316

SENIOR SECONDARY COURSE

GEOGRAPHY

2

National Institute of Open Schooling

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Senior Secondary Course

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2

NATIONAL INSTITUTE OF OPEN SCHOOLING

(An autonomous institution under Ministry of Education, Govt. of India)

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A Word with You

How to use the Learning Material

Congratulations! You have accepted the challenge to be a self-learner. NIOS is with you at every step and has developed the material in Geography with the help of a team of experts, keeping you at the focal point. A format supporting independent learning has followed. You can take the best out of this material if follow the instructions given. The relevant icons used in the material will guide you.

Title: will give a clear indication of the contents within. Do read it.

Introduction: This will introduce you to the lesson linking it to the previous one.

Objectives: These are statements that explain what you are expected to learn from the lesson. The objectives will also help you to check what you have learnt after you have gone through the lesson. Do read them.

Notes: Each page carries empty space in the side margins, for you to write important points or make notes.

Intext Questions: Very short answer self check questions are asked after every section, the answers to which are given at the end of the lesson. These will help you to check your progress. Do solve them. Successful completion will allow you to decide whether to proceed further or go back and learn again.

What You Have Learnt: This is the summary of the main points of the lesson. It will help in recapitulation and revision. You are welcome to add your own points to it also.

Terminal Exercises: These are long and short questions that provide an opportunity to practice for a clear understanding of the whole topic.

Do You Know: This box provides additional information. The text in boxes is important and must be given attention. It is not meant for evaluation, but only to improve your general knowledge.

Answers : These will help you to know how correctly you have answered the questions.

Activities: Certain activities have been suggested for better understanding of the concept.

COURSE OVERVIEW

MODULE		LESSON
1. The study of Geography as a discipline	1.	Nature and subject matter of Geography
2. Dynamic and Geomorphic Processes of the Earth	2.	Endogenic Forces
	3.	Exogenic Forces and their resultant landforms
	4.	Running water, moving ice, wind and sea waves
3. The domain of the water on the earth	5.	Hydrological Cycle and Ocean
4. Dynamics of Atmosphere	6.	Structure and composition; Insolation
	7.	Atmospheric pressure and winds
	8.	Humidity and precipitation
	9.	Climate and Climate Change
5. Biogeography and Biodiversity	10.	Biosphere, Biomes and Biodiversity
6. Physical Geography of India	11.	Physical Settings
	12.	Climate
	13	Natural Hazards and Disasters

MODULE		LESSON
7. Natural resources, Utilisation and Management	14.	Land and Soil Resources
	15.	Forests and Biodiversity
	16.	Water Resources
8. Economic Geography of India	17.	Agriculture and Food Security
	18.	Mineral and Energy Resources
	19.	Major Industries and Industrial Complexes
	20.	20 Foreign Direct Investment (FDI), Transport, Communication and Trade
9. Human resource development in India	21.	Population Growth and Distribution
	22.	Population Composition
	23.	Human Development
10. Contemporary Issues and Challenges	24.	Sustainable Development Goals (SDGs)
	25.	Environment, Health and Sanitation

PRACTICAL MANUAL

1. Maps: Types and Elements; Toposheets
2. Geospatial Technologies
3. Data and Statistical Diagrams

CONTENTS

Note: The syllabus has been bifurcated into two sections -

(i.) Lessons for the Tutor Marked Assignment (TMA)

(ii.) Lessons for public examination question paper

The details of the different sections are on the next page.

National Institute of Open Schooling

Bifurcation of Syllabus in Geography - 316

Sr. Secondary

Total no. of Lessons=25

MODULE (No. & name)	**I. TMA (40%) (No. of lessons -9)**	**II. Public Examination (60%) (No. of lessons -16)**
1. The study of Geography as a discipline		L-1: Nature and subject matter of Geography
2. Dynamic and Geomorphic Processes of the Earth	L-2 : Endogenic Forces L-4: Running water, moving ice, wind and sea waves	L -3: Exogenic Forces and their resultant landforms
3. The domain of the water on the earth		L-5 : Hydrological Cycle and Ocean
4. Dynamics of Atmosphere	L-6 Structure and composition; Insolation L-8 : Humidity and precipitation	L-7 : Atmospheric pressure and winds L-9: Climate and Climate Change
5. Biogeography and Biodiversity		L-10 : Biosphere, Biomes and Biodiversity
6. Physical Geography of India	L-13 : Natural Hazards and Disasters	L-11 : Physical Settings L-12 : Climate
7. Natural resources, Utilisation and Management	L-14 : Land and Soil Resources	L-15 : Forests and Biodiversity L-16 : Water Resources
8. Economic Geography of India	L-19 : Major Industries and Industrial Complexes	L-17 : Agriculture and Food Security L-18 : Mineral and Energy Resources L-20 : Foreign Direct Investment (FDI), Transport, Communication and Trade
9. Human resource development in India	L-21 : Population Growth and Distribution	L-22 : Population Composition L-23 : Human Development
10. Contemporary Issues and Challenges	L-25 : Environment, Health and Sanitation	L-24 : Sustainable Development Goals (SDGs)

MODULE -7

Natural resources, Utilisation and Management

14. Land and Soil Resources

15. Forests and Biodiversity

16. Water Resources

14

LAND AND SOIL RESOURCES

The nation's wellbeing, be it social, economic or political depends mostly on the available resources and their optimum utilisation. Resource is the matter or substance which satisfies human wants at a given time and space. Before any element can be designated as a resource three basic pre-conditions must be satisfied. They are; the knowledge, technical skills and demand for the material or services produced. If one of these conditions is not satisfied the particular substance remains unutilised. Let us explain it through one example. From time immemorial, water is present on the earth. But it became a source of energy when people acquired the knowledge and technical skills for hydel power generation. It is therefore human ability and need which gives importance to a particular resource and not their mere physical availability. So the basic concept of resources is also related to human well-being.

India is endowed with abundant resources. An integrated effort is being made in our country to make the best use of the existing resource potential. It helps to meet the demands of a growing population and also provides opportunities for employment. Simultaneously, it acts as an indicator for the levels of development. In this lesson we will study two vital resources i.e. Land and Soil.

OUTCOMES

After studying this lesson, learner:

- explains the significance and distribution of land and Soil resources;
- analyses the Land Use Pattern;
- discuss the characteristics of soil types with their uses;
- explains the problems related to land and Soil resources with suitable/appropriate solutions;
- suggests the methods of land resource management and Soil conservation.

14.1 LAND RESOURCES

Land is our basic resource. It includes all the features and processes of the land, which can be used to fulfil certain human needs. Throughout history, we have drawn most of our sustenance and much of our fuel, clothing and shelter from the land. It is useful to us as a source of food, as a place to live, work and play. It has different roles. It is a productive economic factor in agriculture, forestry, grazing, fishing and mining. It is considered as a foundation for social prestige and is the basis of wealth and political power. It has many physical forms like mountains, hills, plains, plateaus, lowlands and valleys. It is characterised by climate from hot to cold and from humid to dry. Similarly, land supports many kinds of vegetation. In a wider sense, land includes soil and topography along with the physical features of a given location. It is in this context that land is identified closely with the natural environment. However, it is also regarded as space, situation, factor of production in economic processes, consumption goods, property and capital. Soil is considered a core component of land resource and the foundation of all agricultural development and ecological sustainability. Soil is a complex, dynamic form of living system and its suitability varies from one region to another.

Before studying in details let us know shome of the important terminologies related to land use:

- Land under miscellaneous tree crops and groves include all cultivable land which is not included under net area sown, but is put to some agricultural use. Land under casuarina trees, thatching grass, bamboo, bushes, other groves for fuel, etc. which are not included under orchard are classed under this category.
- Forest area is land under natural or planted stands of trees of at least 5 metres in situ, whether productive or not, and excludes tree stands in agricultural production systems and trees in urban parks and gardens.
- Culturable Waste Land: This includes land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years.
- Land Put to non agricultural Use: This category of land includes barren lands, uncultivable land put to non agricultural uses, land occupied by buildings, roads and railways or under water.
- Unculturable Land is which cannot be brought under cultivation except at an exorbitant cost is classified as unculturable whether such land is in isolated blocks or within cultivated holdings.
- Barren land : The land which cannot be used for cultivation is called barren land such as hilly terrains, deserts and ravines etc.

- Current Fallow : This is the land which is left without cultivation for one or less than one agricultural year. Following is a cultural practice adopted for giving the land rest. The land recoups the lost fertility through natural processes.

- Fallow Lands other than Current Fallows : This includes all land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years.

- Net sown area is the total area sown with crops and orchards. It represents an area in which total crops are grown only once in a year.

India is well endowed with cultivable land which has long been a key factor in the country's socio-economic development. In terms of area, India ranks seventh in the world, while in terms of population it ranks second. Arable land includes net sown area, current fallow, other fallow and land under tree crops. Arable land covers a total area of 167 million hectares which is 51 % of the total area of the country.

The physical features in India are diverse and complex. There are mountains, hills, plateaus and plains which produce varied human response to the use of land resources. About 30% of India's surface area is covered by hills and mountains. These are either too steep or too cold for cultivation. About 25% of this land is topographically usable which is scattered across the country. Plateaus constitute 28% of the total surface area but only a quarter of this is fit for cultivation. The plains cover 43% of the total area and nearly 95% of it is suitable for cultivation. Considering the differences in proportion of surface area, we can conclude that about two third of the total land area is usable for cultivation. Moreover, soils, topography, moisture and temperature determine the limits of cultivability and the quality of arable land is determined by these factors. As a result of this, half of the surface area is cultivated. This proportion is one of the highest in the world.

14.2 LAND USE AND LAND USE PATTERN

Land Use is the function or functions that humans apply to the land available to them or in other words the various uses the available land is put into by human beings. The study of land use is the study of how the land is managed, according to human needs. The layout or arrangement of the uses of the land is referred to as "land use pattern". The land may be used for agriculture, forest, pasture etc. Land use is determined by physical factors such as relief, terrain, climate, soil, vegetation and Socio-Economic factors such as density of population, technical know how, skill and levels of literacy.

1. Out of the total geographical area (328 million hectares), land utilisation statistics are available for 305 million hectares only. The balance 23 million hectares remains unsurveyed and inaccessible. The relevant statistic is given in Table 14.1. From the

table it is clear that there are 5 major types of land utilisation in India. They are: Forest land, Net sown area, Land not available for cultivation, Fallow land and Other cultivable land excluding fallow land.

The significant features of land utilisation are:

(a) high percentage of area suitable for cultivation;

(b) limited scope for further extension of cultivation and

(c) small area under pastures despite a large bovine population.

Year	Geographical Area (Thousand Hectares)	Reporting area for land utilisation statistics (col.4+7+11+14+15)	Forests	Not available for cultivation			Other uncultivated land excluding Fallow Land				Fallow Lands			Net area Sown
				Area under non-agricultural uses	Barren & unculturable land	Total (col.5+6)	Permanent pastures & other grazing lands	Land under misc. tree crops & groves (not incl.	Culturable waste land	Total (col.8+9+10)	Fallow lands other than current fallows	Current fallows	Total(Col.12+13)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
2009-10	328726	307408	71555	26158	17177	43334	10340	3214	12945	26499	10838	16009	26847	139173
2010-11	328726	307483	71593	26400	17175	43575	10305	3200	12647	26152	10323	14277	24600	141563
2011-12	328726	307392	71599	26308	17217	43525	10314	3161	12637	26111	10665	14512	25177	140980
2012-13	328726	307491	71571	26503	17071	43573	10260	3181	12643	26085	11037	15292	26328	139934
2013-14	328726	307797	71828	26911	16943	43855	10265	3186	12387	25837	10694	14157	24851	141426
2014-15	328726	307781	71756	26942	16992	43934	10262	3104	12416	25782	11090	15091	26181	140128
2015-16	328726	307752	71866	27077	16945	44022	10261	3093	12286	25639	11308	15410	26718	139506
2016-17	328726	308316	72020	27838	16985	44823	10340	3124	12238	25702	11270	15086	26356	139415
2017-18	328726	307767	72047	27326	16992	44319	10338	3167	12287	25792	11621	14809	26430	139180
2018-19	328726	307787	72011	27344	17168	44512	10376	3154	12219	25749	11633	14531	26164	139351

Source: Land use statistics at a glance; 2009-10 to 2018-19; Ministry of Agriculture and farmers welfare department of Agriculture & Farmers Welfare Directorate of Economics & Statistics; November, 2021.

The above table portrays a timeline graph of various uses under which land has been put into. It's a trend from 2009-10 to 2018-19. We can very clearly observe that the Forest area has shown an increasing trend with the afforestation drives going on very seriously throughout the country. Permanent Pastures as well as Barren and unculturable land and Fallow land have seen a slight rise. There has been a decline in Net Sown Area although in between it did rise (2013-14 and 2014-15), this rise and fall is negligible. There is a remarkable rise in the category of land put to non-agriculture use. The decline in land put to agriculture, along with the rise of non-agricultural land can be attributed to the overgrowing population which requires land for institutional, residential, recreational purposes.

Land use is a dynamic process. The land use pattern of any area changes over time due to a number of factors such as increasing population, changes in cropping system and technology, socio-economic development etc.

Land Degradation

Land resources are under immense pressure in India due to growing demand from an exploding population and the impacts of climate change. Increase in demand on land resources is escalating manifold due to human needs. The ecosystem is also impacted as a result of this pressure on land. All these factors lead to land degradation.

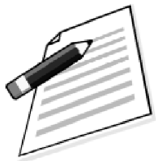
Land degradation is often defined as the long-term loss of ecosystems and their productivity caused by human activities which cannot be recovered unaided. It may also refer to the destruction or deterioration or depletion of the health of terrestrial ecosystems, thus affecting the associated biodiversity, natural ecological processes and ecosystem resilience. It also leads to the reduction or loss of biological/economic productivity of croplands, pasture, woodland, forest, etc. and various other types of land uses.

DO YOU KNOW?

It is estimated that during the last 40 years nearly one-third of the world's arable land has been lost to erosion and continues to be lost at a rate of more than 10 million hectares per year. -UNCCD Report

Fig. 14.1 Deforestation

The causes of land degradation can be broadly divided into two: the natural causes include earthquakes, tsunamis, droughts, avalanches, landslides and mudflow, volcanic eruptions, floods, tornadoes, and wildfires etc.; human induced causes include rapid urbanisation, deforestation, overgrazing, faulty irrigation practices, urban sprawl , pollution from industries, quarrying and mining activities.



Notes

Out of the total land area, as many as 175 million hectares suffer from degradation. Land degradation is caused largely by soil erosion, but also by water logging and excessive salinity. The most serious threat to the soil is posed by deforestation. Heavy rainfall during the monsoon damages the soils. Steep slopes encourage rapid runoff leading to soil erosion especially on the southern slopes of the Himalayas and the western slopes of the Western Ghats. Major portions of the Himalayas are prone to landslides and erosion. Wind erosion is prevalent in Rajasthan, gully erosion in Chambal Valley, Chotanagpur, Gujarat, Sub-montane Punjab Himalaya. Water logging and salinisation which constitute the second major threat to soil have already consumed 13 million hectares and threaten many more. The lands affected are mostly situated in canal irrigated areas. They have suffered because of the absence of adequate drainage. Land is also degraded due to mining operations in many parts of the country. The total land area affected is about 80 thousand hectares by mining. Urban encroachment on good quality agricultural land is another problem by which the amount of land used for agriculture is steadily declining. In other words, there is a tough competition between agriculture, urban and industrial development. There are social conflicts that are arising out of the rights to occupy and transfer of land. The tenant cultivators face major disincentives such as the fear of eviction, the insecurity of tenure, high rents and inadequate surplus to invest. Land ceiling laws have not been implemented with adequate strictness.

Land Resource Management

The major land problems include land degradation due to soil erosion, water logging, salinisation, mining operations and urban encroachment on good quality agricultural land. To deal with these problems, the country has adopted a two-fold approach; physical and social. Physical reclamation of land is achieved through developing sub-surface drainage systems of water-logged land and is followed by scientific rotation of crops. Similarly, land rendered useless by river action and river floods are also reclaimed after necessary treatment to restore their fertility and texture. Physical reclamation of desert lands calls for more sustained efforts. It requires introduction of suitable natural vegetation and a canal or well irrigation or even both. It helps to raise the water table. Social approach on the other hand is reflected through state legislation aiming at overall rural reconstruction, promoting agriculture and its productivity in particular. Consolidation of land holdings is one measure among many. It provides necessary motivation and empowerment of a tiller by confirming on him the rights of land tenure/ownership. Elements of social exploitation are promptly removed e.g. absentee landlords. Thus legislation is used to ensure social justice.

Remote sensing data have shown that about 200 square kilometres of the Gulf of Kachchh have been covered by sedimentation. The National Remote Sensing Agency has estimated 53 million hectares (16%) as wasteland in the country. Among the states and UTs the highest incidence of wastelands is recorded in Jammu and Kashmir (60%) followed by Rajasthan (38%), Sikkim and Himachal Pradesh (37% each) and Gujarat (17%). The Government of

India constituted the National Wasteland Development Board in 1985 with a view to enhancing productivity of wastelands. It includes the programe of afforestation of 5 million hectares per year. India does not have a shortage of land. But, land reform policies need to be reoriented for further increase in food production.

There is a need to achieve Zero Net Land Degradation (ZNLD) which means the achievement of a state of land degradation neutrality. Achieving it involves a combination of reducing the rate of further degradation of land and offsetting newly occurring degradation by restoring the productivity and other ecosystem services of currently degraded lands.The ZNLD is best achieved by the introduction and promotion of Sustainable Land Management(SLM) practices on a global basis.

Sustainable Land Management practices include the integrated management of crops (trees), livestock, soil, water, nutrients, biodiversity, disease and pests to maximise the delivery of a range of ecosystem services. The objective is to maximise provisioning services (e.g. food, water, energy) while enhancing the resilience of land resources and the communities which depend on them. Adopting simple and affordable techniques which can stop land degradation and replicating them at the global level can have a major impact. Practices such as agro-forestry and sustainable agriculture, can boost yields and prevent future land degradation. For example- In Zimbabwe, water harvesting combined with conservation agriculture increased farmers' gross margins 4-to-7-fold and increased returns on labour 2-to-3-fold compared to standard practices. These practices have had the greatest success in regions with lower rainfall.

To fulfil the demand of increasing population, rather than bringing new land under managed ecosystems, productivity should be enhanced from land that is already devoted to agricultural production. While enhancing productivity from land already under production through land restoration, laws and policies and educational programs must also be followed to protect/preserve/conserve natural ecosystems against indiscriminate cutting of firewood, grazing, etc. Protection and enhancement of vegetation cover are essential to control soil erosion. Afforestation of denuded lands with adaptable species is essential to conserve soil and water which also helps in strengthening the nutrient cycle.

