minimum surface area in proportion to its volume. Therefore, spherical diagrams are better suited as 'located diagrams' than other three dimensional diagrams namely cubes and block pile diagrams. They are especially used when the variations in the quantities to be shown are

considerably large. For example, spheres have a unique utility when the proportion of a big city like Delhi is to be shown along with the population of its satellite towns. However, a sphere cannot be sub-divided and cannot show components of quantities. For example, a sphere can show only the total population of a city, but not its male-female or literate components.

Example 8: Draw a Spherical diagram representing the below given data in table.

Table 14.8: Population of Metropolitan Cities.

Metropolitan City	Total Population (in crores)
Mumbai	12,442,373
Delhi	11,034,666
Bengaluru	8,499,399
Hyderabad	6,731,790
Ahmedabad	5,577,940

Points to be considered for drawing Spherical Diagram:

(i) The first step in the construction of spheres is to calculate the radius of the sphere. As you know, it is proportional to the cube root of the quantity to be shown. Following formula is used for calculating the radius of the sphere.

$$\text{Required radius} = \text{Assumed radius} \times \sqrt[3]{\frac{\text{Given figure}}{\text{Assumed figure}}}$$

For convenience, we keep assumed radius as 1 cm. Cube roots can be found from the logarithmic tables.

(ii) The next step is to select a suitable scale. This is generally being done by considering the size of the paper and the quantities to be shown. Supposing 1 cm radius of the sphere represents 15,00,000 persons, then the radius of the spheres showing 12,442,373 population of Mumbai will be as follows:

$$\text{Required radius} = 1 \times \sqrt[3]{\frac{12,442,373}{15,00,000}}$$

$$1 \times \sqrt[3]{8.29} = 2.02 \text{ cm.}$$

(iii) Radii of spheres showing population of other cities can be calculated in a similar way. The required radius for Delhi, Bengaluru, Hyderabad and Ahmedabad are 1.95, 1.78, 1.65 and 1.55.

(iv) Draw four circles to show population of these cities and give it the shape of spheres. Care should be taken that the centers of all the spheres are on the same straight line and the spheres are equidistant. Write the names of the cities below the respective spheres and complete the diagram.

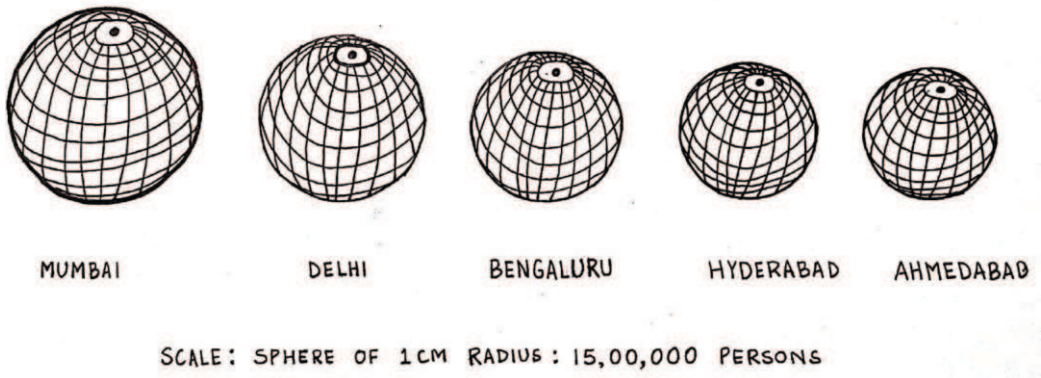

Fig. 14.8: Spherical diagram showing population of major metropolitan cities of India 2011.

SAQ 5

Fill in the blanks with suitable words.

(i) _____ and _____ are main examples of three-dimensional diagrams.

(ii) Spherical diagrams are also used as _____ on distribution maps.

(iii) The volume of three dimensional diagrams is _____ to the quantity they represent.

14.7 SUMMARY

In this unit, you have studied so far:

- Representation of geographical data through diagrams follow some general rules are namely selection of an appropriate method, selection of suitable scale, appropriate title, proper legend and design.
- The diagrams can broadly be grouped into one-dimensional, two-dimensional and three-dimensional. One-dimensional diagrams such as line graph, poly graph, bar diagram, histogram, age-sex, pyramid, etc., whereas two-dimensional diagram includes pie diagram, square diagram and rectangular diagram. Important three-dimensional diagrams are cube and spherical diagrams.
- One dimensional diagram represents one dimension which is length. Bar and line diagrams are the best example of one dimensional diagram.
- Two dimensional diagrams have two dimensions i.e., length and breadth. They are also known as area diagrams in which area is proportional to the quantity represented by them. Two dimensional diagrams have an advantage over one dimensional diagrams in that they cover comparatively less space and capable of showing greater variations of data. Major types of two dimensional diagrams are square diagram, rectangular diagram and circular diagrams.
- Three dimensional diagrams have three dimensions namely length,

breadth and height. Cubes and spheres are the main examples of three dimensional diagrams. The volume of three dimensional diagrams is proportional to the quantities they represent. These diagrams occupy far less space as compared to two-dimensional diagrams and are especially useful when the values of the given quantities vary greatly.

14.8 TERMINAL QUESTIONS

1. Describe the general rules to be followed while representing geographical data through diagrams.
2. Name any five types of bar diagrams. State any two advantages and disadvantages of bar diagrams.
3. Explain various types of line diagrams with suitable examples.
4. Why circular diagrams are most popular among two-dimensional diagrams? Explain.
5. Why three-dimensional diagrams are called volumetric diagram? State advantage and disadvantage of wheel diagram.

14.9 ANSWERS

Self Assessment Questions (SAQ)

1. (i) Title, legend or index and scale.

   (ii) One dimensional: Bar diagram and line graph; Two dimensional: Square, rectangular and circular; and Three dimensional: Cubical and spherical.

2. (i) Columnar diagrams

   (ii) Comparative bar diagram

   (iii) Drawing, good comparison

3. A - ii; B - iii, C - iv; D - i

4. (i) True

   (ii) False

   (iii) False

5. (i) Cubical, spherical

   (ii) Located diagrams

   (iii) Proportional

Terminal Questions

1. To answer this question, you must include the essence and importance of general rules while constructing a diagram meant to represent variety of geographical data. Refer to the Sec. 14.2.

2. After describing the five types of bar diagrams, you should highlight any two advantages and disadvantages of the same by referring to the Sub-Sec. 14.4.1.

3. Your answer should incorporate various kinds of line diagrams and their utility. Refer to the Sub-Sec. 14.4.2.

4. In your answer, you must highlight the key reasons behind the popularity of circular diagrams. Refer to the Sec. 14.5.

5. You should include the importance of volumetric diagrams. Additionally, you have to also highlight the merits and demerits of wheel diagram. Refer to the Sec. 14.6.

14.10 REFERENCES/SUGGESTED FURTHER READING

- Khullar, D.R. (2003). *Essentials of Practical Geography.* Jalandhar: New Academic Publishing Co.
- Mishra, R. P. and Ramesh, A. (1989). *Fundamentals of Cartography.* New Delhi Concept Publishing Company.
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- Sarkar, A. (2009). *Practical Geography: A Systematic Approach.* Kolkata Orient Blackswan Private Limited.
- Singh R. L. and Singh, R. P. B. (1991). *Elements of Practical Geography.* Ludhiana Kalyani Publishers.

UNIT 15

MAPS

Structure

15.1 INTRODUCTION

In previous Unit 14, you have learnt about various types of graphs and diagrams being put to use by the geographers and practitioners of other disciplines to represent the varied nature of diverse geographical and non-geographical data meaningfully. You have got the good idea that graphs and diagrams provide the visual grasp of the things at a glance to its user without going into the lengthy manuscript material in the given document, paper or textbooks etc. Basically, such methods facilitate to see the nature, pattern and trend of distribution as well as spatial variations of the phenomenon under study over a part of or whole earth's surface.