Community-Based Traditional Approaches - There is an increasing realisation that local communities have an important role to play in land management. Customary SLM practices in forested, agricultural and pastoral regions are prevalent in many parts of India. These practices are jointly supported by government policies/programmes and also by local community participation. These regulatory frameworks have the potential to reduce the causes and effects of Land degradation processes.

Some of the measures to prevent degradation and restore degraded lands are mentioned below:

- Afforestation as well as reforestation
- Sustainable pastures and livestock management
- Narrow strip planting, Use of Windbreaks and Shelterbelts
- Optimum utilisation of water for irrigation
- Proper use of fertilisers and pesticides
- Growing salt tolerant soils in saline land
- Sustainable mining practices
- Proper discharge of industrial effluents
- Proper management of wastelands

INTEXT QUESTIONS 14.1

1. Name any five types of land use.
2. Name the land which is left without cultivation for one or less than one agricultural year.
3. What are human induced causes for land resource degradation?

14.3 SOIL RESOURCES

Soil is defined as the upper layer of the earth composed of loose surface material. It is a mixture of many substances including an endless variety of minerals, remnants of plants and animals, water and air. It is the end product of continuing interaction between the parent material, local climate, plant and animal organisms and elevation of land. Since each of the elements varies over space, soils also differ from place to place. Soil is an important segment of our ecosystem, as it serves as an anchorage for plants and a source of nutrients. Thus, soil is the seat, the medium and fundamental raw material for plant growth. Through its relative fertility, it affects man's economic activities and shapes the destiny of our country. When the soil is lost, property and culture are also lost. Therefore, it is a valuable national and fundamental earth resource of the country.

A Soil Profile

A soil profile is a vertical cross-section of the soil, made up of many layers running parallel to the surface. These layers are known as soil horizons. The soil is arranged in a number of layers or horizons during its formation process. Thus the Soil Profile consists of layers or horizons.

Notes

Soils typically have six horizons. From the top down, they are Horizon O,A,B,C and R. Each horizon has certain characteristics. O Horizon is the top most layer, made up mostly of leaf litter and fresh organic matter. The A Horizon is made up of decomposed organic matter, micro organisms such as earthworms, fungi, bacteria etc. The B Horizon consists of less humus, but more minerals. The C Horizon is made up of broken bed rocks and R Horizon is the compact bedrock region.

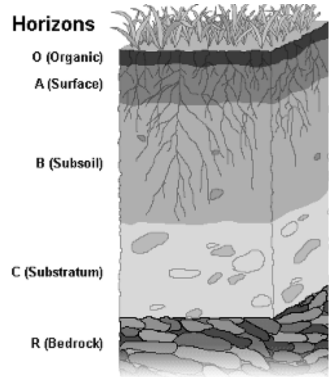


Fig. 14.2 Soil profile

B. Major Soil Types and Distribution

The soils of India are broadly divided into following six types:

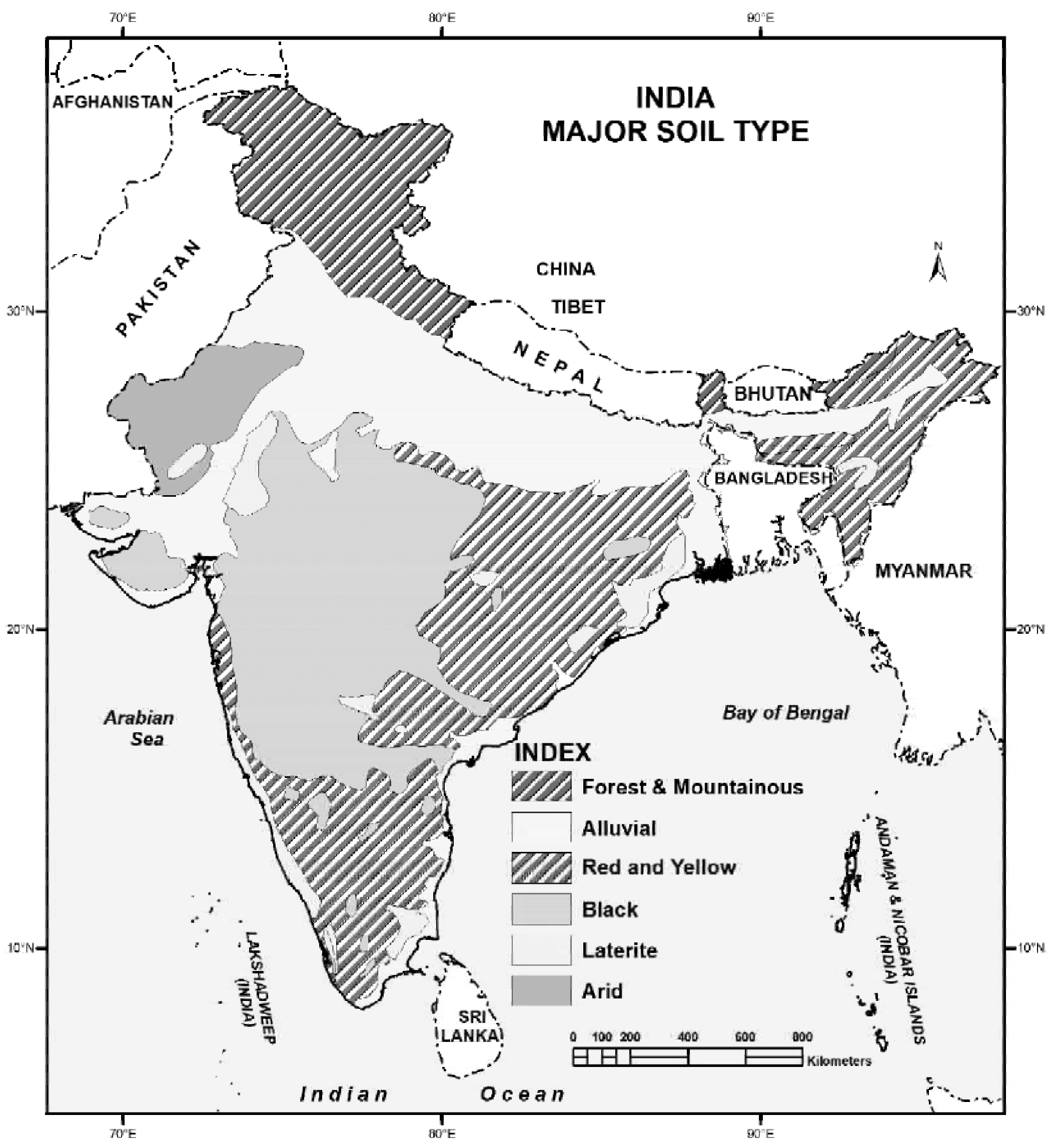


Fig. 14.3 India: Major soil resourece

1. Alluvial Soils

Alluvial soil is the most important soil type of India. It covers the vast valley areas of the Sutlej, Ganga and Brahmaputra and the fringes of the southern peninsula. It is thin near the fringe of the plateau. The alluvial soils occupy 64 million hectares of the most fertile land. The soils vary from sandy loam to clay in texture and are rich in potash but deficient in nitrogen and organic matter. Generally, the colour varies from grey to reddish brown. These soil are formed of deposits of silt and sand brought down by the rivers flowing from the Himalayas and the Great Indian plateau. Being young, the soils lack profile development. Being extremely productive, these soils are most important from the point of view of Indian agriculture. Based on geographical considerations, this soil can be subdivided into two divisions: newer alluvium (khadar) and older alluvium (bangar). Both are different in texture, chemical composition, drainage capacity and fertility. The newer alluvium is a light friable loam with a mixture of sand and silt. It is found in river valleys, the floodplains and deltas. On the other hand, the older alluvium lies on the interfluves. The higher proportion of clay makes the soil sticky and drainage is often poor. Almost all crops are grown on these soils.

2. Black Soils (Regur)

The black soils are found mainly in the Deccan lava region covering large parts of Maharashtra, some parts of Gujarat and Madhya Pradesh and small parts of Karnataka, Telangana, Andhra Pradesh and Tamil Nadu. The soils are formed by disintegration of volcanic basaltic lava. The colour of the soil is generally black due to the presence of compounds of aluminium and iron. The soil is locally known as regur which extends roughly to 64 million hectares. It is generally clayey deep and has low permeability and impregnability. But its depth varies from place to place. It is very thick in lowlands but very thin on highlands. The most important characteristics of this soil are its ability to retain moisture even during the dry season. The soils form wide cracks during summer due to moisture loss and swell and become sticky when saturated. Thus, the soil is aerated and oxidised to deep levels which contribute to maintaining its fertility. This continued fertility is favourable in the area of low rainfall for cotton cultivation even without irrigation. Other than cotton, this soil is favourable for the cultivation of crops like sugarcane, wheat, onion and fruits.

3. Red Soils

Red soils cover a large part of the Peninsular upland in Tamil Nadu, Karnataka, Goa, South east Maharashtra, Telangana, Andhra Pradesh, Orissa, Chotanagpur Plateau and Meghalaya Plateau. They encircle the black cotton soil zone. They have developed on the crystalline rocks like granite, gneisses and cover roughly 72 million hectares of the arable land. Iron compounds are abundant making the soil reddish in colour but

Notes

they are deficient in organic matter. The red soils are generally less fertile and are not as important agriculturally as the black and alluvial soils. But the productive capacity can be raised through irrigation and use of fertilisers. This soil is suitable for rice, millet, maize, groundnut, tobacco and fruits.

4. Laterite Soils

The laterite soils are commonly found in areas of high altitude and heavy rainfall in Karnataka, Tamil Nadu, Madhya Pradesh, Jharkhand, Orissa, Assam and Meghalaya extending over 13 million hectares. They generally form under hot and humid climatic conditions.The lateritic soils are particularly found on high flat erosion surfaces in areas of high and seasonal rainfall. Loss of nutrients by accelerated leaching is the most common feature which renders the soil infertile. The pebbly crust is the important feature of laterites which is formed due to alteration of wet and dry periods. As a result of weathering, laterite becomes extremely hard. Thus, their characteristics include complete chemical decomposition of the parent rock, complete leaching of silica, a reddish brown colour given by the oxides of aluminium and iron and lack of humus. The crops which are generally grown are rice, millets, sugarcane on lowland and tropical plantations such as rubber, coffee and tea on uplands.

5. Desert Soils

The desert soils occur in western Rajasthan, Saurashtra, Kachchh, western Haryana and southern Punjab. The occurrence of these soils is related to desert and semi-desert conditions and is defined by the absence of water availability for six months. The soil is sandy to gravelly with poor organic matter, low humus contents, infrequent rainfall, low moisture and long drought season. The soils exhibit poorly developed horizons. Plants are widely spaced. Chemical weathering is limited. The colour of the soil is either red or light brown. Generally, these soils lack the basic requirements for agriculture, but when water is available, a variety of crops like cotton, rice, wheat etc. can be grown with a proper dose of fertilisers.

6. Mountain Soils

The mountain soils are complex and extremely varied. The soils vary from deep alluvium in the river basins and lower slopes to highly immature residual gravel on higher altitudes. Because of complex topographic, geologic, vegetation and climatic conditions, no large areas of homogenous soil groups are found. Areas of steep relief are mostly devoid of soil. Various types of crops are grown in different regions like rice in the valley, orchards on slopes and potatoes in almost all areas.

C Problems of Soil Resources

Soil erosion is described as the carrying away of soil. It is the theft of the soil by natural elements like water, wind, glaciers and waves. Gravity tends to move soil down slope either very slowly as in soil creep or very rapidly as in landslides. The present shape of land has been carved through thousands of years. Soil erosion has become now one of the major environmental problems and a serious constraint for agricultural production. There are many physical and social factors which determine the extent and severity of soil erosion. The principal physical factors are erosivity of rainfall, erodibility of soil, severity of periodic floods, length and steepness of the slope. The important social factors are deforestation, overgrazing, nature of land use and methods of cultivation.

Ravines, gullies and landslides are the most serious and highly visible forms of soil erosion. On the other hand, sheet erosion caused by rains and erosion due to winds are least visible but equally serious as they too take a heavy toll on our precious top soils. Soil erosion by ravines and gullies is widespread in India, It has been estimated that 3.67 million hectares of soil surface is damaged. There are four major areas of ravines and gullies in India. They are (1) Yamuna-Chambal ravine zone, (2) Gujarat ravine zone, (3) The Punjab Siwalik foothills zone and (4) Chhotanagpur zone. There are other areas of substantial ravine erosion in the Mahanadi valley, upper Son valley, upper Narmada and Tapi valleys, Siwalik and Bhabar tract of the western Himalayan foothills and edges of Ganga Khadar in western Uttar Pradesh. The relatively less affected areas are the whole of Deccan south of the Godavari, the Ganga-Brahmaputra plains, east of Varanasi, Kutchchh and western Rajasthan.

Sheet erosion is widespread over sloping deforested terrain, terraced uplands of Peninsular region, Sutlej-Ganga plains, Coastal plains, Western Ghats and NorthEastern hills. The occurrence of landslides is common in earthquake sensitive belts, particularly the Siwaliks. Heavy rainfall and cutting of slopes for roads, buildings and mining activities trigger landslides. Glacial erosion is limited to high Himalayas and sea erosion is confined to coastal areas only. In the last 50 years, the Thar desert has encroached upon 13000 hectares of land in Rajasthan, Gujarat, Haryana and Uttar Pradesh.

Soil erosion and soil exhaustion due to loss of soil nutrients pose serious threats to our efforts of increasing the productivity of soil faster than the population growth. Overgrazing by sheep, goats and other livestock has been partly responsible for soil erosion. Erosion due to these factors has been reported from Jammu & Kashmir, Himachal Pradesh, Rajasthan and Karnataka.

INTEXT QUESTIONS 14.2

1. What is a soil profile?

2. The soils of India are broadly divided into how many types? Name them.

3. Based on geographical considerations, Alluvial soil can be subdivided into how many divisions? Name them.

4. Why the colour of the 'regur soil' is generally in black colour?

14.4 SOIL CONSERVATION

It takes thousands of years for a single inch of soil to be formed naturally, but it takes only a few years for that single inch to be eroded by human interference. If the soil is wasted or blown away, it is not easy to replenish it. Soil conservation is the prevention of loss of the top most layer of the soil from erosion or prevention of damaged fertility caused by over usage, acidification, salinization or other chemical soil contamination. The most important step of soil conservation is to hold the soil in place. This is possible by improved agricultural practices in different regions. Contour ploughing and terracing are generally practised on the hill slopes of the Himalayas. They are the simplest conservation methods. Rows of trees or shelter belts are planted to protect the fields from wind erosion in desert regions of Rajasthan. Afforestation of the river catchment areas and in steep slopes has been implemented in many parts of India. The important among them are: the Himalayas, the Upper Damodar valley in Jharkhand, the Nilgiri hills in the south etc. It reduces the surface runoff and binds the soil. Ravines are noted for their enormous size and depth with vertical sides. The Central Soil Conservation Board has established 3 research stations: (1) Kota in Rajasthan, (2) Agra in Uttar Pradesh and (3) Valsad in Gujarat to suggest methods of reclamation of ravine lands. Soil fertility loss can be prevented by the application of manures and fertilisers.

Various methods for soil conservation are:

1. Planting more and more trees.

2. Using new farming methods.

3. Reducing rivers flooding.

4. Building small check dams in gullies to slow down water run-off.

5. Digging channels across farm slopes to divert water.

6. Protecting areas likely to be eroded.

7. Checking deforestation.
8. Contour ploughing terrace farming.
9. Restore wetlands
10. Planting vegetaion cover and forest restoration
11. Planting buffer strips along stream banks
12. Windbreaks
13. Proper waste disposal and management

14.5 SOIL HEALTH CARD

Soil Health Card (SHC) is a printed report of a particular land holding which gives information on 12 soil parameters along with recommendation in dosage of nutrients to be utilised for different crops. On 5th December 2015, the Soil Health Card Scheme was introduced by the Ministry of Agriculture and Farmers' Welfare, Government of India. It is being implemented through the Department of Agriculture of all the State and Union Territory Governments in India. Under the scheme, the card is provided to all farmers of the country at an interval of 3 years.

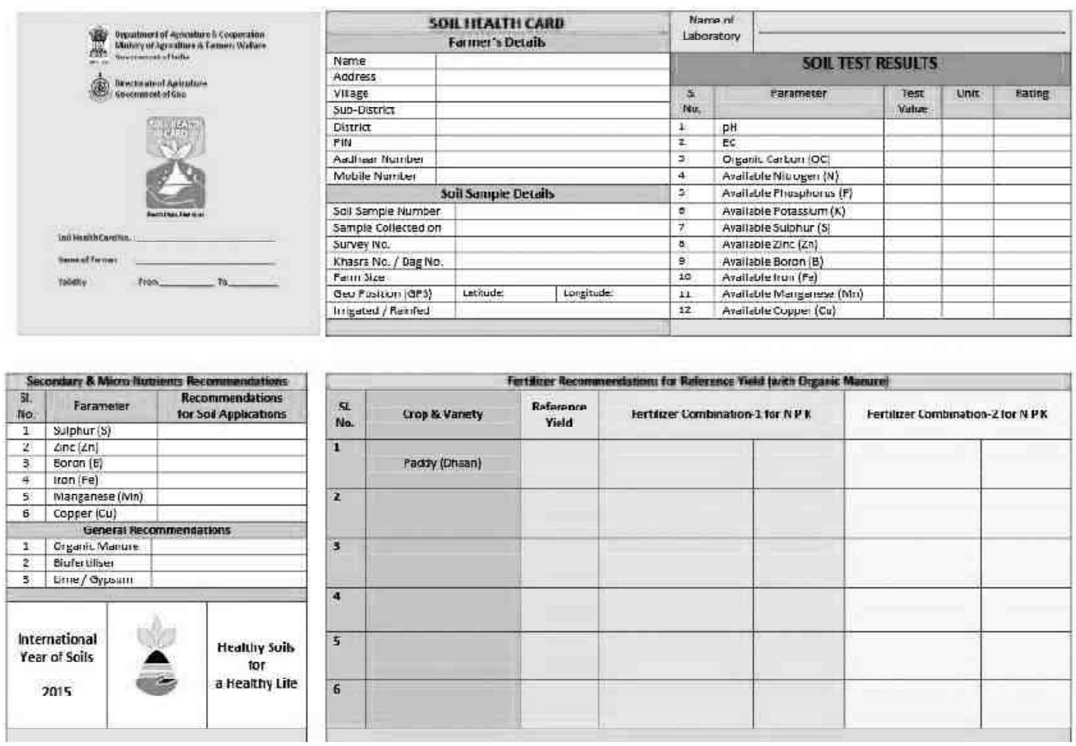
Significant features of Soil Health Card Scheme are:

- The Government issues individual soil cards to farmers once every 3 years.
- Cards carry crop-wise recommendations of nutrients and fertilisers in the respective individual farms. These recommendations aim at improving productivity through judicious use of inputs.
- To deliver the recommendations Soil samples are collected and tested in various soil testing labs across the country. After testing, various experts analyse the strength and weaknesses of the soil and suggest measures to deal with it. The result and suggestion are displayed in the cards.
- The soil samples are tested for 12 parameters. They are pH, Electrical Conductivity (EC), Organic Carbon (OC), Nitrogen (N), Phosphorus (P), Potassium (K), Sulphur (S), Zinc (Zn), Boron (B), Iron (Fe), Manganese (Mn), Copper (Cu) of farm holdings.

The benefits of Soil Health Cards are:

- It decreases 8 to 10 per cent use of chemical fertilisers
- It increases productivity by 5 to 6 per cent.
- It creates job for the agrarian youths in terms of laboratory establishment to undertake soil testing
- It curbs the overuse of urea which leads to the deficiency of many soil nutrients.
- It gives crop wise guidance to farmers.

The card displays farmer's detail, soil sample detail, soil test results and general recommendations. The sample of the Soil Health Card is given below.



Department of Agriculture & Cooperation
Ministry of Agriculture & Farmers Welfare
Directorate of Agriculture
Government of Goa

Soil Health Card No.
Validity From ______ To ______

SOIL HEALTH CARD

Farmer's Details		
Name		
Address		
Village		
Sub-District		
District		
PIN		
Aadhaar Number		
Mobile Number		
Soil Sample Details		
Soil Sample Number		
Sample Collected on		
Survey No.		
Khasra No. / Dag No.		
Farm Size		
Geo Position (GPS)	Latitude:	Longitude:
Irrigated / Rainfed		

Name of Laboratory

SOIL TEST RESULTS

S. No.	Parameter	Test Value	Unit	Rating
1	pH			
2	EC			
3	Organic Carbon (OC)			
4	Available Nitrogen (N)			
5	Available Phosphorus (P)			
6	Available Potassium (K)			
7	Available Sulphur (S)			
8	Available Zinc (Zn)			
9	Available Boron (B)			
10	Available Iron (Fe)			
11	Available Manganese (Mn)			
12	Available Copper (Cu)			

Secondary & Micro Nutrients Recommendations

Sl. No.	Parameter	Recommendations for Soil Applications
1	Sulphur (S)	
2	Zinc (Zn)	
3	Boron (B)	
4	Iron (Fe)	
5	Manganese (Mn)	
6	Copper (Cu)	
General Recommendations		
1	Organic Manure	
2	Biofertiliser	
3	Lime / Gypsum	

International Year of Soils 2015

Healthy Soils for a Healthy Life

Fertilizer Recommendations for Reference Yield (with Organic Manure)

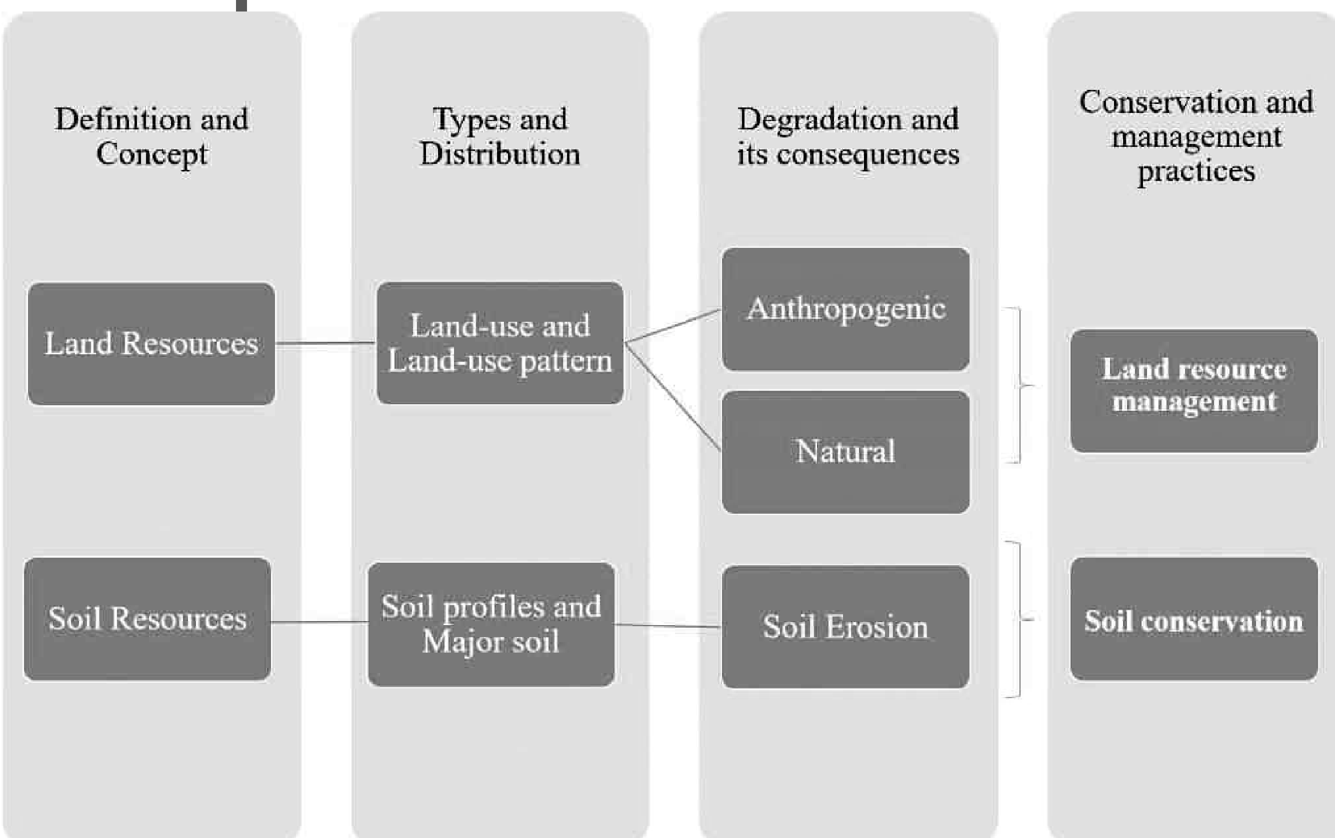
SL No.	Crop & Variety	Reference Yield	Fertilizer Combination-1 for N P K	Fertilizer Combination-2 for N P K
1	Paddy (Dhaan)			
2				
3				
4				
5				
6				

Fig. 14.4 Soil Health Card

INTEXT QUESTIONS 14.3

1. What is the soil Health Card (SHC)?
2. What are the measures to conserve soils?
3. In which year SHC was introduced?

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. What are the significant features of land utilisation in India?
2. Give a brief description of various types of land use in India.
3. Write two main characteristics of each soil type of India.
4. Describe various measures undertaken for conservation of soils.

5. Differentiate between:

   (a) Laterite soil and red soil

   (b) Soil erosion and soil conservation

   (c) New alluvium and old alluvium

6. Locate and label the following on an outline map of India:

   (i) Alluvial soil.

   (ii) Laterite soil.

   (iv) Desert soil.

ANSWERS TO INTEXT QUESTIONS

14.1

1. Forest land, Net sown area, Land not available for cultivation, Fallow land, Other cultivable land excluding fallow land (any 3)
2. Current Fallow
3. Rapid urbanisation, deforestation, overgrazing, faulty irrigation practices, urban sprawl, pollution from industries, quarrying and mining activities.

14.2

1. A soil profile is a vertical cross-section of the soil, made up of many layers running parallel to the surface.
2. Six (6); Forest and mountainous soil, alluvial soil, laterite soil, black soil, red soil and desert or arid soil.
3. Two divisions, named Bangar (older alluvium) and Khadar (newer alluvium).
4. Due to presence of Aluminium and Iron.

14.3

1. Soil Health Card (SHC) is a Government of India's scheme promoted by the Department of Agriculture & Cooperation under the Ministry of Agriculture and Farmers' Welfare. It is being implemented through the Department of Agriculture of all the State and Union Territory Governments in India.

2. i. Planting more trees

   ii. Using new farming method

   iii. Reduce river flooding

   iv. Checking deforestation (Any 3)

3. 2015

15

FORESTS AND BIODIVERSITY

Forest refers to an area covered with trees or a dense growth of trees and underbrush covering a large tract. The Latin word 'Foris' means the outer part of settlements. The importance of forests for our survival is of many folds - from air we breathe to the timbre from wood we use. Forests provide habitats for wildlife and livelihoods for humans. Forests also offer watershed protection, prevents soil erosion and landslides and helps in mitigating climate change. In this lesson you will learn about the importance of forests, distribution of forest resources, methods of forest conservation etc.

OUTCOMES

After studying this lesson, learner:

- describes the importance and use of forest resources and their distribution;
- explains the flora and fauna and biodiversity hotspots;
- analyses the methods of forest conservation and
- appreciates community development initiatives with special reference to joint forest management strategies.

15.1 FOREST RESOURCES

Forest resources are of paramount importance for all living beings.Forests provide us with food, shelter, livelihood, fuel security and water. Over 2 billion people rely on forests either directly or indirectly in the world. Major parameters used for measuring forest resources are forest cover, species composition, timbre and non-timber products, annual increment, growing stock, biodiversity etc.

DO YOU KNOW?

The International Day of Forests (World forest Day) is celebrated every year on 21st March to spread awareness about the environment. Since 2013, Government of India observes 11th September as 'National Forest Martyrs Day' to pay tribute to the valour and sacrifice made by forest personnel to protect the forests and wildlife of India.

Significance of forest

Forest have very significance role on the earth. You can find its significance as:

- Forests are the world's second largest storehouse of carbon after oceans. They are also the source of oxygen. They provide services like absorbing greenhouse gases, protecting watersheds and reducing or slowing the soil erosion etc.
- Forests are like giant sponges where trees and soil help in ground water recharge; and feeds rivers, ponds, lakes and springs; reduces runoff and chances of floods. Forests regulate precipitation; they also emit biological particles like pollen and fungal spores which act as condensation nuclei for raindrop formation.
- Forests are natural cooling systems as trees use solar energy to evaporate moisture and have a cooling effect on the environment. They help in slowing global warming as they act as carbon sinks and also purify air from carbon monoxide, sulphur dioxide, nitrogen dioxide and fine dust. Forests near urban settlements help in reducing the 'heat island' impact of urban activities and transportation.
- Forests control many disasters like controlling river floods especially flash floods and Mangrove forests act as wind breakers in cyclone prone areas. They also help in reducing risk from landslides, avalanches and sand storms. It helps in preventing droughts.
- Forests provide habitats to diverse animal species. They are home for more than 80% of world terrestrial biodiversity and livelihood for different types of settlements including 60 million indigenous people.
- Forests are of great economic value worldwide; it is estimated at 16.2 trillion dollars. Forests create jobs for 13 million people in the world. Forests play an important role in tourism. Third of the world's population still depends on forests and trees for their daily needs, especially for heating and cooking.
- Forests are also vital for health; they provide a treasury of medicinal plants and pharmaceutical ingredients and fresh air for oxygen-rich walks.

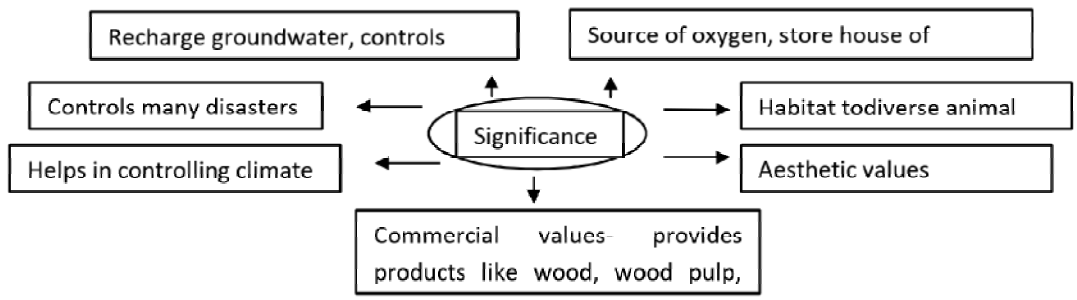


Fig 15.1 Significance of forests

15.2 FOREST OF INDIA

As in any other part of the world, forests of India are determined by climate, physiographic condition and soil types. Factors affecting different types of forest are temperature, precipitation, gradient of land, slope aspect, depth and texture of soil etc. Having great variation in all these factors, India has great diversity of forests. The forests of India can be broadly divided into the following groups:

A Tropical Evergreen Forests

B Tropical Deciduous Forests

(a) Tropical Moist Deciduous

(b) Tropical Dry Deciduous

C Thorn Forests

D Tidal Forests and Littoral and Swamp forests

E Himalayan Forests and southern Montane forests

A. Tropical Evergreen and Semi evergreen forests

Trees in these forests remain green all the year round as the climate of the region is warm and wet throughout the year. A large number of species spread over this region. No specie dominates large areas along with under growing climbers. Different species shed their leaves in different seasons. Hence, the forest looks evergreen throughout the year. These forests are found in the areas having more than 200 cm of rainfall with a short dry season. The mean annual temperature remains above 20^{o} C in this region.The trees reach a height up to 60 metres or even more.The forest has a dense and mixed vegetation of all kinds including trees, shrubs, climbers, creepers, epiphytes and ferns giving it a multilayered structure. Hence, their economic exploitation is not viable. The number of species of trees is very large in a small area. Rosewood, ebony, mahogany, rubber, jack wood, kail, white cedar and bamboo are the important species of trees found in Tropical Evergreen Forests. In India, this type of vegetation is found in the areas of heavy rainfall in western slope of Western Ghats, upper parts of Assam and hills of north eastern regions and islands of Lakshadweep and Andaman and Nicobar. Hardwood from these forests is used for furniture, handicraft etc. They prevent landslides and soil erosion. Some forest areas are cleared for plantations crops like tea, coffee and rubber

B. Tropical Deciduous Forests

Broadly, divided into two categories of Tropical Moist Deciduous and Tropical Dry Deciduous. Trees in these forests shed their leaves once a year. That is why they are called tropical deciduous forests. These are the most widespread forests of India. These forests are found in the areas receiving annual rainfall between 75 to 200 cm and many times called 'Monsoon forests'. As far as the physical distribution of this type of forests is concerned, they are found in the entire country excluding some parts of Deccan Plateau, North-Eastern Region, Western Ghats and Eastern coast. One species of trees found in large numbers together making them most viable for economic exploitation. The deciduous forests are the most economically exploited forest types in India. These forests have been subject to extensive clearance by humans for the purpose of cultivation. Still some patches of natural vegetation are found along the foothills of Himalayas, hilly regions of peninsular and central part of the country. On the basis of the availability of rainfall these forests are further divided into moist deciduous and dry deciduous.

(a) The moist deciduous forests are found in the areas receiving 100 to 200 cm of rainfall. These are distributed mainly in the eastern parts of the country, North eastern states along the foothills of Himalayas, Jharkhand, Odisha and Chhattisgarh, and eastern slopes of Western Ghats. Teak, Bamboo, Sal, Shisham, Sandalwood, Khair, Kusum, Arjun, Mahua, Jamun and Mulberry are the important species of trees found in these forests.

(b) The dry deciduous forests are spread in the areas receiving annual rainfall between 75 to 100 cms annually. These forests are found in the interior parts of the peninsular plateau and the plains of Uttar Pradesh, Madhya Pradesh and Bihar. Tree species of this forest are Teak, Sal, Tendu, Bel, Amaltas, Peepal, and Neem. In the dry season most trees shed their leaves completely and the forest looks like vast grasslands. Dry grass sometimes catches fire either due to natural causes or by human negligence.

C. Thorn Forests

The areas with less than 75 cm of annual rainfall are characterised by the natural vegetation of thorny trees and bushes. Climate of this part is mainly dry with occasional wet periods, so it does not support dense vegetation. They are mainly found in North-Western India, interior parts of the Peninsular India including semi arid areas of Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Haryana, Karnataka, Andhra Pradesh and Maharashtra. Vegetation of these forests is widely distributed in the form of small trees and bushes with deep roots. The stems are succulent to conserve water. Leaves are mostly thick and small to minimise evaporation and many plants and trees have thorns to preserve water and reduce evaporation. Acacia, euphorbias, babul, cacti, khair, date and palms are common variety of trees in this type of vegetation among grasses. Tussocky grasses have roots which can go down to 2 m deep are also seen abundantly growing in thorn forests.

D. Tidal or Mangrove Forests

As suggested by the name, tidal forests are found in tidal creeks and swamps influenced by the tides and wetland topography. These areas are characterised by mud, silt and water accumulated on the surface. Roots and branches of the trees are submerged under water for a specific period of time. They are also called mangrove forests. Mangroves are practically evergreen with thick leathery leaves. Such types of forests are found in the deltas of Sundarbans, Mahanadi, the Godavari, Krishna, Kaveri rivers and in the Andaman and Nicobar Islands. Mangrove or Sundari is the common tree in Sundarbans while palm, coconut, keora, and agar are other important species of tidal forest. Mangrove spread over 6,740 sq. km accounting for 7 percent of world's mangrove forests. It is interesting to know that this type of forest has remained away from large -scale commercial exploitation. These forests are located along the coasts. They provide protection against cyclones.

Along with tidal forests other similar types of forest are Littoral and Swamp forests which have an abundant variety of wetland habitats. Such forest areas witnessed 70% land use conversion into paddy cultivation. Wetlands sites are identified as Ramsar sites.

E. Montane Forest

These forests are mainly found in the Himalayas. The decreasing in temperature and increasing in altitude lead to varied types of vegetation. Other important factors like slope of the mountain and sun facing side of the slope influence the vegetation. The ecosystem is highly fragile. Himalayan forests have been exploited in many ways in recent decades. Areas with relatively low altitude up to 1000 metres, warm climate and good amount of rainfall are characterised by dense vegetation cover. These areas look like tropical forest. Sal and Bamboo are main species in these areas. Between the elevation of 1000 to 2000 metres, evergreen broad leaves Oak and Chestnut are the common species found in these forests. In easternHimalayas the same elevation is

Notes

occupied by subtropical Pine forests. Chir is common species found in this part. Moist temperate forests in Himalayas are found between the elevation 1500 to 3500 metres which receives annual rainfall in the range of 100 to 250 cm. Oak, laurel, chestnut, cedar, Silver, Firn, spruce rhododendron and deodar are the main species found in this part of Himalayas. They have been widely exploited for their timber.Alpine forest found in Himalayas at the height of 3000 to 3800 mts with large and extensive highland grassland and sparsely distributed pine, birch, sliver, fir and rhododendron trees.