In this unit, we will focus on the meaning, types and techniques along with importance, uses and limitations of primarily thematic or theme based maps. Section 15.2 will focus and throw light on the thematic maps, its meaning

along with types. It is also known as distribution maps that makes possible the depiction of the varied nature of geographical phenomenon's including both natural and human found over the portion of or entire earth's surface. The techniques to make such maps will be discussed in Section 15.3. Study of such maps would enable you to interpret different theme based maps prepared by various government agencies and in research papers, reports and thesis etc., being drawn for one or other specific purposes. Section 15.4 will briefly highlight the uses, importance and limitations of thematic maps. You will get a fairly good idea about the different aspects of theme based maps along with its usage in geographical and thematic studies.

Expected Learning Outcomes

After completing this unit, you should be able to:

- appreciate and comprehend the meaning of thematic or theme based distribution maps along with their types and sub-types;
- define the scientific techniques of making thematic maps to enable the representation of various geographical features on a map; and
- figure out the multifarious uses, importance and limitations of thematic maps meant to serve diverse purposes.

15.2 THEMATIC MAPS: MEANING

Apparently, you may think that any map representing one particular theme may be termed as thematic map. It is true in general with little variations as discussed in the next paragraphs. Certainly, it is a kind of map in which generally one particular theme is displayed to show the geographical distribution and spatial variations therein. It is necessary to give you a broad idea or a background of all the possible themes here. It will help you to envisage the same determinedly before you proceed to solve the questions including self assignment and terminal ones of this unit along with the practical exercises given in the integrated laboratory course.

Thematic map is a map based on one or other definite themes. These maps came into existence approximately by the middle of 17th Century B.C. Such maps make use of the baseline information derived from an accurate base map. The base map contains both physical and cultural features (which you have already studied in Unit 11 of Block 4 of this course in detail), along with political boundaries, etc. A thematic map may represent a variety of physical and cultural themes. The physical themes could be geological, hydrological, glaciological, physiographic and climatic whereas human themes may include several themes as well as sub-themes including social, cultural, political and economic etc. For example, sub-themes for social category may be *Other Backward Castes (OBCs)*, and its numerous sub-groups, along with various caste and tribal groups such as for example, *Bhil, Santhals, Oraon, Andamanese* and *Nicobarese* tribal groups etc. Both physical and human themes may represent a particular part (e.g. ~ 111 or even less than or more than square kilometres of total geographical area), of a village, block, tehsil, district, state or nation in terms of its spatial context. The essence of thematic

map lies in the portrayal of invisible objects and their associated spatial or geographical patterns across the variety of physical and human themes and sub-themes altogether. The spatial pattern of rainfall distribution, major points of mineral deposits and arrangement of political boundaries which may not be visible on the ground are few examples. Thematic map is a symbolic illustration of the visualized location, patterns of distribution of various objects and phenomena under the earths' surface or any other terrestrial bodies under consideration. Diverse category of users or stakeholders including geographers and other earth scientists, social scientists, architects and planners, administrators and media etc., do make use of such theme-based maps for different needs. Nowadays, we believe that most of you are already aware of such theme based maps which are available from different sources including both government and non-government sources. Surprisingly, there is no doubt that you may have come across or may have used one such map unknowingly that deals with the distribution of geographical elements over the planet Earth.

As explained, it displays a specific theme, for example, the density and distribution of population in a given geographic region. It may differ from ordinary reference maps. The topo sheet on a scale of 1:1 million is an example of a general purpose map prepared by the Survey of India, Dehradun. Whereas soil map of India on a scale of 1:1,000,000 is an example of a thematic map. By and large, thematic maps are generally prepared on small scales. However, there are exceptions also. One example is that of a series of '**Golden Maps Service**' on a large scale of 1:10,000 and 1:5,000 with an aim to show the glimpse of the major landmark features and set-up of Indian cities prepared by ***'National Atlas & Thematic Mapping Organisations'*** (NATMO). An ordinary reference map displays all of the physical and human characteristics such as mountains and rivers, urban areas, state and nations etc. However, because of its focus on a single theme, a thematic map simply improves both the quality as well as purpose of a map. The classic example of thematic map in our country is that of the detailed district map series prepared by the ***NATMO*** for a number of districts in India. A detailed map prepared at 1: 500,000 scale displaying the basic physical and infrastructural characteristics of a district is one such example (Fig. 15.1). It also includes the following important and other ancillary themes as under:

a. Index map of the district.

b. A representative photograph/picture showing socio-economic and cultural aspects.

c. A small write-up indicating the geographical, historical and economic aspects.

d. Index maps (1:1 M scale) including:

i) relief and slope, ii) rocks and minerals, iii) soils, irrigation and hydrology, iv) population, v) general land use and cropping pattern, vi) climatic conditions, and industry etc.

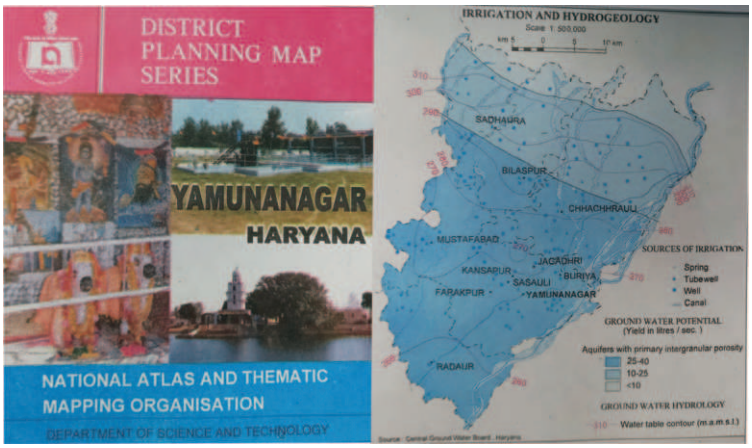

Fig. 15.1: An example of a District Planning Map Series.

(Source: NATMO, Government of India, Department of Science and Technology, Kolkata)

Fig. 15.1 shows a thematic map which offers a comprehensive picture of the various development parameters to facilitate the possible inputs from science and technology from different forums. Besides, NATMO also produces a variety of theme based maps as given under:

Population, industry, administrative, state maps, climate, Indian ocean, physical, tourism, forest, historical, water resources, education, land resources, health, agriculture, environment and pollution, social, business and economical, infrastructure and cultural etc.

A thematic map explores and studies the areal variation in a single geographic element. It helps the observer to ascertain the geographical as well as non-geographical factors responsible for producing the spatial variations. Geographic elements could be either physical or human characteristics as mentioned earlier. These maps may help the geographers, earth scientists, planners and academicians etc., to ascertain the causes of areal variations and inter-relationships among geographical factors in a part of or an entire region, state and nation etc. Presently, thematic maps are designed and produced in order to cater the needs of different user segments. The user segments could be academia, planners, administrators, politicians, non-governmental organizations, entrepreneurs and public as well. A map maker or map making agency should try to collect authentic and current information from the different data collection agencies. You have already studied some of such important agencies which provides different sorts of data in previous block of this course.

Besides, ensuring the preciseness of data used, several other techniques could be employed to check the data authenticity. For example, uni-variate mapping examines only one category of dataset that is ideal for mapping population distribution or some other geographical features of a region. And, bi-variate data mapping technique takes into account the relationship between two types of datasets. These could be distribution of population in relation to the type of terrain. Further, multi-variate technique of data mapping deals with two or more types of datasets to examine the distribution of population, type of terrain and the availability of resources in relation to each other.

A kind of thematic mapping depends upon the need and requirement of

cartographers to use and represent datasets in several ways. A cartographer is an expert in map making techniques. Both the type and techniques act as a medium to portray various geographical parameters in a visual way. It enables the diverse user segments to observe and comprehend the given thematic map more effectively without reading the written text. Thus, it enhances the visual as well as aesthetic appeal as well as saves on precious time of the diverse user groups. A good map is considered as a shorthand script of a geographer with which you are well familiar.