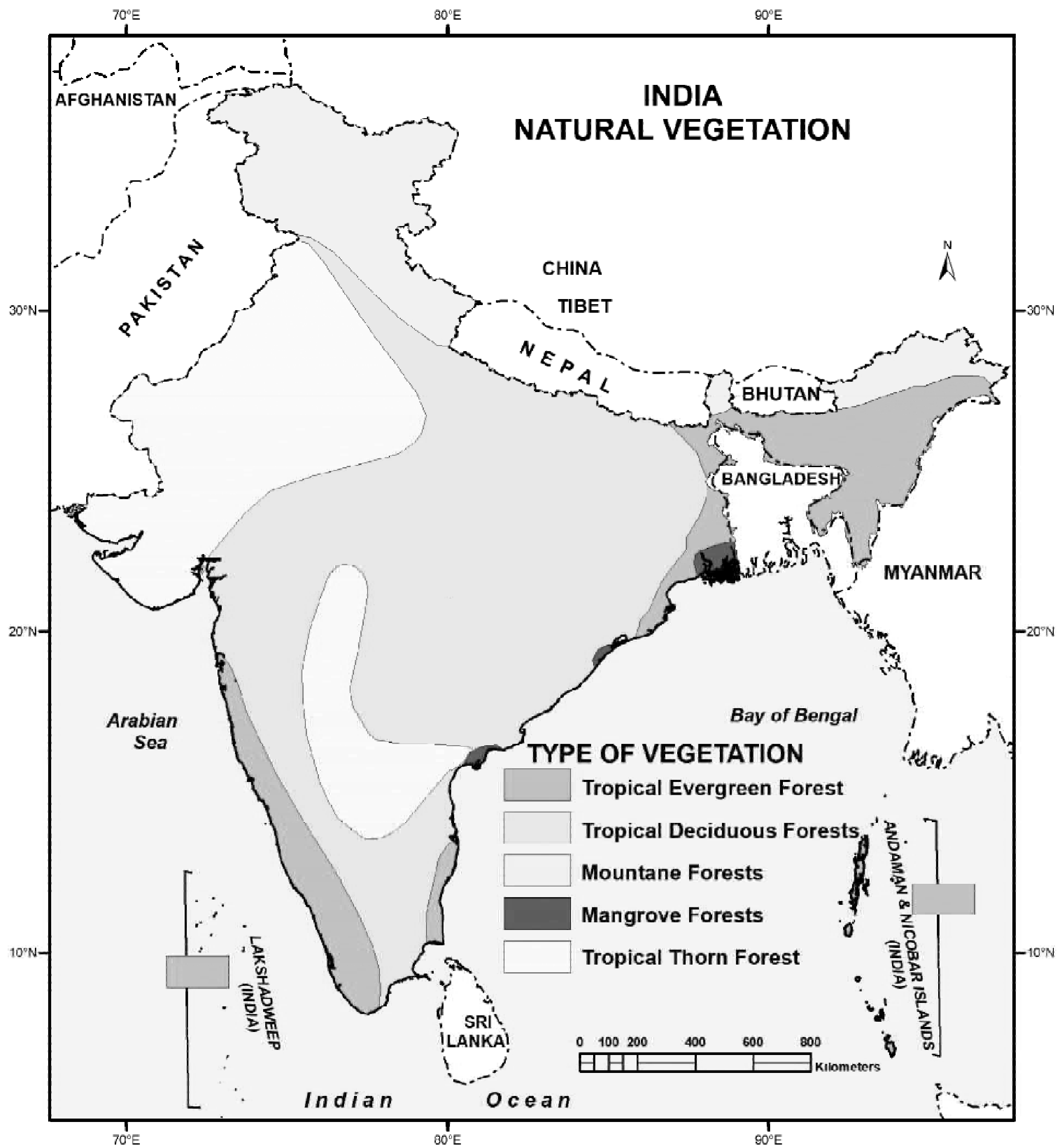


Fig. 15.2 India: Natunal Vegetation

Montane forests are also found in the southern part of India. The three distinct areas of Peninsular India where these forests are found are:

(a) The Vindhyas including Satpura and Maikal ranges (Madhya Pradesh, Chhattisgarh, and the Chota Nagpur region): These are generally moist deciduous forest zones with sal and teak.Patches of dry deciduous forests or scrubs are also found.

(b) Nilgiris (Nilgiris, Anaimalai and Palani hills): The temperate forests in Nilgiris are called 'Sholas'. Major trees species found are laurel, magnolia, wattle, cinchona and others which have great economic importance

(c) The Western Ghats or the Sahyadris (Kerala, Tamil Nadu And Karnataka):The areas have temperate vegetation in higher regions and sub- tropical in lower elevations.

According to state records, 23.28 per cent of the total land area of India is under the forest cover. The better indicator to get the correct picture of the actual forest cover is by assessing the area with canopy cover. According to India State of Forest report 2011, the actual forest cover in India is 21.05 per cent. The share of dense forest is 12.29% and open forest is 8.75%. Lakshadweep has zero forest area whereas Andaman and Nicobar have 86.93 % of land area covered by forests. The north and north western states have less than 10% area under forest cover.They are Gujarat, Punjab, Rajasthan, Haryana and Delhi. Large areas of Punjab and Haryana are under cultivation, so these states have very less forest cover. Tamil Nadu and West Bengal have 10-20 % land under forest cover. Except for Tamil Nadu, Goa and UT of Dadra and Nagar Haveli most of peninsular India has 20-30 % of land under forest. The North- eastern states have more than 30% of land area under forest. Good rainfall and varied terrain supports good forest growth in this region of the country.

The Forest Survey of India (FSI) have classified the forest areas into 4 broad classes as following

Very dense	All forest with tree cover (including mangrove cover) of canopy density 70% and above
Moderately Dense Forest	All forest with tree cover (including mangrove cover) of canopy density 40% and 70%
Open forest	All forest with tree cover (including mangrove cover) of canopy density 10% and 40%
Scrub	All forest lands with poor tree growth mainly of small or stunted trees having canopy density less than 10 percent
Non forest	Any area not included in above classes

The classification of the forest area into dense and open forests is based on internationally adopted norms of classification. Mangroves are separately classified because of their characteristic tone and texture and unique ecological functions.

15.3 FLORA AND FAUNA OF INDIA

India has 2.4% of the world's total land area, accounting for 7-8% of all recorded species, including species of animals and plants. Due to India's unique geographical position, it is endowed with rich reserves of flora and fauna as there are varied terrain, climate, soils, water resources etc.

India has rich flora ranking 10th in the world and 4th in Asia in regard to its diversity. Many plants synthesise substances that are useful for the maintenance of health in humans and other animals. The Botanical Survey of India (BSI), Kolkata have surveyed 70% of the geographical area of India and have identified 47,000 species of plants. Out of total 35% are native (endemic) to India has not been reported anywhere in the world. There are 15,000 flowering plants. About 1,336 plant species are considered vulnerable and endangered. The BSI brings out inventory of endangered plants in form of a publication titled 'Red Data Book'

Wildlife of India is a great natural heritage.There are 89,451 animals' species, accounting for 6.5 % of world's fauna. These include 372 mammals, 1,230 bird species, 440 reptiles, 2,456 fish species, 60,000 insect species and 200 amphibians and 500 molluscs (animals having soft bodies with no spine and covered with shells like snails, oysters). In India livestock diversity is high as there are 40 breeds of sheep, 22 of goats and 27 of cattle.

INTEXT QUESTIONS 15.1

1. Name five major types of forest found in India
2. Name four classes of Forest cover given by Forest Survey of India.
3. At which height the alpine forest in the Himalayas are found?
4. Name the famous mangrove tree species found in Sundarbans delta.
5. What is the Annual Rainfall range in dry and wet (moist) deciduous forest?
6. What is the rank of India in flora ranking of the world?
7. How many percent of world's fauna is found is Indias?

15.4 METHODS OF FOREST CONSERVATION IN INDIA

Forest is vital resources for all life forms to exist. It is important to conserve, protect and nurture forests for future generations. There are various methods adopted in India to conserve forest.

Following are various methods and steps to conserve forests in India:

1. Controlling forest fires
2. Afforestation and reforestation
3. Regulated and planned cutting of trees

Controlling forest fires - Forest fire causes destruction and loss of forests and many a limes forest fires become uncontrollable. Forest fires in forests and parks caused major destruction in Australia in December 2019-January 2020. More than 110,000 sq km or 27.2 million acres were burned. Indian forests have not yet been exposed to fires of real significance like other parts of the world. In India there were 37,059 fires in 2018 as detected by MODIS (Moderate Resolution Imaging Spectro- radiometer) sensor. According to forest inventory records about 54% of forests are exposed to occasional fire episodes, 7% to moderately frequent fires and 2% to high incidence while 35% of India's forests are not exposed any real significance. Forest fires are caused either due to natural processes by lightning or friction between trees in summer during high wind speed. It is also caused by human negligence (intentionally or unintentionally) like leaving bonfires unattended or leaving burning cigarettes or beedis on forest floors.

Geographical Information System (GIS) and Satellite based remote sensing technology are important tools which have been effective in better prevention and management of forest fires. Early warning in forest fires prone areas, monitoring fires in real time basis and estimation along with assessment of burn scars are possible with the help of advanced Remote Sensing and GIS technologies. Latest technologies in firefighting along with trained staff, Dome techniques like developing 3 metre wide fire lanes around the periphery of the fires, arrangement to water spray, fire redundant chemicals, help of helicopters are few of the techniques to control forest fires.

Afforestation and reforestation- The areas which witness partial or total clearing of forest areas (deforestation) or due to mining or fire must be reforested. The process can take place naturally by keeping the forest area untouched or fallow so that degraded forests naturally grow back.Afforestation and reforestation can be done artificially by sapling of trees, plants and seeds. New plantations and afforestation programmes not only help in increasing forest cover but also help in making a healthy eco- balance. The tree species used for afforestation should be native and suitable to local geographical conditions. The young trees and plants during their initial growth should be taken care of.

The Ministry of Environment, Forest and Climate Change (MoEFCC) plays an important role in afforestation plantation schemes with a participatory approach. Joint Forest Management Committees (JFMC) are major implementing agencies after assessing the needs, ecological conditions of the forest area.

Three strategies for conservation and development of forests are adopted.

a. Afforestation through natural/ artificial regeneration

b. Protection

c. Management

Major schemes of forest conservation and development are-

i. National Afforestation Programme (NAP) aims to do afforestation of degraded forest lands. Ecological restoration of degraded forests develops forest resources with local people's participation.

   The overall objective of the National Afforestation Programme (NAP) scheme is ecological restoration of degraded forests and to develop the forest resources with peoples' participation, with focus on improvement in livelihoods of the forest-fringe communities, especially the poor. NAP aims to support and accelerate the on-going process of devolving forest conservation, protection, development, and management functions to the Joint Forest Management Committees (JFMCs) at the village level, which are registered societies. The scheme is implemented by a three tier institutional setup through the State Forest Development Agency (SFDA) at the state level, Forest Development Agency (FDA) at the forest division level and JFMCs at village level.

   The major components of the scheme include afforestation under Seven plantation models, maintenance of previous years plantations and Ancillary Activities like soil and moisture conservation activities (SMC), fencing, overheads, monitoring and evaluation (M&E), micro-planning, awareness raising, Entry Point Activities (EPA) etc.

ii. National Mission for a Green India Mission (GIM) focuses on improving the quality of forest and increasing forest cover along with cross sectoral activities on a landscape basis.

iii. Forest Fire Prevention and Management Scheme (FFPM)takes measures towards forest fire prevention and management.

INTEXT QUESTIONS 15.2

1. Identify various methods and steps to conserve forests

   i)…………………..ii)……………..iii)………………

2. Name the major schemes adopted for afforestation in India

   i)…………………..ii)……………..iii)………………

3. Name the three strategies for conservation and development of forests.

   i)…………..ii) ……………iii) ……….

4. Full form of following abbreviations

   (i) SMC

   (ii) JFMC

   (iii) FDA

   (iv) SFDA

15.5 BIODIVERSITY

Biodiversity is a short form of biological diversity. In simple terms biodiversity is the total number of genes, species and ecosystems of a region. Biodiversity broadly means the variability among organisms from all sources including-terrestrial, marine and other aquatic ecosystems and ecological complexes also including the diversity within species, between species and ecosystems. You can find more details on biodiversity is lesson 10. India falls in the category of mega diversity nation.

Plants and animals constitute only a small component of biodiversity. Do you know that invisible micro-organisms constitute a large component of biodiversity? lets know some important term related to biodiverisity.

Genes- The basic biological unit of heredity. Genes of an individual belongingto the same species are similar and genes control the characteristics of particularspecies.

Gene pool- The total amount of genetic material found within a freely interbreeding population at a given time.

Species- A group of very similar genes having some common characteristics or qualitiesand capable of interbreeding.

Habitat- Habitat means the place or type of site where an organism or population naturally occurs.

Biosphere- Biosphere is the part of the earth system comprising all ecosystems and living organisms, in the atmosphere, on land, in inland water bodies or in the oceans and seas. It also includes derived dead organic matter, such as litter, soil organic matter and oceanic detritus etc.

Protected area- A geographically defined area which is designated or regulated and managed to achieve specific objectives.

Indigenous or native species- A species or lower taxon living within its natural range both past and present including the area which it can reach and occupy using its natural dispersal systems.

DO YOU KNOW?

Taxon- A taxon or taxonomic unit, is a unit of any rank (i,e,. class, Kingdom, order, family, species etc) designating an organism or group of organisms.

Fig. 15.3 Biodiversity

A Significance of Biodiversity

Biodiversity is fundamental to the existence and prosperity of life on the earth. Its importance cannot be underestimated. The varieties of living species are interrelated and interdependent and form an ecosystem. Any disturbance in this very important balance by humans or natural calamities can lead to loss of biodiversity either partially or totally. Human beings are also an important component of biodiversity. Any negligence due to over exploitation of biotic resources by deforestation or wildlife poaching etc leads to imbalance in the system and affects everyone in the chain , even humans. Biodiversity indicates variations of life forms in species, ecosystem and biome. Biodiversity is essential for consistency of climatic features, soil maintenance, ecological balance, pollination of plants, water recycling, recycling nutrients etc. Biodiversity has many direct and indirect uses

Biodiversity increases as we move from the poles towards the equator. India is located between 8°4 North and 37°6' North latitudes and 68°7 East and 97°25 East longitude. Due to this position India has such rich biodiversity.

B Causes of Loss of Biodiversity

Increasing population and changing lifestyle leads to extensive commercial exploitation of the natural resources. The major causes of loss of Biodiversity are invasive species, habitat destruction, global warming and climate change, environmental and genetic pollution, overpopulation and natural calamities. This results in loss of biodiversity. Consequently, it is adversely affecting the ability of nature to continue delivering the goods and services for human existence. The loss of biodiversity affects not only the physical environment but also the social, cultural, religious and spiritual well being of human life. The United Nations has proclaimed the year 2010 as the 'International Year of Biodiversity.

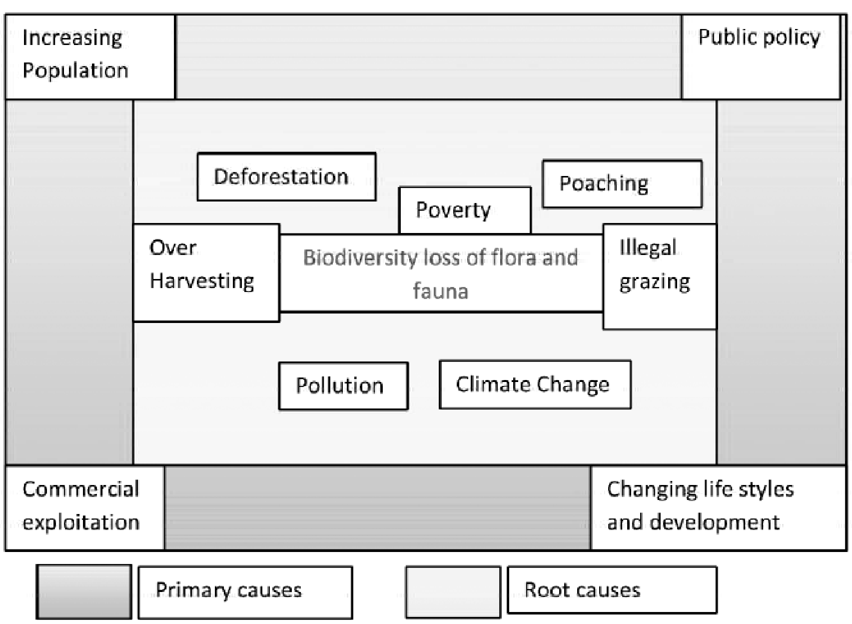


Fig. 15.4 Causes of Biodiversity loss

C Biodiversity conservation

Biodiversity can be conserved broadly by two methods-

i. **In-situ conservation-** Biodiversity conservation of species takes place within their natural habitat. Large numbers of floral and faunal species are conserved together which is a cost effective and convenient method. The natural ecosystem is maintained and protected without any locational shock to living organisms. For example, national parks, biosphere reserves and wildlife sanctuaries.

ii. **Ex-situ conservation-** In this conservation method breeding and maintenance of endangered species is practised in botanical gardens, zoos, gene banks, nurseries. The species of both plants and animals are bred in enclosed and under the vigil of trained personnel and suitable environments. Later on, species are introduced or reintroduced to natural environments through rehabilitation programmes. For endangered species gene pools are made and genetic techniques are used for preservation of endangered species.

INTEXT QUESTIONS 15.3

1. Define Species diversity
2. Mention the three uses of Biodiversity.
3. Mention Two methods of biodiversity conservation

15.6 BIODIVERSITY HOTSPOTS AND CONSERVATION OF WILDLIFE IN INDIA

The term 'Biodiversity Hotspot' was given by Norman Myers (1988) with the identification of 10 tropical forest hotspots which have witnessed high levels of habitat loss. According to the Critical Ecosystem Partnership Fund (CEPF), by 2016, there are 36 recognized biodiversity hotspots in the world. The international organisation has identified two strict criteria for biodiversity hotspots-

1. The hotspot region at least contains 1,500 species of vascular plants which are found nowhere else on the earth; they are called "endemic" species.
2. The region has lost at least greater or equal to 70 percent of its primary native (indigenous) vegetation.

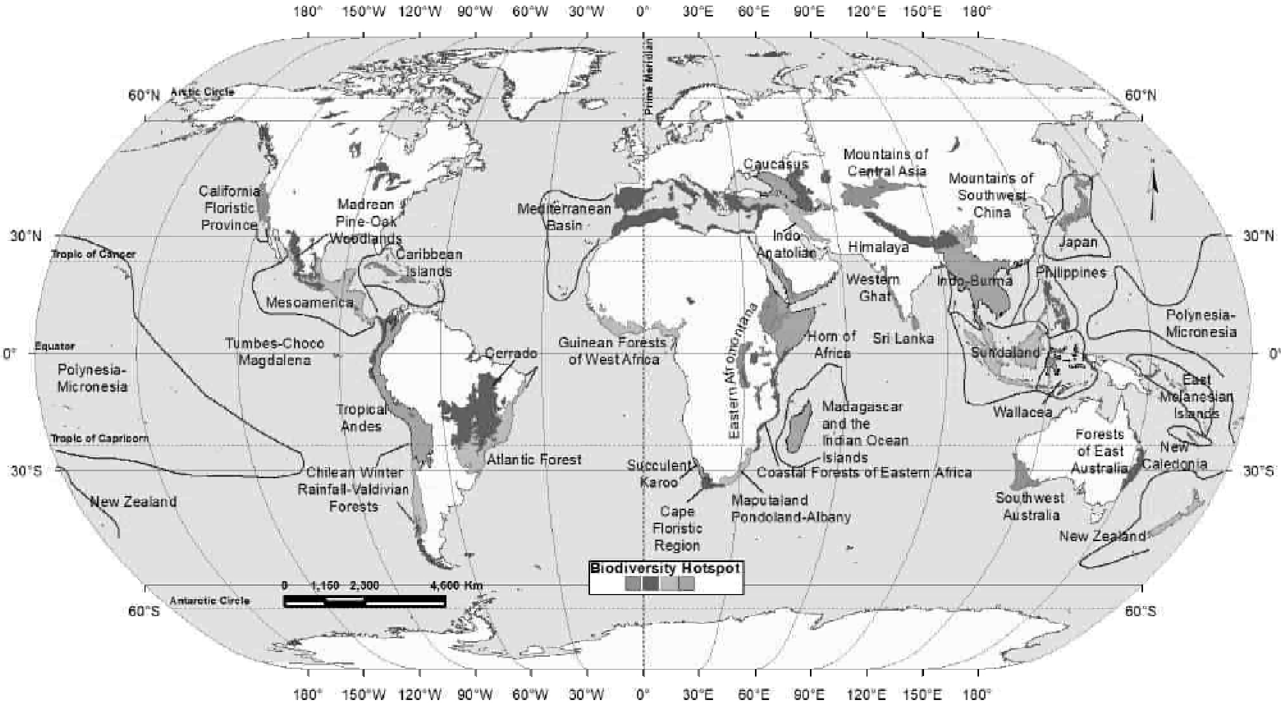


Fig. 15.5 Biodiversity hotspots of the world

A Biodiversity hotspots and various measures adopted by government to preserve biodiversity in India

Having diverse physical features (relief/ terrain, water bodies, soils etc) and climatic conditions (precipitation and temperature), our country has varied ecosystems such as wetlands, forests, grasslands, coastal, marine, desert etc. These ecosystems can sustain and harbour a large variety of species and varied biodiversity and also contribute to human wellbeing. There are 4 major hotspots in India:

Name of the Hotspot	**Locations in India**
The Himalayas-	Areas of Jammu and Kashmir, Himachal Pradesh, Sikkim, Uttarakhand, Arunachal Pradesh, Nagaland, Manipur, Mizoram, Meghalaya, Tripura and hill regions of West Bengal and Assam come in this zone.
The Western Ghats and Sri Lanka-	Western Ghats include regions in states of Maharashtra, Gujarat Kerala, Karnataka, Tamil Nadu and Goa.
Indo- Burma-	Northeastern India including states of Manipur, Nagaland, Meghalaya, Mizoram and Tripura. It also includes Andaman group of Islands
Sundaland-	Nicobar group of Islands

Important initiatives taken by Indian government for safeguarding these hot spots are:

a. Survey, Inventory generation, taxonomic (classification of living things) validation, threat assessment of floral and faunal resources

b. Designing Biosphere reserves for conservation of representative ecosystems.

c. Establishment of Protected Area Network of National Parks, Wildlife Sanctuaries, Conservation and Community reserves

d. Assessment of forest cover to develop an accurate database for planning and monitoring

e. Species oriented programmes like 'Project Tiger', 'Project Elephant' etc

f. Complemented with ex-situ conservation efforts (meaning conserving biodiversity outside their natural habitats through different techniques like captive breeding, zoos, botanical gardens, aquarium and gene banks etc.

Biological Diversity Act was enacted in 2002 with an aim to conserve biological resources of the country.

B Measures to protect wildlife

In recent decades, human encroachment has posed a threat to India's wildlife. In response to this, the system of National parks, Wildlife sanctuaries and protected areas, first established in 1935, has substantially expanded through wildlife protection Act 1972. Efforts are being made to protect and preserve the biological diversity of our country under various programs. India has preserved vast tracts of natural habitats, birds and plants in its 553 existing wildlife sanctuaries covering an area of 119,776 km2, which accounts for 3.64% of the geographical area of the country (National Wildlife Database, March, 2019). 218 sanctuaries are proposed in Protected Area Network Report covering area of 16,829 km2. There are 101 existing national parks covering an area of 40,564 km2 which accounts for 1.23% of geographical area of the country (National Wildlife Database, March, 2020). 75 additional National Parks are proposed for future in Protected Area Network Report. There are 86 Conservation Reserves in country with an area of 3858.25 km2 accounting for 0.12% of the geographical area. There are 163 existing Community Reserves covering area of 833.34 km2. (National Wildlife Database, March, 2020).

Besides this, there are 35 Botanical Gardens (the oldest and largest is Acharya Jagadish Chandra Bose Indian Botanic Garden in West Bengal), 275 Zoological Parks, Deer Parks, Safari Parks, Aquaria etc. to make people aware conservation of threatened and endangered wildlife species in their respective areas. In India, for the purpose of effective conservation of natural habitat of wildlife, special schemes like Project Tiger 1973 to save the endangered species at the onset 9 reserves were made. There are 53 tiger reserves currently (2022) accounting for 2.4% of total geographical area of India. Project Elephant have been launched in 1922 and there are 32 elephant reserves in 2010. These are very important as many species are at the brink of extinction. However, none of these efforts will be truly successful unless all Indians recognize their role in conserving biodiversity.

Wildlife Sanctuaries: The main objective of the wildlife sanctuaries is to ensure maintenance of a viable population of wildlife and their desired habitat. There are 553 existing wildlife sanctuaries in India covering an area of 119,776 km2 which accounts for 3.64% of geographical area (National Wildlife Database, March 2019). Another 218 sanctuaries are proposed in the Protected Area Network Report covering an area of 16,829 km2.

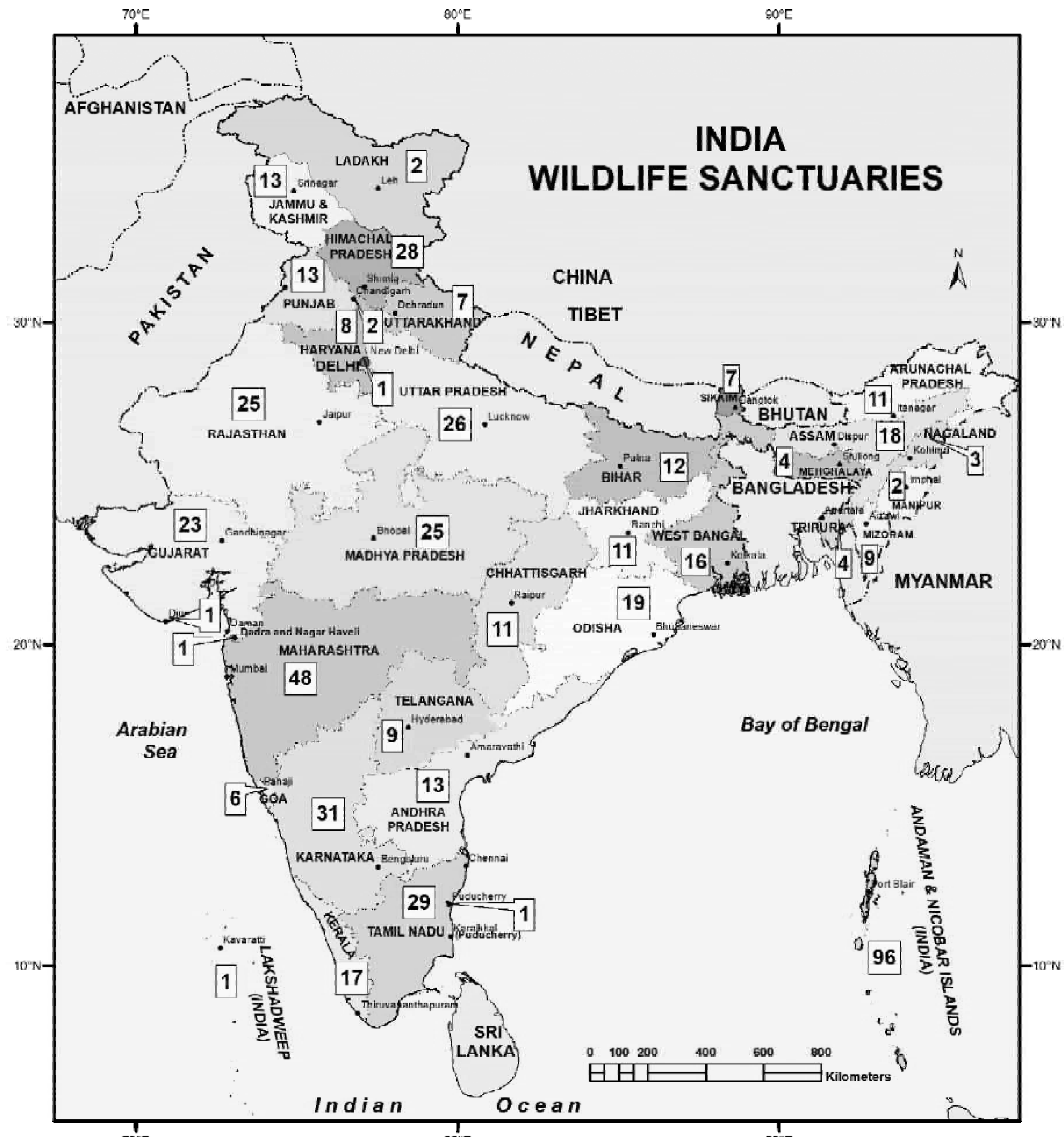


Fig. 15.6 State wise break up of sanctuaries in India

Success story of Panna National Park- Tiger reserve

By year 2009 the Panna national lost all its majestic tigers due to poaching. T1 tigress from Bandhavgarh national park was introduced on 3rd March, 2009. Over the next decade the efforts to restore the past glory of the Panna national park the founder 7 tigers (5 females and 2 males) have mated more than 30 times to produce 80 cubs by 2019.

The Panna National Park is rare success story of very positive initiatives adopted in aspect of wildlife conservation. Still there are challenges remaining along with poaching. Other issues like water scarcity, rocky terrain, rising temperature etc., also puts stress to tiger population.

Ramsar wetland sites

A wetland is an area of land where soil is saturated with moisture either permanently or seasonally. These areas may be partially or completely by shallow pools of water.

Ramsar is a city in Iran and the International treaty for conservation and sustainable use of wetlands was signed in 1971 in this city. So, the wetland sites are named as Ramsar convention sites. The mission of the convention is "the conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world". The main aim was to halt worldwide loss of wetlands and build international cooperation, policy making, capacity building and technology transfer.

The convention's focal theme is to maintain the ecological character of wetlands. The list of internationally important wetlands is based on botanical, zoological, ecological, limnological (study of inland water bodies like lakes) or hydrological importance.

The Ramsar Convention is focused on conservation and sustainable utilisation of wetlands and recognizing the fundamental ecological functions of wetlands and their cultural, economic, scientific and recreational value. These are total 75 Ramsar sites (2022) in India.

INTEXT QUESTIONS 15.3

1. How many Hotspots are identified in the world.
2. Name the Hotspots found in India.

   i)…………ii) ………….iii)……………iv)………….
3. How many biosphere reserves are in India?

15.7 JOINT FOREST MANAGEMENT (JFM)

The state of West Bengal is pioneer in implementation and attaining successful achievements of Joint Forest Management. The model was first introduced in Arabari Reserve Forest Range in west Medinipur district which is commonly Known as 'Arabari Model' introduced in 1971.

The concept of JFM was introduced by the Government of India through the National forest policy of 1988. It involves both the forest departments, and local communities in natural forest management. The village communities are required to form forest protection committees, forest conservation and development societies. Each of the committees has an executive committee to manage its day to day affairs. Under Joint forest management, the Government along with village communities are entrusted with the protection and management of nearby forests. In return to services provided by village communities, they get the benefit of using minor non- timber products. With the involvement of importance of stakeholders, the forest can be conserved in a sustainable manner. Joint Forest Management helps in building a strong setup of state government with participatory approach among local communities. The local community helps in building a strong base at grassroots level of development.

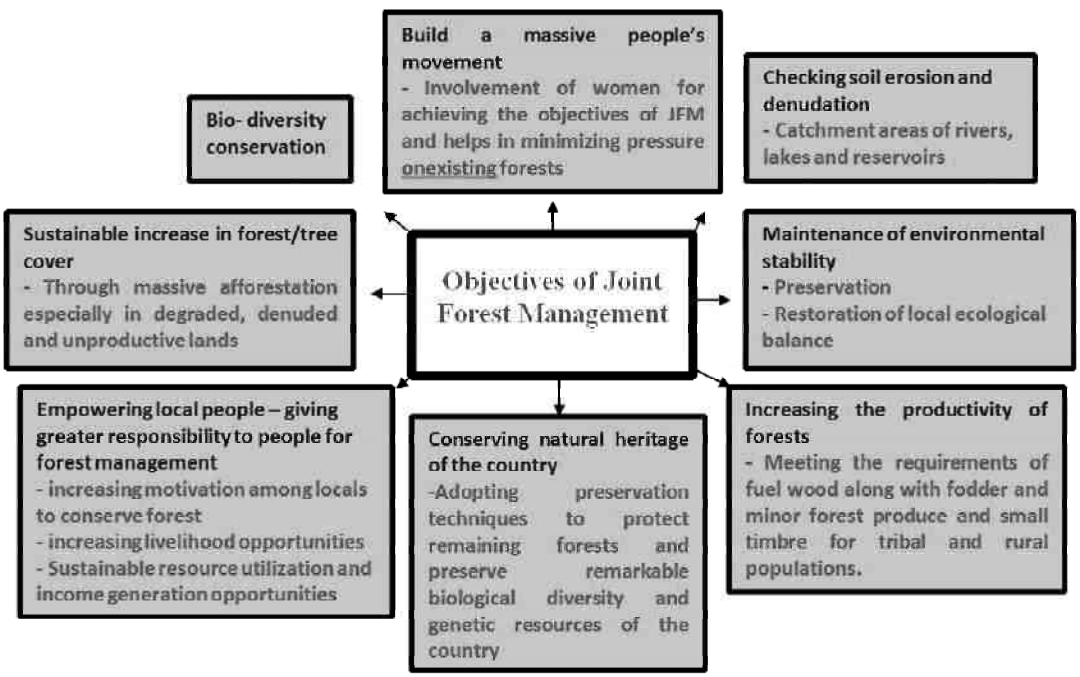


Fig. 15.7 Objectives of Joint Forest Management

a Following are main components of JFM functioning

1. The Joint Forest Management is a generic term for partnership which involves forest management jointly with the state forest department and local communities.

2. The local village committees enter into Memorandum of Understanding (MoU) with the forest department to manage the forest area jointly.

3. The JFM committees have democratic constitution with representation to weaker sections of the society and enhance the role of women in the decision making process. In many JFM committees women are appointed as Chairpersons. In states like Odisha the member secretary is also an elected representative.

4. The nomenclature of JFM is different in some states like Vana SamrakshanaSamities (VSS) in Andhra Pradesh, Van Panchayats in Uttarakhand etc.

5. The resolutions are formed by the state government in accordance with local conditions regarding composition of village institutions. The nature of forest areas taken under JFM with rights and responsibilities of partners and usufructs (it means legal rights are granted to a person or party which grants a temporary right to derive/use income or benefit from forest property which is owned by the government as a natural resource).

6. There are 1,18,213 JFM as of March 2011 in 29 states and 8 UT. Madhya Pradesh has the largest number of 1,228 JFMCs who manage a forest area of 6.69 million hectares.

7. Centrally sponsored schemes like National Afforestation Programme (NAP), other externally aided projects and schemes of Centre and State governments are implemented through the JFM approach.

8. The concept of JFM including livelihood concerns along with conservation management of forests is gaining importance. It includes checking on degradation of forests and provision of employment for the people.

9. The JFM with other institutions plays a vital role. Green India Mission (GIM) proposed to increase the quality of forest cover in 5 million ha and to increase forest cover in another 5 million ha.

b. Strengthening JFM

i. Legal backup to the JFM committees- All the state governments register the JFM or village committees under the Societies Registration Act, 1860. All adults of the village should be eligible to become members of the JFM committees.

ii. Women play an important role in the committees- Suggested guidelines say that at least 50% of the JFM general body members should be women and at least 33% members of management/ executive committee should be filled by women.

iii. JFM should be extended in good forest areas- the programmes aim to cover both the degraded and good areas (crown cover of 40%). The implementation of JFM in good forest shall be done in planned manner on plot basis. The plots

should be monitored and feedback a success should be assessed and before allowing plot basis use of good degraded forest in the locality should be taken care simultaneously.

iv. **Micro plan in JFM areas-** Flexible guidelines should be evolved for preparation of local need based micro plans for the area in overlapping circles. The micro plans should be prepared by Forest officers and Village Forest Protection Committees while keeping in mind the consumption and livelihood utilising indigenous knowledge along with needs of local communities and as well as attaining them sustainably. The micro planning should be done with due regards to environmental productive and functional potentials of the forests along with carrying capacity of the forest.

v. **Evaluating conservation and biodiversity values of nature-**The micro plan should take into consideration and provide suitable advice for species to be planted in community lands and other Government notified areas outside forest areas including district council areas of North east. The Eco development and infrastructure should have separate entity funding under micro plan through concerned development agencies.

vi. **Identification and recognition of Self-initiated groups-** Community groups in many states like Andhra Pradesh, Gujarat, Odisha, Bihar and Karnataka for regeneration and protection of the forests need to be identified, recognized and registered with JFM.

vii **Conflict resolution-** In order to have harmony and resolve conflicts among all functionaries of JFM the State governments may constitute divisional or state level representative forums including NGOs participation.

viii. **Contribution for regeneration of resources-** To maintain long term sustainability not less than 25% of revenue earned from final harvest should be deposited in village development funds. There should be transparent mechanisms to compute income and sharing benefits among different stakeholders.

ix. **Monitoring and Evaluation-** continuous monitoring of progress and performance taken at Division and State level. The evaluation should be planned after 3 and 5 years at Division and State level respectively.