15.2.1 Types

Traditionally, thematic maps are categorized under three main components and various sub-components in general (which you have already studied in Unit 2 of this course), as emphasized and briefly discussed below:

Physical or Natural: There may be a variety of themes under physical or natural map types. It could be orographic (relief), bathymetric, geological, climatic, climate change, natural vegetation, soil, weather, astronomical and several other maps etc. These broader themes may have several sub-divisions e.g., natural vegetation may be sub-divided into several categories including temperate, tropical and desert type of natural vegetation etc., and so on.

Socio-Cultural: This type of theme based maps also covers a lot of topics. It may be economic, political, historical, social, land utilisation and special types. Again, as like physical category, socio-cultural types of maps may also be categorized under several sub-themes. For example, economic theme may have sub-themes like occupational structure, income groups (such like high, medium and low), type of economy be it agrarian based, industry based or information and communication technology driven economy etc. However, in reality, you may encounter or come across several other complex categories along with highly unorganised and unassorted sub-categories. The role of an active geographer fits here as he/she tries to unravel and differentiate these complex economic processes into a orderly, uniform patterns and associations. The government run organizations dealing with economic activities are primarily '***Directorate of Economic and Statistics'*** and '***Census of India'*** that tries to capture and distinguish the same across the states and union territories (UT's).

Strategic or Military Maps: As the name suggests that strategic maps are specific and is of special type. This category is, however, restricted to general, strategic, tactical and photomaps etc. It is primarily on account of strategic reasons of the concerned nation in question.

Besides, thematic maps are also broadly classified on the basis of aim of representation under two types. These are briefly discussed below.

1. Simple Thematic Maps

As the name itself tells us that a map which represents a unitary feature of a one theme only with the help of a various mapping techniques. You may

refer to above-mentioned text. Based on the type and nature of data inputs, simple thematic maps have further been categorized into three kinds. These are as under:

1. Qualitative thematic maps
2. Semi-quantitative thematic maps
3. Quantitative thematic maps

We will discuss few cases pertaining to each of these types with the help of a suitable example in the next section on techniques.

2. Complex Thematic Maps

You may be wondering that what do we mean by complex thematic maps? Such maps are developed to show the set of relationships in the form of associations, correlations, combinations, interconnectedness as well as dissimilarities etc. Such relationships could be employed and explored to represent one or more than one theme of study to highlight the myriad of tangible and intangible aspects as entailed in such themes. One such example could be of a map showing the relationship between the proportion of literate and illiterate segment of population, ratio of employed and unemployed youth having post-graduation degree, rainfall and its variability and so on. Basically, this type is used to highlight some specific piece of information. Essentially, all of the complex thematic maps are analytical in nature and belong to the quantitative category of representation. They generally make the comparison easier among the different aspects of a same theme or feature etc.

You can observe these techniques of visual representation meant to portray range of geographical data under these broad groups and sub-groups as shown in Fig. 15.2.

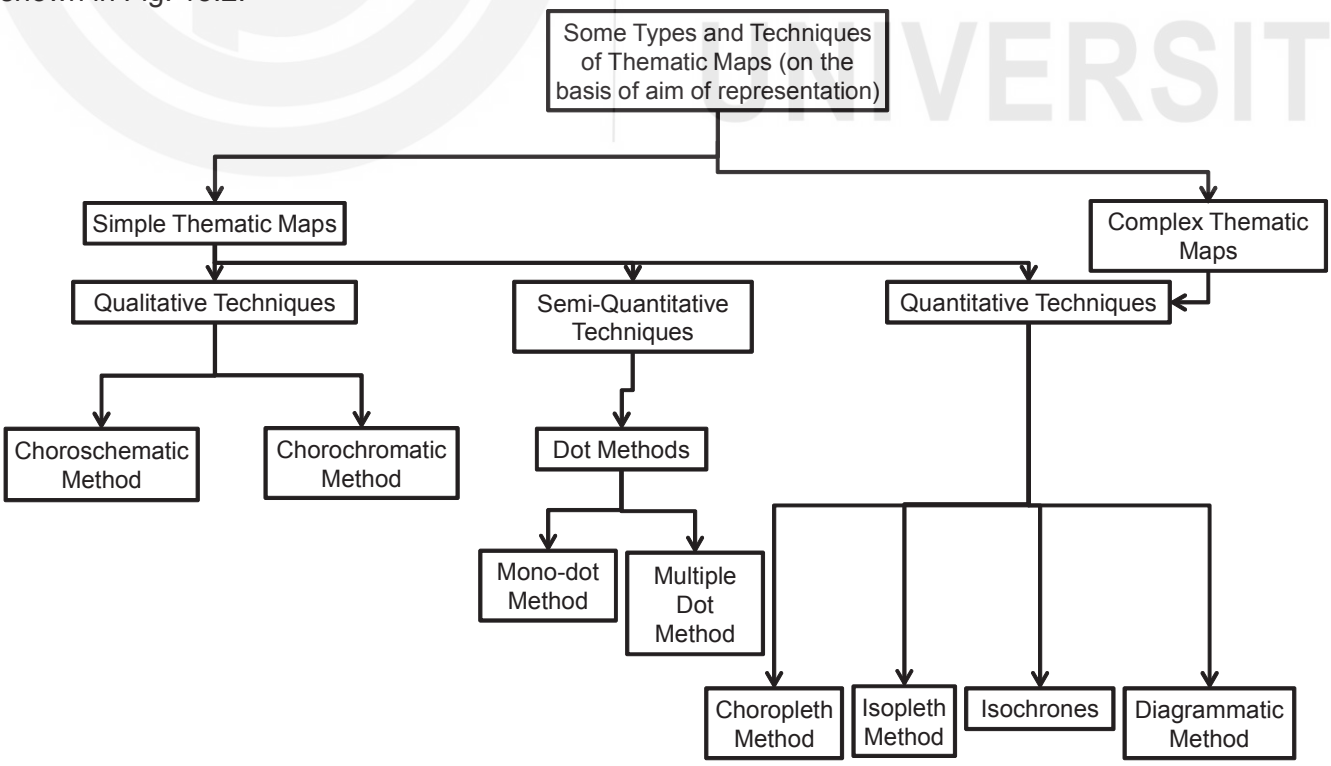

Fig. 15.2: Schematic diagram showing some types and techniques of thematic maps.

SAQ 1

What is a thematic map? Explain with examples.

15.3 TECHNIQUES OF MAKING THEMATIC MAPS

Many of the map making techniques which the practitioners of geography and other disciplines are using today has evolved through different periods of time and space. It is only through the application of these diverse and complex mapping techniques which lends a visual character to the variety of tangible and intangible geographical attributes on any given map. These techniques essentially act as a very important visual tool not only for geographers, but also for earth scientists and other natural and social scientists alike as mentioned earlier. In general, there are several principal thematic mapping techniques. You will study the theory part of some useful ones at undergraduate level here and learn about the techniques to make some of such maps in your integrated laboratory course. These are discussed as under:

15.3.1 Qualitative Techniques

In this technique, we may show one or more than one theme without the statistical or numerical inputs. The most commonly employed techniques with their sub-variants are discussed below:

i) Choroschematic or Symbol Method

This method demonstrates the spatial distribution of geographical features drawn either through geometrical, pictorial or letter symbols. Geometrical shapes, pictures or letter symbols for each of the chosen elements are first written meticulously on a map that is prepared. Secondly, these are drawn cautiously with even size and boldness. Scaling technique is employed to make it better and more useful. It highlights the symbols to represent a specific amount and the number of symbols that has to be made also gets evaluated with respect to the quantity that is being shown. Choroschematic map has major benefit of showing more than one element simultaneously on a single map. One of the classic examples is that of weather events map of India prepared by the Indian Meteorological Department, Pune as shown in Fig. 15.3. This map shows the spatial distribution of significant weather events during the year 2019 across the states and union territories of India. Another classic example is that of a mineral map (to show the spatial distribution of both metallic and non-metallic category of minerals), prepared by the Geological Survey of India. You may explore the web site links given in the reference Section to find out more on the same and other aspects.