Some success stories and initiatives of JFM

Gujarat- Gender Equity and Joint Forest Management- Women play an important role in forest management as they do bulk of work for commercial and domestic use, of resources like, fodder, fuel and non-timbre forest produce.

The JFM has been initiated in around 60 villages covering around 3000 hectares through village institutions like Gram Vikas Mandal (GVM) where both men and women can be members, Mahila Vikas Mandal (MVM) where only women are involved.

Odisha- In Odisha there are 2373 Van Samrakshan Samiti (VSS) are protecting 25% of the total degraded forests in the state. There are 5000 Self- Initated Forest Protection Groups (SIFPG's) are also protecting and regenerating forests adjoining their habitation. Kesharpur village in the foothills of Odisha's Nayagarh district villagers guarded the forest from timbre smugglers and stray grazing. Similar efforts are initiated in 28 districts of Odisha. Nowadays local communities have been protecting degraded forests driven by economic needs.

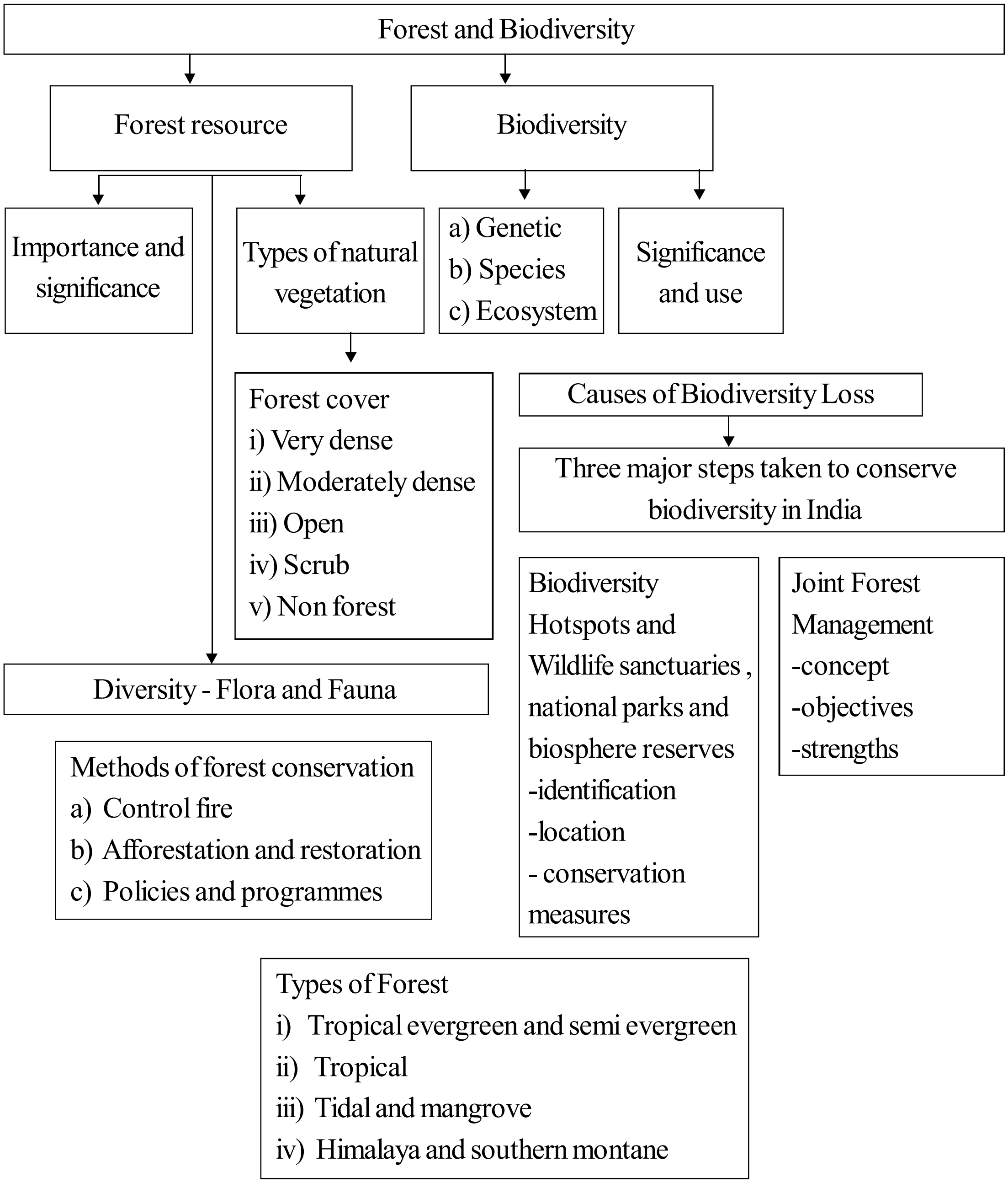
Andhra Pradesh- Behroonguda is a hamlet in Andhra Pradesh. There were 97 families belonging to Naikpod and Gond tribes themselves formad forest protection groups in 1990. In 1998 the state government recognized their efforts an referred them as Vana Samarakshana Samithi (VSS). JFM has allotted 500 hectares of degraded forest of whose cost they have to borne and benefits they derive from it. The residents began to derive usufruct benefits from the forest. TheVSS is widely regarded as being successful. There are now 6580 Vana Samarakshana Samithis (VSS) have been formed. Degraded forest area of 16.58 lakh hectares has been brought under JFM. The Samithis have been successful in upliftment of tribals and bringing them into the mainstream. Like increasing availability of fuel and fodder, reduction in incidences of fire, smuggling illegal grazing, employment for villagers, increase in water table, increase in non timbre products etc.

INTEXT QUESTIONS 15.5

1. The first step towards Joint Forest Management is called as ………..model introduced in state of…………………….. in year…………
2. The concept of JFM was introduced by the Government of India through National forest policy in that year.
3. Which state in India has the largest number of JFMC's and the size of area managed under the JFM scheme.
4. Two example of nomenclature of JFM

   i)………………… ii) ………………………
5. What are various ways through which strengthening JFM is practised in India?

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Write a note on the significance of forests.
2. Explain major five types of forest types in India? Describe their distribution and their tree species.
3. Major causes of biodiversity loss, with the help of a diagram.
4. Describe various steps adopted to preserve wildlife in India.

5. Explain vegetation found in southern mountains.
6. Describe various initiatives adopted by the Indian government to safeguard biodiversity hotspots.
7. Name and location of Biodiversity hotspots in India.
8. Discuss measures adopted to protect wildlife in India.
9. Describe the significance and use of Biodiversity with a suitable flow chart.
10. Elaborate on various methods adopted for forest conservation in India.
11. What are Ramsar Wetland sites and how many are located in India?
12. With the help of flow diagrams show objectives of Joint Forest Management.
13. Discuss main components for smooth functioning of Joint Forest Management.
14. Highlight (any five) initiatives taken for strengthening the Joint Forest Management.

ANSWERS TO INTEXT QUESTIONS

15.1

1. Five major types of forest found in India-
   (i) Tropical Evergreen Forests
   (ii) Tropical Deciduous Forests
   (iii) Thorn Forests
   (iv) Tidal Forests and Littoral and Swamp forests
   (v) Himalayan Forests and southern Montane forests
2. Name four classes of Forest cover given by FSI (Forest Survey of India)
   (i) Very dense
   (ii) Moderately Dense Forest
   (iii) Open forest
   (iv) Scrub
3. Alpine Forest found in Himalayas at the height of 3000 to 3800 mts
4. Sundari
5 (i) Dry deciduous forests receive 70 to 100 cm of rainfall annually.
   (ii) Moist deciduous forests receives100 to 200 cm of rainfall annually.

Notes

6. India has rich flora ranking 10th in world
7. India is accounting for 6.5 % of world's fauna

15.2

1. (i) Control Forest fires ii) Regulated and planned cutting of trees iii) Proper utilisation of forests products and forests Iv) Protection of forests
2. (i) National Afforestation Programme (NAP) ii) National Mission for a Green India (GIM) iii) Forest Fire Prevention and Management Scheme (FFPM)
3. (i) Afforestation through natural/ artificial regeneration ii) Protection iii) Management
4. (i) SMC- soil and moisture conservation

   (ii) JFMC-, Forest Development Agency

   (iii) FDA- , Forest Development Agency

   (iv) SFDA- State Forest Development Agency

15.3

1. Species diversity covers the full range of species on earth. includes all species, viruses, bacteria, microbes to animals.
2. Three uses of Biodiversity

   (i) Production

   (ii) Consumption

   (iii) Indirect
3. (i) In- situ

   (ii) Ex- situ

15.4

1. 36
2. (i) The Himalayas

   (ii) The Western Ghats and Sri Lanka

   (iii) Indo- Burma

   (iv) Sundaland
3. There are 553 existing wildlife sanctuaries in 2019, India covering an area of 119,776 km2 which accounts for 3.64% of geographical area.

4. 15
5. (i) The hotspot region at least contains 1,500 species of vascular plants which are found nowhere else on the earth; they are called "endemic" species.

   (ii) The region has lost at least greater or equal to 70 percent of its primary native (indigenous) vegetation.

15.5

1. Ramsar is a city in Iran and the International treaty for conservation and sustainable use of wetlands was signed in 1971 in this city.
2. 41
3. Sundarbans wetland and 4320 sq km

15.6

1. The first step towards Joint Forest Management is called as Arabarimodel introduced in state of West Bengal in year 1971
2. 1988
3. Madhya Pradesh has the largest number of 1,228 JFMC's and forest area 6.69 million hectares.
4. (i) Vana Samrakshana Samithi (VSS)

   (ii) Van Panchayats
5. (i) Legal backup to the JFM committees

   (ii) Women plays an important role in the committees

   (iii) JFM should be extended in good forest areas

   (iv) Micro plan in JFM areas

   (v) Evaluating conservation and biodiversity values of nature

   (vi) Identification and recognition of Self- initiated groups.

16

WATER RESOURCES

Water is one of the basic resources for human beings as well as all other life forms on earth. Water is so important for life that we cannot imagine life without it. The evolution of life itself took place in the water. In the evolution of all kinds of life, water has played an important role. The amount of water found in living beings is 65 percent and 65 to 99 percent in plants. This clearly shows the need and utility of water. Water, which is a precious gift of nature , has several uses. Water is very essential for development. Although it is available in abundance covering 3/4 of the earth, yet it is a scarce resource; and the fact is that only 3 % is potable. Hence its utilisation and conservation is the most challenging task for mankind. The demand for water continues to rise whereas the supply and availability of water resources is limited as far as human use is concerned. Thus, an efficient planning and implementation programme of water resource appraisal, development, conservation, and management is required.

From the point of view of availability and suitability, the potable water is limited in India. Moreover, it has highly uneven geographical distribution. Another disturbing issue is day by day deteriorating quality of water. It is a matter of great concern for all of us. Besides coordinating the demand and supply of the water, there is a need to keep the balance among different sources of water along with the balance among different uses of water. Hence conservation of water resources is an essential requirement.

OUTCOMES

After studying this lesson, learner:

- states the significance of water resources;
- describes the different sources of water and its utilisation pattern;
- explains the uneven distribution of water;
- asseses the issues related to water resources and suggest solutions and

- analyses methods of Water Resource conservation and Management with special reference to traditional methods.

16.1 WATER RESOURCES: SIGNIFICANCE FOR LIFE

Water is the most valuable resource of nature. This is a renewable and inexhaustible resource but is in trouble these days. Demand for water has been increasing continuously and its supply decreasing. If we look at the water resources of India in the global context, India has 4 percent water whereas she is housing 16 percent of the world's population. It means the per capita availability of water is quite low in our country. One-eighth area of the country is flood prone and one-sixth area is under the grip of drought. Nature of the monsoon is mostly responsible for uneven distribution of water. Food grains and other agricultural products are required in large quantities for the growing population. For this reason, the use of water for irrigation of crops has been increasing. India ranks first in the world in terms of irrigated area. The demand for water has increased in the cities due to rapid urbanisation, industrialization, and modernization. In addition, the demand for water has been increasing for sewerage and for removing all kinds of wastes.

16.2 SOURCES OF WATER

There are four main sources of water:

A. Surface water

B. Underground water

C. Atmospheric water

D. Oceanic water.

In our daily life we use only surface water and underground water.

A. Surface water

The main source of surface water is precipitation. About 20 percent of the precipitation evaporates and becomes atmospheric water. A part of the running water goes underground. The large part of surface water is found in rivers, rivulets, ponds, and lakes. Remaining water flows into the seas, oceans. Water found on the surface is called surface water. About two - third of the total surface water flows into three major rivers of the country - Indus, Ganges and Brahmaputra.

The water storage capacity of reservoirs constructed in India so far is about 17400 billion cubic metres. At the time of independence, the water storage capacity was only 180 billion cubic metres. Hence water storage capacity has increased about ten times. The storage capacity of usable water in the Ganges basin is the maximum. Despite maximum annual flow, the storage capacity of usable water is the least in the Brahmaputra basin. The storage capacity in Godavari, Krishna, Mahanadi and Indus is sufficient. Annual water flow in the three major rivers of India - Indus, Ganga and Brahmaputra are very high. Hence water storage capacity of these rivers can be increased.

Table 16.1 INDIA: Distribution of surface and underground water according to river basins (Figures in billion Cubic metre)

River Basin	Catchment Area (km^3)	Avg. monsoon runoff (km^3)	Avg. annual SW potential (km^3)	Estimated utilisable SW (km^3)	Estimated replenishable GW (km^3)	Static GW reserve (km^3)	Predominant Aquifers
Indus	321289	58.60	73.31	46.00	26.49	1338.20	Cr
Ganga	861452	401.30	525.02	250.00	170.99	7834.10	Al, Cr
Brahmaputra, Barak, and others	236136	477.50	585.60	24.00	35.07	1018.50	Al, Cr
Godavari	312812	107.10	110.54	76.30	40.65	59.40	DT, Cr,
Krishna	258948	61.00	78.12	58.00	26.41	36.00	DT, Cr, St
Cauvery	81155	18.90	21.36	19.00	12.30	42.40	Cr, St
Subernarekha	29200	6.20	12.37	6.81	1.82	11.10	Cr, Al
Brahamani and Baitarni	39033	15.30	28.48	18.30	4.05	41.30	Cr, St
Mahanadi	141589	16.00	66.88	49.99	16.46	66.00	Cr, St
Pennar	55213	60.20	6.32	6.86	4.93	119.70	Cr
Mahi	34842	32.60	11.02	3.10	4.20	43.40	Al
Sabarmati	21674	9.70	3.81	1.93	3.00	10.80	Al
Narmada	98796	3.40	45.64	34.50	10.83	28.20	DT, Al
Tapi	65145	10.70	14.88	14.50	8.27	12.60	Al
West flowing rivers from Tapi to Tadri	52900	13.60	87.41	11.94	8.70	113.20	DT
West flowing rivers from Tadri to Kanyakumari	56200	36.90	113.53	24.27	9.00	18.40	Cr
East flowing rivers between Mahanadi and Pennar	—	16.20	22.52	13.11	9.00	7.50	Cr
East flowing rivers between Pennar and Kanyakumari	100100	80.30	16.46	16.73	9.20	11.20	Cr
West flowing rivers of Kutch, Saurashtra including Luni	321900	97.80	15.10	14.98	11.23	—	Cr, St
Area of inland drainage in Rajasthan desert	60000	—	—	—	—	—	Sand, Al, St
Minor river basins draining into Bangladesh and Myanmar	36300	24.80	31.00	—	18.80	—	Al, St
Total	3184684	1548.10	1869.37	690.32	431.40	10812.00	

Source: Basin wise distribution of surface and groundwater resources in India (source: Central Water Commission and Central Ground Water Board)

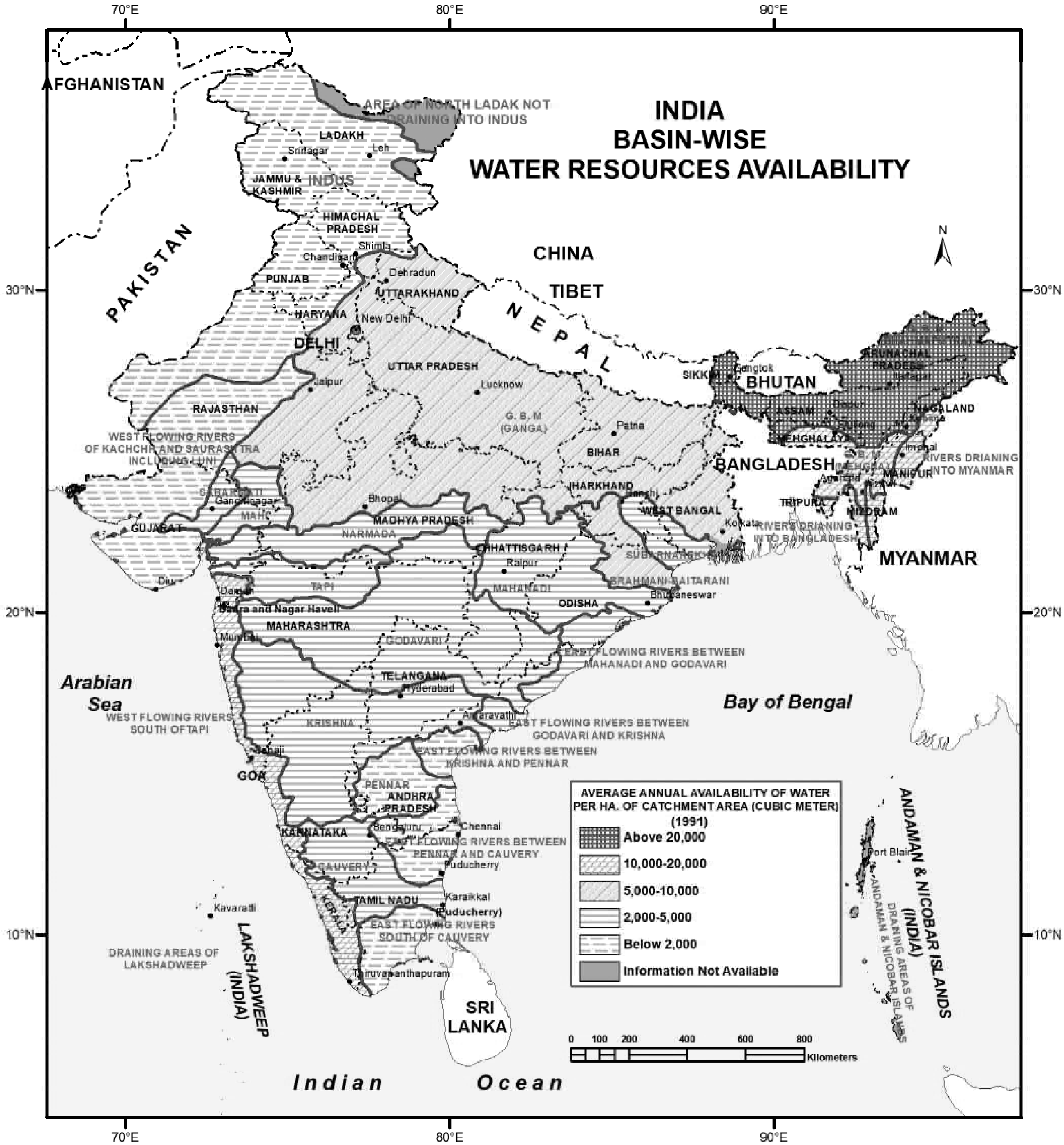


Fig. 16.1 : India Basin wise Water Resource

B. Underground water

Rain water percolates into the earth's surface and becomes underground water. The process of percolation also takes place from the surface water. Large amount of water gets collected under the Earth's surface by these two methods. This is called underground water.