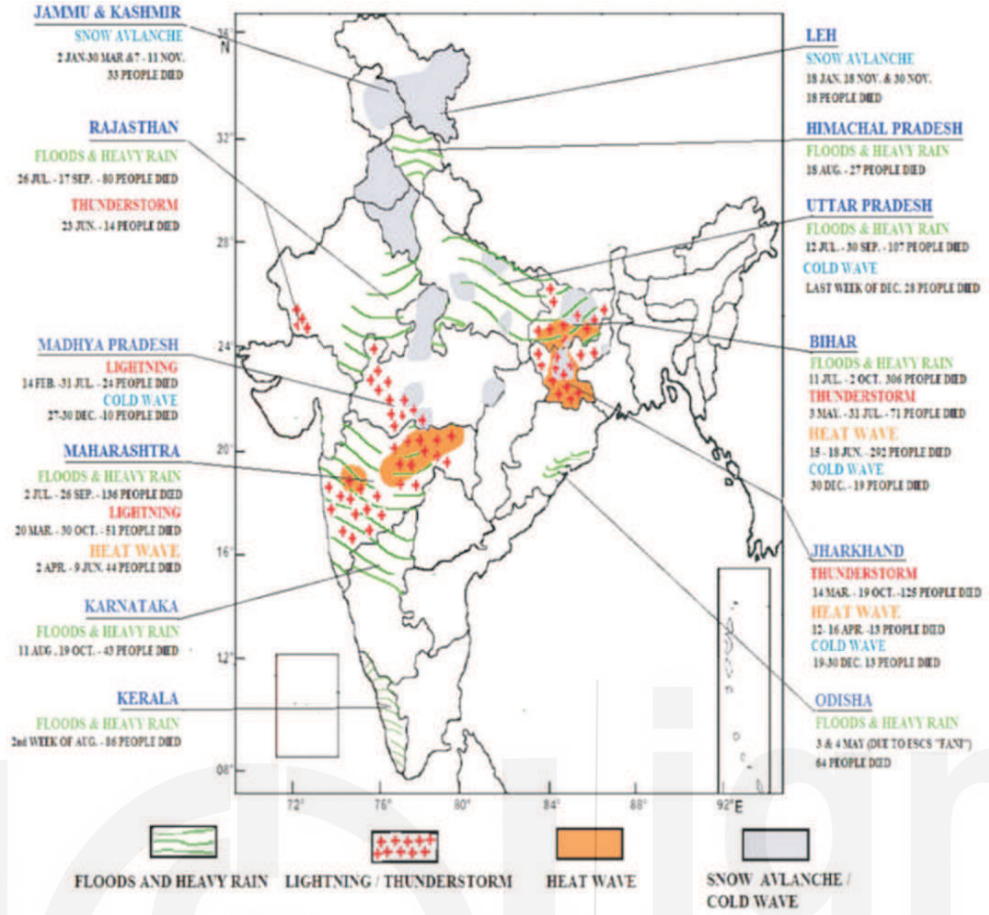

Fig. 15.3: Choroschematic map showing significant weather events during 2019, India.

(Source: Annual Climate Summary 2019, IMD, Pune, India)

Similarly, many other geographic elements may be conveniently shown with the help of this method. Few important ones are distribution of crops, fruits and vegetables and so on. You may think of more such themes and write in the page margin.

ii) Chorochromatic or Colour or Tint Method

The word 'Chorochromatic' is made up of two Latin words i.e. ***'Choro'*** means area and ***'Chromos'*** means colour. It is also known as **colour patch maps**. Different colours are used to represent the areal variations and spatial distributions of geographical phenomenon on a map.

Basically, this category of map is qualitative in nature since the steps involved in mapping techniques are done without taking the numerical inputs. Firstly, the emerging spatial patterns are outlined and then coloured accordingly. Generally, same colour tints are used to show characteristics of a single level spatial distribution. However, tint variations are also used to emphasize variations in spatial characteristics of a single element. The colour choice should mostly be conventional to depict the phenomena. Map should ideally contain the well arranged legend to show the used colour schemata. Colour mosaic enables the rational identification of the nature of spatial distribution. Sex ratio in general and child sex ratio, rural in particular, through different colour schemata along with many other geographical themes and sub-themes can also be represented. Such sub-themes may cover both natural as well as

human characteristics. These may encompass depletion of natural resources, air and water pollution, global warming, climate change, health problems like occurrence of cancer and flu epidemics and pandemics, crime and sustainable development etc., to indicate few plausible fields. One such theme is portrayed in the Fig. 15.4 to show the values of summer temperature in an isotherm map.

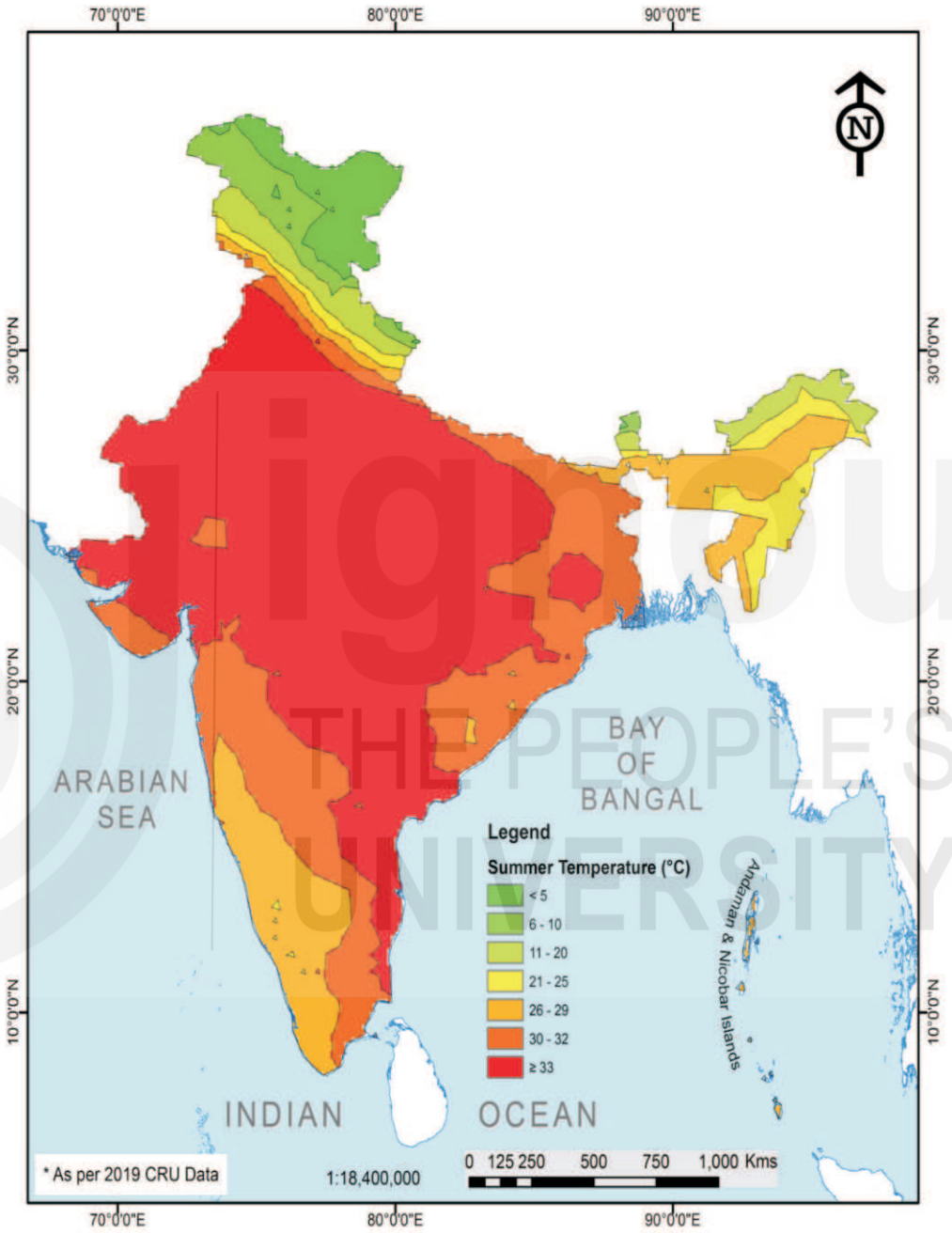

Fig. 15.4: Chorochromatic map showing summer temperature values in degree Celsius in India.

(Source: Data abstracted from Climatic Research Unit, CRU, 2019)

15.3.2 Semi-Quantitative Techniques

In this type, the techniques employed make use of a mixture of both numerical data and non-numerical data as an input to prepare a thematic map. Some of the prominent examples are dot map and slope maps etc., belonging to this category. We are dealing with one case as under:

i) Dot Methods

In this thematic mapping technique, the identical dots are used to explain the occurrence of a particular geographic theme like distribution and density of population and livestock resources. It provides a quantitative value with the help of a plotted dots for the visual representation. However, such dots placed on a map are rarely used for quantitative interpretation. Hence, dot maps are different than choropleth maps as they cannot provide the idea of area and quantitative measurement as such. Here, few important ones are discussed out of the several methods as under:

a) Mono-dot method: Spatial distribution of an array of socio-economic variables can be represented by this method. The technique to do so is by placing uniform size dots on a given map. Such map lends a visual impression regarding the relative density to be shown. However, it does not provide the absolute figures. To obtain the absolute figures, the user has to count all the dots on a given map. Dot maps are comparatively easy to construct since it doesn't employ either complex computations or manual skill unlike other type of maps as discussed earlier and some others also. On the whole, mono-dot maps are used to show the distribution of a single geographical variable. It

Fig. 15.5: Dot map showing the population density in India.
(Source: Census of India, 2011)

could be crop acreage, irrigation amenities or livestock and human resources etc. However, it is possible to present more than one geographical variable by adopting multi-coloured dot map. For example, male and female literacy can be presented in diverse colours in literacy map of a geographical region under study. One thing which needs to be taken care is the size of dots so as to create neither sparse nor crowded dot map to its users. After the careful selection of size and value of the dots, the pattern of distribution is determined by the areal unit that needs to be shown. In order to minimize the visual and spacing variation which would otherwise be high, dots need to be equally spaced within each areal unit in case of larger administrative units. An example of a dot map is shown in Fig. 15.5 representing the distribution of population density in India.

b) Multiple dot method: Mono-dot method doesn't yield desired output in many cases where the mass of the item to be shown is quite high. It gives rise to the trouble of residue. For example, suppose one particular geographical region has three types of animals with 10,100 and 500 number of animals. To represent this quantity, around 61 dots may be placed with each dot signifying 10 animals. The depiction of data may not be correct in both the cases. Such kind of inaccuracies could be reduced by decreasing the data values shown by each dot. In this way, large number of dots will be produced. In order to remove these data inaccuracies, multiple dot method which represents different values may be put to use. Thus, it is a suitable method if one is interested to represent large population base in a highly densely inhabited country similar to India and China etc. Due to uneven distribution of population density across the country, mono-dot method fails to yield good output. For example, the National Atlas and Thematic Mapping Organization (NATMO), of India has used multiple-dot method to show the distribution of population and population density. It is known as '**Population Series Maps**' of India constructed on 1:1 million scale. Dots are rightly placed at tehsil, sub-tehsil and town levels.

15.3.3 Quantitative Techniques

In this type, the techniques employed make use of the numerical data as an input to prepare a thematic map. Quantitative thematic maps embrace a greater number of techniques as compared to earlier two cases. Some of the prominent cases belonging to this category has been discussed as under:

i) Choropleth or Shading Method

This map displays the quantitative data in the form of colour. In this way, it is quite similar to that of chorochromatic method which you will study in the next section. It can be used to represent density, percent and average values or quantities of an event in a geographic region. The colouring scheme is chronological that displays rising or declining trends as well as positive or negative trends in the data values of the phenomenon under consideration. A single colour scheme displays a series of data values of a geographical occurrence as shown in Fig. 15.5. It shows the distribution of population (absolute numbers), in different states and union territories of India as per the data of 2011 Census period.

Basically, Choropleth maps are quantitative areal maps in terms of technical aspect (Fig. 15.6). It is used to explain the spatial distribution of intensity or density of any geographical factor. In doing so, it employs a system of categorized shadings using colour schemes. Choropleth maps are drawn along the boundary lines of the administrative units of a chosen geographical region under study. Intensity of shading is directly proportional to the density of elements portrayed as a basic principle. This map only shows average distributions over large administrative units. It gives rise to certain misunderstanding is that the grouping of a considerable unit under one average value implies distributional uniformity. But, it significantly differs from the real world situation as there may be a huge scope of local variations compared to the broader generalization. It is needless to mention that broader the study units shown, the wider will be the generalization shown in the choropleth maps.

This map also highlights the departure of the chosen data from its average values. For example, the literacy rate of a state may be taken as the mean and the deviation of regional disparities from this mean can be represented to give

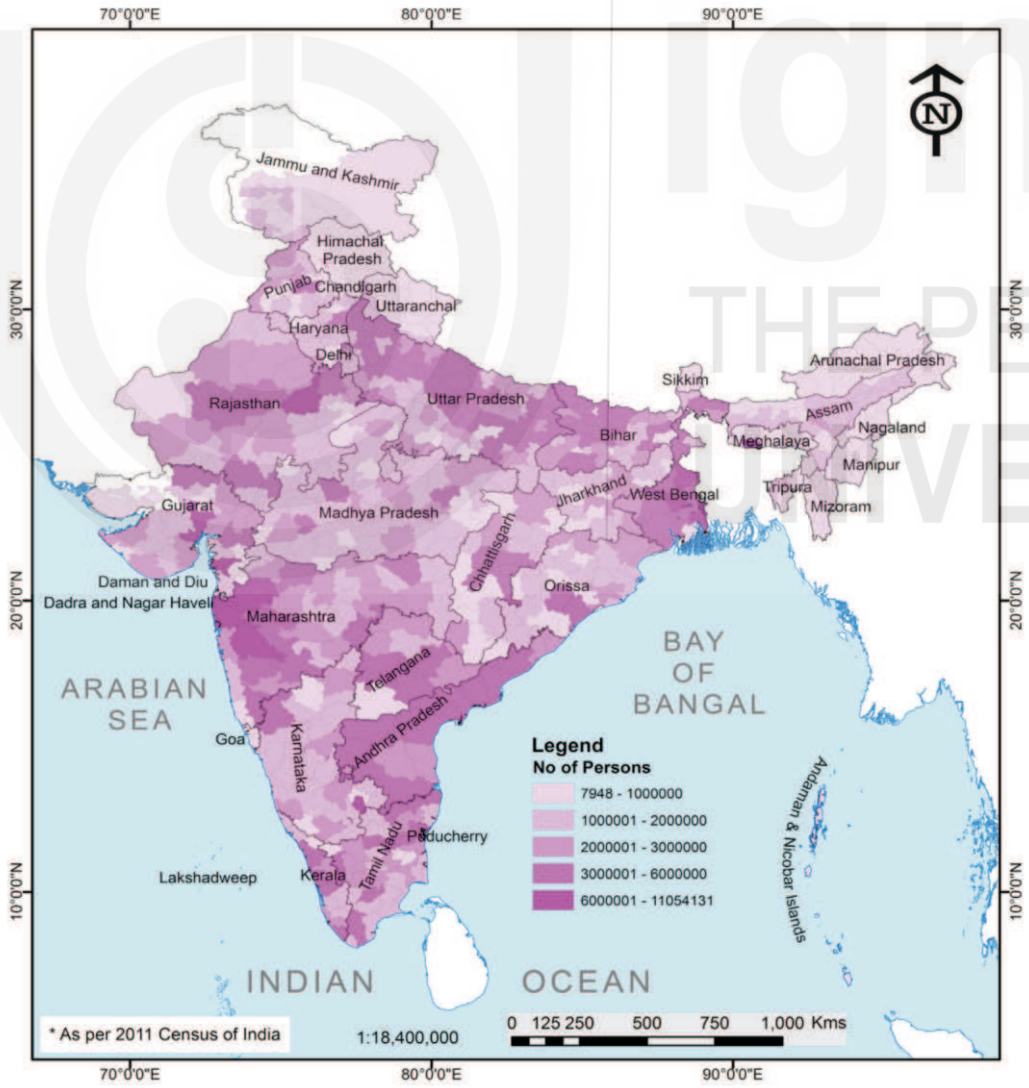

Fig. 15.6: Choropleth map showing population distribution in India, 2011.
(Source: Census of India, 2011)