Notes

According to the Central Underground Water Board, the annual replenishable underground water resource in India is 433 billion cubic metres. Out of this about 399 billion cubic metre water is available for various uses.

The distribution of underground water is not the same everywhere. Availability of underground water depends upon the amount of rainfall, nature of rainfall, nature of land and its gradient. In the areas of high rainfall where the land is almost flat and has porous rocks, the water easily percolates and reaches the aquifers. Therefore, underground water is available in plenty at shallow depths in these areas. In the areas like Rajasthan where the land is flat and has porous sandy soil, the underground water is less in amount and is available at greater depths due to lack of rainfall. In the North-Eastern regions of the country, in spite of adequate rainfall, underground water is available in less quantity at greater depths. It is because the land is sloppy and the conditions are not suitable for percolation of water. There are large reserves of underground water in the plains of Ganga - Brahmaputra and in coastal plains. The availability of underground water is less in peninsular plateau, Himalayan region and desert areas.

Underground water is used on a large scale in the areas where the rainfall is comparatively less. The use of groundwater is more in Punjab, Haryana, Rajasthan, Tamil Nadu, Gujarat and Uttar Pradesh. Andhra Pradesh, Madhya Pradesh, Maharashtra, Karnataka and Chhattisgarh are such states where in spite of rainfall, the use of underground water is less. There is a dire need to develop underground water resources in these states.

16.3 WATER BUDGET

Water Budget means the balance between the available water in the country and the water under use. There is a great variation in the availability of water resources in India. The availability of water also varies according to the season. Water is available in sufficient quantities during the rainy season. As the dry season sets in, there is a shortage of water. Likewise water is available plentily in areas having flat surface, porous soil in comparison to the areas having sloped land and non-porous soil. The use or demand on water resources is increasing day by day with the increase of population. The reserves of our surface and underground water are about 23840 billion cubic metres. Out of this only 10860 billion cubic metre water is required for use. The unit of measurement of the amount of water is cubic metre and hectare metre.

In simple terms, Water budget means the rate of change in water stored in a region. For example, a watershed is balanced by the rate at which water flows in and out of the region. After thorough understanding of water budgets and underlying hydrologic processes, a foundation for effective water-resource and environmental planning, conservation and management could be formulated. The Observed changes in water budgets of an area over time thus can be used to assess the effects of changes in the climate and as a result of human activities on water resources. Comparison of water budgets from different areas helps in assessing the factors such as geology, soils, vegetation, and land use on the hydrologic cycle.

The natural hydrological cycle is affected in many ways by human activities. Modifications carried out on the land to accommodate large scale agriculture, such as installation of drainage and irrigation systems, many a times alter infiltration, runoff, evaporation, and evapotranspiration rates. Similarly, Buildings, roads, and parking lots in urban areas tend to increase runoff and thus decrease infiltration. Dams reduce flooding in many regions. Water budgets thus provide a basis for assessing how a natural or human-induced change in one part of the hydrologic cycle may affect various other aspects of this cycle.

INTEXT QUESTIONS 16.1

1. What is the ranking of India in the World in terms of irrigated area
2. The surface water storage capacity of which river basin is maximum in India?
3. Name 5 states of India where underground water is used on a large scale.

16.4 UTILISATION PATTERN

Population in India has been increasing rapidly. It has increased about three times since independence. Due to this increase in population, the demand for water has increased in all the spheres for eg. for domestic use, irrigation and industries. On the other hand, per capita annual availability of water has been decreasing over the years. In 1951 per capita annual availability of water was 5177 cubic metre per person which has decreased to 1829 cubic metre per person annually in 2001. In the coming years by 2025 per capita availability of water is expected to become 1342 cubic metres annually. It is to be noted that the water crisis arises when the per capita availability of water falls below 1000 cubic metres annually. Today many countries are facing the water crisis and have to import water to sustain.

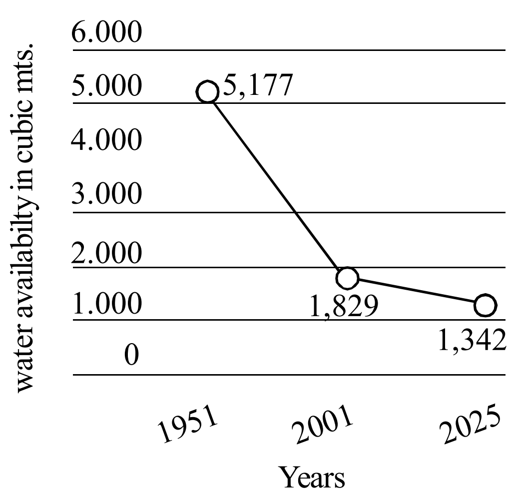


Fig. 16.2 : Water Availability in India

Notes

Water is used for many direct and indirect purposes. Direct purposes include mostly domestic i.e. bathing, drinking, cooking and irrigation while examples of indirect purposes are in processing wood to make paper and also in producing steel for automobiles. The major bulk of the world's water use is for agriculture, industry, and electricity. Even one cannot imagine fishing, forestry and water sports without huge amounts of water resources. In this way, water is essential for all kinds of developmental work. It is essential in all spheres of life. Due to rapid growth of urban population, the demand for water in urban areas has increased tremendously.

The most common water uses include:

- Domestic (drinking and Household) Needs;
- Recreation (Sports activities such as River Rafting, Kayaking etc);
- Industry and Commerce;
- Agriculture (Irrigation);
- Hygiene and Public Health;
- Hydroelectricity Generation (Energy)

We humans require fresh water. Only 2.5% of total water on the Earth is freshwater, and over two-thirds of this is frozen in the glaciers and polar ice caps. The Water demand already exceeds its supply in many parts of the world, and many more areas are expected to experience this imbalance in the very near future. It is estimated that 70% of world-wide water use is for irrigation purposes in agriculture. Climate change will have significant impacts on the water resources. Due to the ever increasing human population the demand for water is growing day by day and many of the world's major aquifers are getting depleted. Pollutants from industries threaten the water quality, but the most widespread, especially in the less developed countries, is the discharge of raw sewage into natural waters.

Table 16.2 India: Changing pattern of use of water 1990-2050
(Figures in billion cubic metere)

Use	1990	2000	2010*	2025*	2050*
Domestic	25	33	42	52	60
Irrigation	460	536	653	770	800
Industry	15	30	79	120	130
Energy	19	27	44	71	120
Others	30	33	35	37	40
Total	549	659	853	1050	1150

*Estimated

Notes

India is an agricultural country. Hence plenty of water is needed for irrigation. 536 billion cubic metre water was used for irrigation in the year 2000. It is 81 percent of the total water used. The remaining percentage of water was used for domestic, industrial and other purposes.

There has been a rapid increase in the irrigated area in India since independence. Total irrigated areas in 1999-2000 was 8.47 crore hectare. The maximum capacity of the use of water for irrigation in India is 11.35 crore hectare metre. But about three-fourth water of this capacity is being used. The demand for irrigation in India has been increasing continuously.

The reasons for the increasing demand of irrigation are as follow:

1. Regional and seasonal variations in the distribution of rainfall.
2. Wide and uncertain gaps in rainfall season.
3. Growing demand for water for commercial crops.
4. Changing cropping pattern.

MEANS OF IRRIGATION

There are three main means of irrigation in India:

A Wells and Tubewells;

B Canals; and

C Tanks.

TUBEWELL

WELL

TANK

CANAL

Fig. 16.3 : Means of Irrigattion

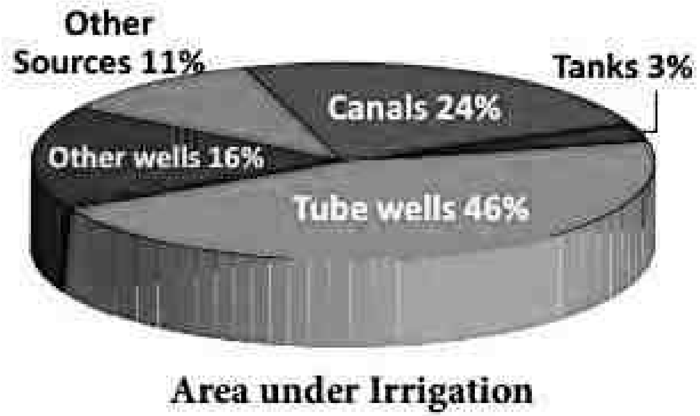


Fig. 16.4 : Area under Irrigation

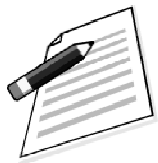
Notes

A. Wells And Tube-Wells

Irrigation by wells is an old practice in India. It has increased tremendously with the use of diesel and electric pumping sets. Irrigated area by wells and Tubewells in 1950- 51 was only 59 lakh hectares which has increased to 30 million hectares in 1997- 98. During this period total irrigated area has increased from 30 percent to 57 percent. From 2001- 02 to 2014-15 there is 20% increase in net irrigation, due to extensive extraction of groundwater. In the said period i.e. 2001-02, nearly 41% of Net irrigated area got water from Tube Wells whereas this increased to 46% in 2014-15. but Irrigation declined from 21% to 16% only. Uttar Pradesh has the largest area under Well irrigation followed by Rajasthan, Madhya Pradesh, Punjab, Gujarat, Maharashtra and Bihar. There are large reserves of underground water in the alluvial plains of north India. Digging and constructing wells and tubewells is easy and the cost of their construction is also comparatively less. Therefore, irrigation by wells and tubewells is popular among farmers. In states like Gujarat, Goa, Rajasthan and Maharashtra, only about 60 percent irrigation is carried on by wells and tubewells.

B. Canals

Canals were the main means of irrigation upto 1960. Canals contributed about 40 percent in the total irrigated area of the country. In 1996-97 it came down to about 31 percent. About 1.74 crore hectare area was irrigated by canals in 1996- 97. Half of this area (52.5 percent) is limited to the states of North India. Haryana, Odisha, Karnataka, West Bengal, Andhra Pradesh and Punjab are worth mentioning for canal irrigation. Jammu-Kashmir, Mizoram, Assam and Tripura are such states which greatly depend upon canal irrigation because there is lack of other means of irrigation in these states. Mizoram which has the least irrigated area is completely dependent upon canals for irrigation. Canal irrigation declined from 27% in 2001-02 to 24% in 2014-15.



C. Tanks

The contribution of tanks in irrigation has reduced. About 3 percent of the irrigated area is irrigated by tanks. Irrigation by tanks is popular in the peninsular plateau area. Tamil Nadu is the leading state in irrigation by tanks. About 22 percent of the area is irrigated by tanks here. In Odisha, Maharashtra, Karnataka, Kerala and West Bengal tank irrigation is prevalent.

INTEXT QUESTIONS 16.2

1. What are the various means of irrigation in India?
2. Name the states where irrigation is done mainly by tanks?
3. Give reasons for the increase in demand for irrigation.

16.5 RAIN WATER HARVESTING

Rain water harvesting generally means collection of rainwater where it falls. Where there is shortage of water, groundwater can be recharged by harvesting rainwater. In this process, water is made to go underground after collecting rain water locally, without polluting the same.

Why do we need Rain water harvesting?

Three main reasons are responsible for this:

1. Scarcity of surface water
2. Growing dependence on underground water.
3. Increasing urbanisation.

There can be two Scenarios of Rain water harvesting:

A. Urban Scenario

Total amount of rain water recovered in an area is called 'rain water reserve'. Effective management of rain water reserves is called 'potential water harvesting'. Think for a while the area of the roof of your house is 100 square metres and the 'average rainfall' of this area is 60 cms. Suppose the water on the roof has neither flowed, percolated nor evaporated then there will be 60 cms, high water on the roof.

Volume of water = Area of the roof X Amount of annual rainfall = 100 x 60 cms = 100 x .6 = 60 cubic metres.

Notes

In other words, a family can collect 60,000 litres of water in a year. All water related needs of this family can be met with this. On an average a person needs 10 litres of water for drinking daily. If your family consists of 6 members, then you need 6x10x365 = 21900 litres of water. Remaining (60,000 - 21,900) = 38,100 litre water can be used in dry weather when there is a scarcity of water.

Fig. 16.5: Rainwater Harvesting in Urban area

B. Rural Scenario

The tradition of rainwater harvesting is very old in India. But the utility of water harvesting has never been felt so much as it is today. Even today the people living in the areas of water scarcity try to do their domestic work by adopting old methods. Deepening and dredging of wells, tanks and ponds are included in these methods. Water harvesting in the small channels (locally known as bawli) is an important traditional method in the areas of water scarcity. Now we can be in a better and secure situation by adopting a new technique of water harvesting. Think for a while. If the people living in 5,87,000 villages in India, engage themselves in harvesting rainwater of their 2000 lakh hectare area, there will be a lot of water available for use. On an average a village comes under the radius of 37,500 lakh cubic metre rain water reserve. By this calculation we come to know that there is great potential for rainwater harvesting.

Fig. 16.6 : A Traditional Method of Rainwater Harvesting

METHODS OF RAINWATER HARVESTING

We can adopt different methods for rainwater harvesting according to need, available facilities and environmental conditions. The following methods are worth mentioning-

1. Construction of potholes - We can harvest water in small ditches constructed in those areas where there is not much underground water. These ditches may be constructed 1-2 metres wide and 2-3 metres deep. Their shape could be anything. These ditches are filled with rubbles and sand. Rainwater can easily percolate through these.

2. Construction of trenches - In the lower regions where porous rocks are found after making trenches of 0.5 to 1-metre width, 1 to 1.5-metre depth and 10 to 15-metre length, these are filled with rubbles. These trenches should be made parallel to the slope of the land.

3. Use of wells - The wells which have become dry and are not being used at present can be used for water harvesting.

4. Handpump - Stored rainwater can be made underground with the help of a filter by running handpumps in the areas of lack of underground water.

Case Study of Rainwater Harvesting

Dudhatoli Lok Vikas Sansthan

Ufrakhal, Pauri Garhwal, Uttarakhand

Ufrakhal village, located in the midst of Chamoli and Almora region, was once considered one of the most backward areas in India. Today, it is completely transformed. The person responsible for this change is Sh. Sachidanand Bharti. He started mobilising women to conserve forests. Then, his task became simple. The villagers began to understand that the conservation of water, land and forest can be done in an integrated manner.

Initial setbacks like the dying of the saplings instigated Bharti to find a solution. After discussions with the villagers, it was decided to dig small pits near the newly planted saplings to collect enough water during monsoon. The idea clicked. Today, the trees of Baas, Kaafal, Amaat, Chir, and Awala amongst many other species are the most precious jewels of this forest. Next, he encouraged the villagers to dig 1,500 small pits (Jal Tarais) in the forests of Gaadkhark. The impact was immediate and evidently inspiring. Today, a number of small nallahs (drains) have become perennial, which culminate into a big nallah known as Gaadganga.

INTEXT QUESTIONS 16.3

1. Why do we need to harvest rainwater?
2. Name any two methods of rain water harvesting.
3. How is water being conserved and channels recharged in Ufrakhal, Uttarakhand?

16.6 ISSUES OF WATER RESOURCES

There are many issues related to water resources. The list is exhaustive. There is scarcity, pollution, depletion of water. We can list them as follows:

- Intense urbanisation leads to increasing demand for water,
- Pollutants in water due to release of untreated industrial water and urban sewage to water bodies
- Tremendous demand for water for drinking and economic and social development.
- Water stress and scarcity in many regions of the planet due to alterations in availability and ever increasing demand.
- Problems of stress/pressure and scarcity due to global changes with extreme hydrological events
- Problems caused by the lack of articulation and lack of consistent actions of governability of water resources as well as environmental sustainability.

16.7 NATIONAL WATER POLICY

The main Objective of National Water Policy is to take cognizance of the existing situation of country's water resource, and to propose a framework for creation of a system of laws and institutions and further for a plan of action with a unified national perspective.

Water is a national valuable reserve. It is essential for the Government to evolve policy for the development and management of water resources so that surface and underground water is not only properly used but also conserved for the future. Nature of rainfall has also compelled us to think in this direction. 'National Water Policy' was formulated and accepted in September 1987. It was revised in 2002 and presented as 'National Water Policy' 2002 and again updated in 2012 as problems arose in the previous policy during the course of time.

Water is an important constituent of the ecosystem. It should be considered essential for all kinds of life. It should be developed, conserved and managed in a planned manner. It is essential to think about its social and economic aspects of water as large areas of the country suffer due to drought and floods every year. It causes not only the loss of property and human life but the wheel of development is also stopped. The problems of floods and drought are not limited to the boundaries of a particular state. This requires thinking at the national level. Several problems arise in planning and management of water resources. More exploitation of underground water in many areas of the country have posed serious challenges such as dried up aquifers as well as lowering of water table. The demand of water is on increase for domestic use, industries, energy production etc. Water resources are already scarce, and with ever increasing demand by the growing population there shall be a worrisome future of water. Quality of water is also an important aspect. Pollution of surface and underground water has been increasing. Main sources of water pollution due to human activities include domestic wastewater, industrial effluents and chemicals used in agriculture. Sometimes water pollution is also caused by natural factors. Erosion, landslides, decomposition of plants and animals are the main natural sources of water pollution. Three fourths of the total surface water in our country is polluted.

IMPLEMENTATION OF NATIONAL WATER POLICY

National Water Board should prepare a plan of action, based on the National Water Policy, as approved by the National Water Resources Council, to regularly monitor its effective implementation. The State Water Policies may need to be drafted/revised in accordance with this policy keeping in mind the basic concerns and principles in a unified national perspective.