an idea of the existing regional disparities. Such type of maps may be produced to highlight a variety of themes encompassing income level, literacy rate and rainfall distribution etc. It is also prepared to exhibit certain changes over two different time periods in two styles. For example, to show changes in the distribution of rainfall between 2001 and 2011, firstly, it can be drawn to choropleth maps showing rainfall distribution in 2001 and 2011. Secondly, it is done by calculating the index of change by dividing the total area of 2011 with the total area of 2001. Choropleth maps are considered as a basic tool of the human geographers than their counterparts i.e., physical geographers. The class intervals should be strictly chosen as per the need of the dataset and theme under study than theoretical base alone. The precision of the choropleth map is directly related to the smaller size of the administrative unit. In other words, you can say that smaller the administrative unit, higher will be precision or vice-versa.

ii) Isopleth Maps

This is a kind of quantitative areal maps. It consists of two words known as ***'Iso'*** which means equal and ***'Plethos'*** meaning a multitude or crowd. Here, quantities are indicated by lines drawn on the basis of equal values. There are several lines of equal values identified under following map types like isopleths, isarithm, isoline, isometric lines, isontic lines and isograms etc. A scholar named Wright (1944), had proposed that isograms can be used across the lines of quantity having two sub-divisions. The first one is the isometric lines which represents and accords an even importance or intensity to all points. Secondly, isopleths representing a quantity or account thought to be even, belonging to certain areas. Primarily, isopleths maps are trend-surface maps which exhibit three dimensions. Spacing of isopleths enables the showing of the spatial trends or distributional aspects concerning the geographical phenomenon that is being studied. Narrowly spaced isopleths depict the high spatial variation. Thus, it enables the regionalization of the feature under consideration. The precision of drawing of isopleths along with the resultant geometric pattern depends on the selected value intervals, the size and shape of the units for which statistics are available, the situation of the plotting-points and the actual method of interpolation as defined by two scholars Mackay in 1953 and Porter in 1958.

The value intervals need to be cautiously chosen based on the general range of quantities to be mapped. The class interval could be either isarithmic, geometric and based on usual splits in a frequency distribution. Both the frequency and density of evaluated points are dependent on the size of the enumeration unit. These two factors decide and control the interpolation of isopleths. This in turn determines the precision level of the maps. The situation and plotting of the points on a map are determined by the form of the areal units. Prior to interpolation, as a practice, areal centres are first marked. However, the actual principle of interpolation assumes that there is a consistent increase of values between any two points over the earth's surface. Consequently, the isopleths are proportionally placed from each other. Both the absolute as well as indexed values of any kind of information could be mapped into isopleths which entails spatial variation. The graded shading and

colours can be used between two isopleths to achieve fine distinction. In case of isometric lines, such maps, are known as 'chroisometer maps' while in case of isopleths, it is known as 'chorisopleth maps' (Wright, 1994). Isopleth maps can also be prepared for different time periods in order to see the change in the regional pattern of any geographical element like temperature and precipitation etc. An example of isopleth map is shown in Fig. 15.7.

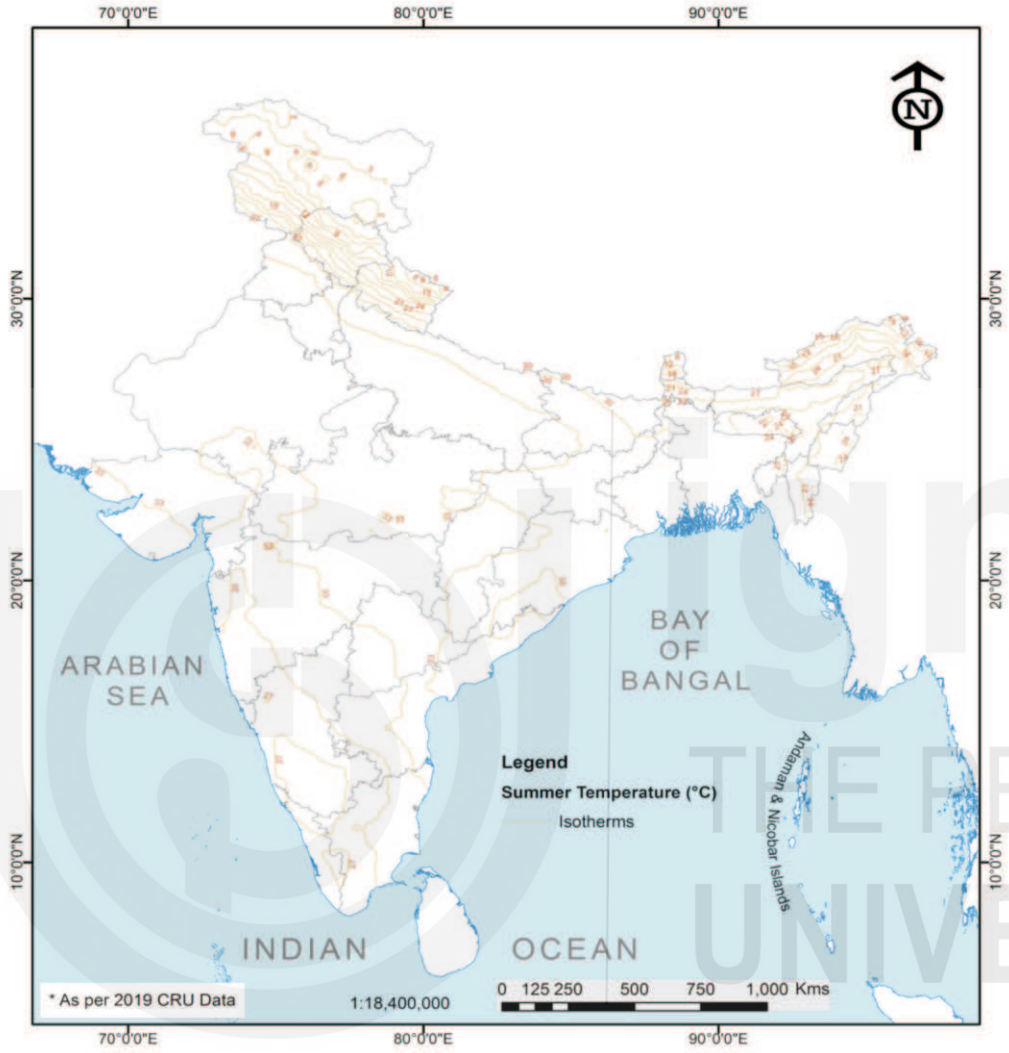

Fig. 15.7: Isopleth map showing the equal values of temperature (Isotherm lines) in India.
(Source: Data abstracted from Climatic Research Unit, CRU, 2019)

ii) Diagrammatic Methods

In this method, diagrams are used to highlight the distribution of various geographic features in a marked area on any given outline map under investigation. The placed diagram on the given outline map becomes known as **'diagrammatic map'** whereas diagrams are known as **'located diagrams'**. For such purposes, some of the commonly employed diagrams include bar, blocks, circular, cubical, line graph, rectangular, square and spherical diagrams etc. You have already learnt in detail about such diagrams in Unit 14 of the same course. However, in this unit, we will further make you learn that this method is specifically used to serve three distinct functions concerned with thematic or distribution maps as outlined below:

1. The necessity of explicitly showing certain geographical facts in terms of absolute statistical figures with the help of diagrams on the maps. One example is that of depiction of land use map of a given geographical region which can best be done by employing the circular diagrams. Secondly, the population of a large city can be best depicted by adopting spherical diagrams.
2. For example, the necessity of showing variation or sub-division within the main distributional features of geographical nature gives birth to make use of the various graphical diagrams. The best example is that of use of a graph diagram to depict the distribution of precipitation to ascertain the monthly and seasonal variations across the different precipitation stations under study. You can easily guess that such kind of information at a glance may facilitate different stakeholders who may be interested in knowing the same. List out three important stakeholders in the margin of this page and explore further to expand your knowledge horizon.
3. In case of non-availability of sufficient statistical data, when one intends to draw isopleths, in such cases, the data may be portrayed diagrammatically in a map. Some of the suggestive examples could be the appraisal of water resources including both realized as well as potential availability and to depict the value of renewable energy resources like solar, wind and geothermal etc. You may visualize some other cases and write the same in the page margins.

iv) Isochrones

This term signifies the occurrence of the same values as like that of 'isolines'. It connects two places to show the same amount of time taken to reach from a given geographic centre. Isochrones connect places which takes the same amount of time to reach from a given centre. We know that geographic distance is different from time-distance. All of you can easily visualize that when places are connected by modern means of transportation with each other spatially, it takes less time to go from one place to another. In our country, Metro Railway Transportation System is a classic example. As opposed to this ideal situation, it is not a difficult task to think that in geographical places or regions, wherever the means of transportation and communication are not very good or still in primitive stages of development, it will certainly take a lot of time to go from one place to another. The far-flung areas of many mountainous and remote states of our country are classic examples. The research studies exemplify that the latter situation is ultimately seen to be exerting a serious hindrance in the course of so-called technologically driven development of a place, region, its peoples and thereby the country as a whole. The visualization of these two situations which leads to development in one case and underdevelopment in another case with intrinsic and intricate localized spatial variations either falling in your place of residence or in neighboring administrative and political units or countryside is not a herculean task for all of you to think of. Example of an isochrone map showing the driving distance in minutes (as shown in legend), taken to traverse different parts of the metropolitan city from the central point, i.e., All India Institute of Medical Sciences (AIIMS), located in capital of India at New Delhi is shown in Fig. 15.8.

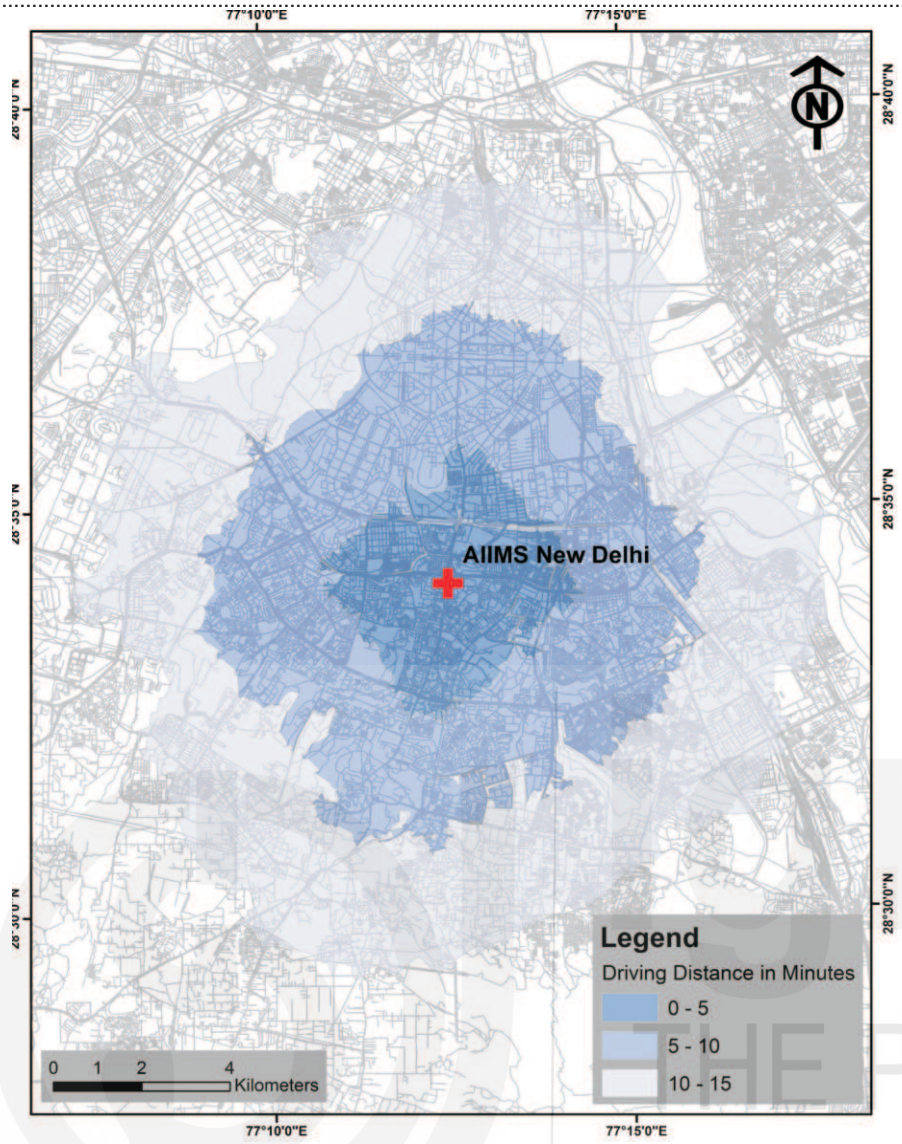

Fig. 15.8: Isochrone map showing the driving distance in minutes.

SAQ 2

Mention in brief about the chorochromatic maps?

15.4 IMPORTANCE, USES AND LIMITATIONS

We will together outline these directly associated aspects of thematic maps, one by one. Let us begin with the importance.

Importance

One of the major qualities of theme based or distribution maps is that it only shows the selected themes or features under study. For example, social, political and economic maps or geological, mineral, population, soil and vegetation maps etc. Such maps are useful in studying the relationship between two or more variables in a geographical region. However, such maps solely based on single themes are more useful than the general maps in studying the man-environment relationships. For example, various categories of isopleth maps like isobar, isotherm and many others etc., are very-very important for scientific purposes. For a meteorologist and earth scientists, it

serves as an indispensable tool who deals with the science of weather and climate on daily basis. Another example may be of diagrammatic and dot maps along with other qualitative and quantitative categories which are used for teaching and academic purposes.

Maps are also very important in terms of resource appreciation, trend and patterns of its utilization and conservation etc. It greatly helps the specialists and planners to prepare precise plans and programmes so as to effectively and sustainably utilize the natural resources such as renewable and non-renewable resources which you will study in detail in a course on 'Economic Geography' in your sixth semester.

Uses

Maps are used by human civilizations since the time of explorations and discoveries for a variety of reasons. These reasons may encompass navigation, finding new land frontiers for exploitation of mineral resources and suitable sites for settlement purposes etc. As globe is considered a nearest exhibition of the earth's features, similarly map exhibits the essential features in a nutshell, including physical and human features both of a globe and that of planet earth. Invention of printing technology has brought a wave of revolution in the history of mapping. Further, this momentum has got a quantum jump fueled by the advancements encircling the fields of satellite navigation, computers and mapping software's etc. All these remarkable developments have radically transformed the entire task of mapping from conventionally hand-made maps which were both tedious and skill-oriented to that of machine made maps at a click of mouse. Maps invariably helps the academicians, scientists, planners and others alike to comprehend the diverse features of the earth's surface effectively. It is considered as a major visual tool of a geographer in particular and other academicians in general. Nowadays, with the use of web rsources like Google Earth, everybody has started acquiring the mapping skills at preliminary levels. Majority of science disciplines employ maps to depict varied nature of spatial data and facts as a supplement, whereas in case of Geography discipline, maps form a major component of representation. Broadly, two categories of maps such as large and small scale acts as a model to investigate and comprehend varied characteristics of the planet Earth in its totality. These are also grouped into two major kinds including physical and cultural characteristics.

It is a major tool to conduct the geographical analysis in order to lend a visual appeal along with shorthand script to the geographers in particular and social and natural scientists in general. Maps are useful and important in order to precisely ascertain the three important geographical concepts of distance, direction and area with the help of various instruments. Most of the aspects of developmental paradigms require a large number of maps so as to plan these activities in a scientific and holistic manner and put on record the same for public consumption. These aspects may be social such as various caste and tribal groups, environmental such as climate change and its effects on livelihood and economy etc.

The quantity of theme based maps produced as well as sold by the government and semi-government organizations reflects the development and economic prowess of a particular region or a country. Thematic maps are widely used by both government and semi-government organizations on one hand and researchers and academia on the other hand to decipher varied indicators of development. Increasing educational levels of citizens of any region may also spur the rise in demand for theme oriented maps of neighbouring and far-flung regions. It may help the concerned stakeholder to compare and better know the spatial similarities and differences existing therein and design the developmental strategies accordingly to bridge the gaps and excel in a particular domain like environmental management, economic prowess, contemporary social needs and changing political dynamics etc.

To conclude, there are number of other usages of thematic distribution maps. You may find different set of developmental aspects either related to social, political, religious, spiritual and economic categories, for which, you may not find the related text mentioned either in your SLM's or other standard undergraduate textbooks, but may encounter such issues on several occasions in a real life situations. Thus, as a keen geographer, you may identify a mappable 'nascent theme' to bring it under the ambit of categories and sub-categories of distribution or theme based maps. Such academic venture may facilitate to represent the different aspects of that phenomenon being explored.

Limitations

Every method has one or other limitations on many fronts like its versatility and accuracy of the used numerical data. As such, none of the methods may be able to satisfy all the requirements of a map-maker or a user simultaneously. A map made on the basis of latest available data may not be able to serve various planning and other purposes in more precise sense during the gestation or a gap period between the conduct of two data enumeration periods and its availability. Suppose, for example, a choropleth map prepared on the basis of 2011 Census which shows the population distribution may not be able to portray the actual picture, if massive migration influx has taken place or natural disaster (which may induce sudden changes in population number), have occurred during this intervening period especially. In case, if, we happen to use such maps after a gap of five years or more before the next census operation commences and data is made available, they may lose their relevance and application. Besides, it also demands the need for academic and technical skills to develop a plan and execute the same to prepare a variety of thematic maps. Nonetheless, thematic maps do serve a specific purpose including scientific, planning and management, teaching and research concerning a variety of stakeholders of the nation.

We will discuss the limitations and other related aspects under four different cases of thematic map in the solved exercises of Laboratory course in detail. In addition, you will also get an exposure and learn to do few exercises/ activities demonstrated with apt examples of the same course.

SAQ 3

Mention in brief the choropleth mapping technique?

15.5 SUMMARY

In this unit, you have studied so far:

- Thematic map is a mapping technique employed to represent the various tangible and intangible objects spread over a part of or entire earth's surface.
- These objects could be both physical as well as human which you may find arranged either discretely or continuously on the planet Earth.
- Basically, you came to know that thematic mapping is an effective approach that helps to analyze the relationship between two or more variables.
- You learnt that such mapping techniques may facilitate the decision-making abilities as well as enhance the aesthetic appeal of a given text to the researcher, academia, geographer and other user segments alike.
- There are diverse datasets that needs to be analyzed to confer and decipher a proper, critical and logical meaning.
- Such analysis, thus, may invariably help a geographer to convert big datasets into a coherent piece of utilizable information for various purposes other than academic.
- It is essential to map these datasets to chalk out comprehensive planning strategies for overall human development.
- In this context, you have learnt that the representation techniques of thematic mapping offers a good medium to effectively and visually represent varied datasets spatially and temporally.

15.6 TERMINAL QUESTIONS

1. Explain in detail the steps involved in the construction of a choropleth map?
2. Define isopleth map by citing suitable examples?
3. Highlight the importance of thematic maps.

15.7 ANSWERS

Self Assessment Questions (SAQ)

1. A thematic map displays a specific theme such as the density and distribution of population in a given geographic region. The classic example of thematic map is the detailed district map series prepared by '***National Atlas & Thematic Mapping Organisations'*** for a number of districts in India.

2. The word Chorochromatic is made up of two words i.e., choro means area and chromos means colour. It is also known as colour patch maps. Different colours are used to represent the areal variations and spatial distributions of geographical phenomenons on maps. Basically, this category of maps is qualitative in nature since the steps involved in mapping techniques are done without taking the numerical inputs.

3. This is a complex variation among the choropleth category of thematic mapping. It employs statistics and additional information so as to merge areas with similar values instead of using the administrative boundaries which is already present in a choropleth map.

Terminal Questions

1. Your answer should incorporate the key steps used to construct the same. For correctly answering it, you may refer to the Sec. 15.3.1.

2. While answering this question, you should bring out the essence and utility of isopleth maps by referring to the Sec. 15.3.4.

3. To answer this question, you are required to throw light on various applications of thematic maps. Refer to the Sec. 15.4.

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GLOSSARY

Bar Diagram: This is a diagram that plots data using rectangular bars or columns that represent the total amount of observations given in the form of data. Bar diagrams can be displayed with vertical columns, horizontal bars, comparative bars or compound bars.

Comparative Bar Diagram: A comparative bar diagram is used to compare two sets of data on the same axis, such as comparing the sex composition in India over the course of five successive Census years.

Compound Bar Diagram: It is a type of bar diagram where columns can be split into sections to show breakdown of the total value.

Choropleth Map: This is a kind of map that uses colour and shading to show variations in a measurement.

Chorochromatic Maps: The word Chorochromatic is made up of two words i.e., choro means area and chromos means colour. It is also known as colour patch maps. Different colours are used to represent the areal variations and spatial distributions of geographical phenomenon on maps.

Choroschematic Maps: It illustrates the spatial distribution of geographical features either through pictorial or letter symbols.

Dot Map: The dots are used to explain the occurrence of a particular geographic theme such as location of a windmill in a particular region.

Isopleth Maps: Isopleth maps are quantitative areal maps. It is made up of two terms known as '*iso'* which means equal and '*plethos'* meaning a multitude or crowd.

Isarithm: A line on a map that links all points with the same value.

Isometric lines: It refers to a line which represents a constant value or intensity with respect to every point through which it passes on a given map. The examples are contour, isobar, isoneph, isohalines and isotherm lines etc.

Isarithmic or Contour Map: This is another thematic mapping technique. Here, isolines are used to explain the incidence of constant values.

Isochrones: An isopleth map that connects various places to travel same amount of time from a common center point is known as isochrones or an isochronic map.

Line Diagram: It displays information as a series of data points connected by straight line segments.

Pie Diagram: This is a circular diagram which is divided into slices to illustrate numerical proportion i.e., the arc length of each slice, is proportional to the quantity it represents.

Proportional or Graduated Symbols: This technique of mapping is used to characterize the data values related to point locations. The point locations could be a village, town, city or metropolitan cities etc.

Thematic Map: It is a map solely based on one or other definite themes. Basically, thematic map represents a variety of physical and anthropogenic themes.

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