Watershed Development Programme

Watershed is defined as an area where the runoff resulting from rainfall is collected and drained out through a common point. Watersheds are composed of a number of streams and creeks that drain into progressively larger streams to eventually form a river. Each of the streams or creeks have their own watersheds, or sub-basins, that flow from higher elevations to lower elevations. The adjacent watersheds are separated by ridges which are called water divides. Within a watershed, water may come from various directions, but it drains out at a single point. Therefore, it is easier to manage water, soil and forest and other related resources within small watersheds by checking water at outlet points. By growing forests in the upper reaches of the watershed, the water flow through streams slows down, groundwater gets recharged and soil erosion gets reduced. The drained out water at the outlet point can be checked easily. Therefore, small watersheds are the ideal units to manage the natural resources like land, soil, water, forest etc.

The Watershed Development Programme was originally initiated by the National Wasteland Development Board, Ministry of Environment and Forest. Now the programme is placed under the Department of Land Resources under the Ministry of Rural Development. The Department of Land Resources is implementing the Integrated Watershed Development Programme (IWMP) from 2009-10 with an objective to cover 55 million hectares of rain fed land by 2027.

Benefits of Watershed Development Programme:

- Water storage, flood control, checking sedimentation
- Erosion control and prevention of soil
- Recharging groundwater to provide regular water supply
- Minimising over-exploitation of resources
- Increase in the agricultural production and productivity
- Decrease in deforestation
- Wildlife preservation
- Pollution control

The success of Watershed Development Programme is possible by:

a. More scientific thinking;

b. perfect techniques;

c. Participation of local population;

d. coordination among various departmental agencies, and

e. an independent ministry to follow up.

National River Linking Programme

The Inter-Linking of Rivers (ILR) programme is aimed at linking water surplus river basins with water deficit river basins so that the excess water from surplus regions could be diverted to deficient regions. The idea behind the interlinking of rivers is to reduce flood and drought havocs in water surplus and water deficit areas respectively. Thirty-seven rivers are identified to be interlinked by a network of about 3000 storage dams.

Benefits of River Linking Programme

- The irrigation of about 250 lakh hectare additional agricultural area is possible by surface water after the success of this programme.
- Underground water will be available to irrigate additional agricultural areas of about 100 lakh hectares.
- Additional hydro-electricity of about 340 lakh kilowatt will be generated.
- Besides these benefits, many other benefits like flood control, water transport, water supply, fishing, removal of acidity from the soil and control on water pollution will also be achieved.

Challenges in River Interlinking

- **Project feasibility:** The estimated cost of the Project is very high which requires huge structure and great engineering capacity.
- **Environmental impact:** The wildlife, flora and fauna of the river systems would be affected because of large scale displacements and modifications.
- **Impact on society:** The displacement of people for building of dams and reservoirs would create agony among local people.
- **Inter-state disputes:** The dispute among states coming under particular projects may arise for sharing of water and other resources.

16.8 METHODS OF WATER CONSERVATION

If we do not conserve water today, future generations may have difficulty surviving due to scarcity of water. The participation of an individual, society and the Govt. is essential for water conservation.

The following methods can be adopted for water conservation -

1. Dams and reservoirs should be constructed on rivers so that river water does not go waste into the seas and oceans.
2. The water of rivers should be saved from pollution by urban waste at all costs.
3. Mass awakening should be around for water conservation.
4. Solicit active participation of the people in all the activities related to water conservation and efficient management.
5. Potable water should not be used for gardening, washing of vehicles and cleaning of households.
6. Broken pipelines of water should immediately be repaired.
7. Every drop of water is precious, this should be popularised among the masses.
8. Such crops should not be grown in rain fed areas which require more water.
9. There should be stress on afforestation.

A case study: efforts of tarun bharat sangh towards water conservation

Tarun Bharat Sangh was established in 1985 under the guidance of Shri Rajendra Singh. It started in Hamirpur village of Thanagazi Tehsil in Alwar district of Rajasthan. The residents of

Thanagazi area under the guidance of Tarun Bharat Sangh(NGO) achieved such a miracle which could not be achieved by Central Water Authority while searching for the Sarswati in Western Rajasthan and Bhabha Atomic Research Centre together. Arvari river was reborn with the efforts of this organisation which took 15 years. Previously the river was dry and barren. There are two branches of Arvari river. The total length of these is 45 kilometres. Its watershed area is spread in 503 square kms. Parts of Jaipur, Dausa and Alwar districts are included in this. Previously agriculture was practised here. There were no means of irrigation. Agriculture used to be done only on 10 percent of the land. Agriculture was entirely dependent upon rain. There was one cropped agriculture. To remove the water scarcity in the area, the NGO-Tarun Bharat Sangh with the help of villagers cleaned and deepened the tanks and ponds. Besides this, they also vowed to construct ponds on the sloppy parts of the hilly region. A village was chosen for this work in 1985-86. The results were very encouraging. Many other villagers followed the same process by making ponds constructed in their areas. 'Save water' and 'JoharAndolan' were started in 1996. More than 3500 ponds have so far been constructed in this area. The villagers themselves have constructed more than 70 ponds. Water level of underground aquifers has risen after construction of these ponds. Water is available throughout the year in wells, tanks, ponds and rivers. Agricultural output has also improved. There is more Greenery. Even the animals are healthier, cows and buffaloes are helping in the rise of dairying as a supplementary occupation,

The standard of living of the people has improved. The families below poverty line are also able to earn 40-50 thousand rupees per annum. Migration of people from villages to cities has stopped. Even migrated families have now started coming back to their villages. The residents of 70 villages in Arvari river basin have constituted a unique 'parliament' of 150 members. This 'parliament' has been named as 'Arvari Sansad' after the name of the Arvari river. The members of 'Arvari Sansad' took oath on the banks of the river in Hamirpur on 26th January 1999. The constitution of Arvari Sansad came into effect from this day. This is such a sansad which not only frames the rules and laws but follows them also. All residents of the area follow these rules and laws strictly and also get them followed by others. Arvari sansad has framed some rules and laws keeping the needs of the people, ecological balance and land in mind.

The following are worth mentoring among them:-

1. Ban on growing crops such as sugarcane, rice and chillies which require more water.
2. No one will use the river water for agriculture after Holi and before the end of the rainy season.
3. No industrial unit will be established in the watershed area.
4. Recommended growing of millets, Jowar-Bajra and Maize.

5. Allowed to grow vegetables in the lower parts of the river.
6. Ban on hunting and cutting of green trees.
7. No person with an axe will enter into the recently developed 'Bhairon Dev Manas' sanctuary.
8. The whole region has been declared as an area of biodiversity
9. Ban on sending food grains and vegetables outside the region
10. Ban on grazing of animals by the people living outside the watershed area.

Today Arvari river has become very useful for the residents of the area. The people of the area worship this river also. Fairs and festivals are celebrated. Arvari Sansad has established 'Arvari temple', 'Arvari treasury' and 'ArvariSectariate'. Such programmes are being carried on in other areas also. In this connection very encouraging programmes are going on in Gujarat, Madhya Pradesh and Chhattisgarh.

INTEXT QUESTIONS 16.4

1. Mention any four problems related to water resources.

   a.______________b._____________c._____________d.____________

2. What is the main objective of the National Water Policy?
3. What are the challenges in interlinking rivers? Any two

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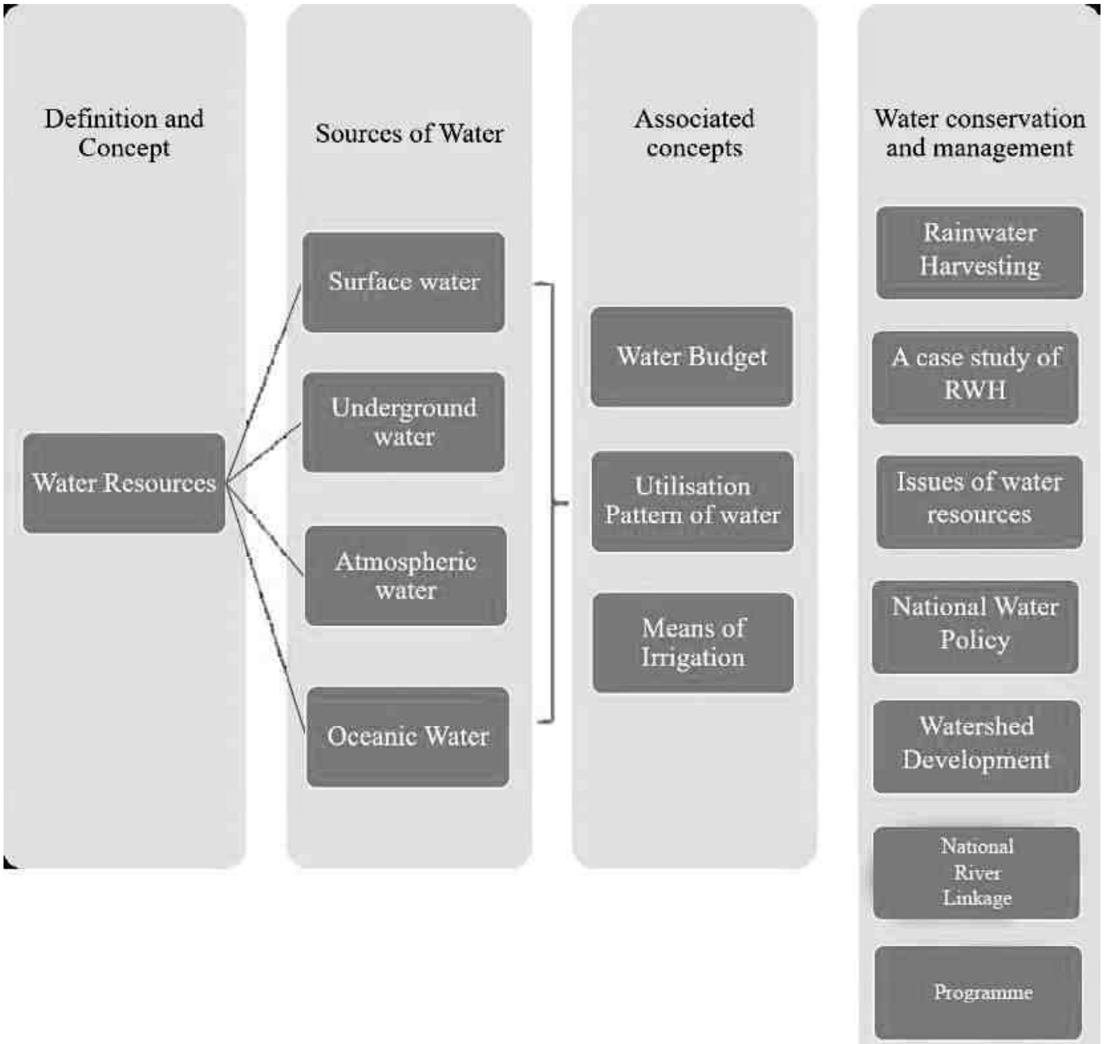


TERMINAL QUESTIONS

1. Answer the following questions in brief-

   (i) What is the meaning of water resources?

   (ii) Mention the main sources of surface water.

   (iii) Why is more underground water available in the northern great plains of the country?

   (iv) State the meaning of rain water harvesting.

   (v) Explain the meaning of watershed.

(vii) What are the benefits of the National River Linking Programme?

2. Differentiate among the following -

(a) Surface water and underground water.

(b) Rain water harvesting and watershed development.

3. Why is the distribution of water uneven in India? Explain with examples.

4. "Underground water is a reliable and continued resource of water supply". Prove the logic of this statement.

5. Describe main methods of rainwater harvesting.

6. Which benefits can be achieved by watershed development? Mention them.

7. Why are desired results not achieved by watershed development projects? Give reasons.

8. Why is water conservation essential? Explain different methods of water conservation.

9. Evaluate the utility and applicability of water-shed development programmes in India.

ANSWERS TO INTEXT QUESTIONS

16.1.

1. First
2. Ganga
3. Punjab, Haryana, Rajasthan, Tamil Nadu, Gujrat, UP (Any Five)

16.2.

1. Wells and tube wells, Canals, Tanks
2. Tamilnadu, Odisha, Maharashtra, Karnataka etc.
3. Regional and seasonal variations in rain, growing demand for commerical crops etc

16.3.

1. Scarcity of Surface water, dependancy on underground water, increasing urbanisation.

2. i) Construction of Potholes
   ii) Construction of trenches
   iii) Use of wells
   iv) Use of handpump
3. Water Pits

16.4.

1. a) Increasing demand of water for urbanisation
   b) Pollution
   c) Demand for economic activity
   d) Scarcity due to global change
2. To take cognizance of existing situatin of country's water resources
3. i) Project Feasibility
   ii) Environmental impact
   iii) Impact on society (Any 2)

MODULE -8

Economic Geography of India

17. Agriculture and Food Security
18. Mineral and Energy Resources
19. Major Industries and Industrial Complexes
20. Foreign Direct Investment (FDI), Transport, Communication and Trade

17

AGRICULTURE AND FOOD SECURITY

In the previous lessons, you studied climate, soils, various types of resources and human activities. In this lesson, you will study agriculture. Agriculture is the milestone in the history of human civilization, due to agriculture man settled at a particular place. India is a unique country from an agricultural point of view. Its vast area, rich soils, high percentage of cultivable land, wide climatic range and long growing season provides a solid base to agriculture. Agriculture is predominant economic activity in India, engaging nearly three-fifths of its working population. Though the share of the agricultural sector in gross domestic product has considerably declined to about one-fourth yet the importance of agriculture as an employment provider to the workforce especially in the countryside is very high. Obviously, agriculture forms the hub of the Indian economy as a large number of industries are also heavily dependent on agriculture for supply of raw materials. Agriculture involves not only crops raising but also animal ranching and fishing.

OUTCOMES

After studying this lesson, learner:

- analyses spatial and temporal variations in agricultural production since independence;
- describes production of cereal and non-cereal crops;
- identifies environmental and socio-economic implications of agriculture development and
- explains the concepts of food security and safety.

17.1 SIGNIFICANCE OF AGRICULTURE

Agriculture is an important part of India's economy and at present it is among the top two farm producers in the world. This sector provides approximately 52 percent of the total number of jobs available in India and contributes around 18.1 percent to the GDP. Agriculture is the only means of living for almost two-thirds of the employed class in India. As stated by the economic data of financial year 2006-07, agriculture has acquired 18 percent of India's GDP. The agriculture sector of India has occupied almost 43 percent of India's geographical area. Agriculture plays a vital role in the Indian economy. Over 70 per cent of the rural households depend on agriculture. Agriculture is an important sector of the Indian economy as it contributes about 17% to the total GDP and provides employment to over 60% of the population. Indian agriculture has registered impressive growth over the last few decades. The food grain production has increased from 51 million tonnes (MT) in 1950-51 to 250MT during 2011-12 highest ever since independence. It is significant due to various reasons such as:

- **Agriculture plays a vital role in generating employment:** In India at least two-thirds of the working population earn their living through agricultural works. In India other sectors have failed to generate much employment opportunity for the growing working populations.
- **Agriculture makes provision for food for the ever increasing population:** Due to the excessive pressure of population labour surplus economies like India face rapid increase in the demand for food. It resulted in the increase in food production at a fast rate.
- **Contribution to capital formation:** There is general agreement on the necessity of capital formation. Since agriculture happens to be the largest industry in a developing country like India, it can and must play an important role in pushing up the rate of capital formation. If it fails to do so, the whole economic development will suffer a setback.
- **Supply of raw material to agro-based industries:** Agriculture supplies raw materials to various agro-based industries like sugar, jute, cotton textile and Vanaspati industries. Food processing industries are similarly dependent on agriculture. Therefore, the development of these industries entirely is dependent on agriculture.
- **Market for industrial products:** Increase in rural purchasing power is very necessary for industrial development as two- thirds of the Indian population live in villages. After the green revolution the purchasing power of the large farmers increased due to their enhanced income and negligible tax burden.

Let's Do Can you name some industries based on agricultural raw material?

INTEXT QUESTIONS 17.1

1. In which percentage, agriculture contributes to the GDP of India?
2. Name any two types of raw materials used by agro-based industries.

17.2 MAJOR PRACTICES IN AGRICULTURE

India has a long agricultural history, which dates back approximately ten thousand years. Today, India has the second-highest crop output in the world and agriculture-related jobs employ nearly 60% of the total workforce. However, as India's population grows, the country is having difficulties meeting the demand for food products like wheat and rice. There are different types of farming activities performed in India which are as follows:

a. **Subsistence farming:** This is one of the most popular farming techniques that can be seen in various parts of India. The farmer along with his family cultivates grains for themselves or for sale at the local market. The entire family works on the farm and most of the agricultural work is done manually here. Traditional methods of farming are followed by the farmers in their small farms. Since facilities like electricity and irrigation are generally not available to the poor farmers, they do not use fertilisers and high yielding varieties of seeds in their fields to the extent they should.

b. **Shifting Agriculture:** This way of farming is widely used by the tribal groups to grow crops. Firstly, the land is obtained by clearing a forested area and then crops are planted. While the land loses its fertility, another area of land is cleared and the crops are shifted there. The commonly grown crops in this type of farming are dry paddy, maize, millets and vegetables.

   This practice is known by different names in different regions of India. For example, it is called Jhum in Assam, Ponam in Kerala, Podu in Odisha, Bewar, masha, penda, and bera in Madhya Pradesh. But since it causes extensive soil erosion, the government has tried to discourage this practice of cultivation by tribal population.

c. **Intensive agriculture:** This farming practice can be seen in densely populated areas in India. It is an attempt to maximise the output of the land, through the use of every possible effort. It requires a huge amount of capital and human labour, more than one crop can be raised per year.

d. **Extensive agriculture:** This is the modern type of farming that can be seen largely in the developed world and in some parts of India. It relies largely on machinery as opposed to a human labour force and raises one crop per year.

e. **Commercial Agriculture:** The goal of commercial agriculture is high yield, so that produce can be exported to other countries for profit making. Wheat, cotton, sugarcane and corn are some commercial crops. They are grown in states of Gujarat, Punjab, Haryana, and Maharashtra.

f. **Plantation agriculture:** This style is often used for crops which require a lot of space and a long growing period, such as rubber, tea, coconut, coffee, cocoa, spices, and fruits. Plantations are only capable of producing a single crop. Plantation agriculture is practised in Kerala, Assam, Karnataka, and Maharashtra.

g. **Dry land farming:** As the name suggests, dry land farming is practised in the more arid and desert-like areas of the country, including northwest and central India. Crops such as gram, jowar, bajra and peas have lower water requirements and can therefore be grown in these conditions.

h. **Wetland farming:** Many areas of India are affected by heavy monsoon rains and subsequent flooding. Well-irrigated areas, such as those in northeast India and the western ghats are suitable for rice, jute, and sugarcane farming.

i. **Terrace Agriculture:** The hill and mountain slopes are cut to form terraces and the land is used in the same way as in permanent agriculture. Due to scarcity of the availability of flat land, terraces are made to provide a small patch of level land. Soil erosion is also checked due to terrace formation on hill slopes.

j. **Mixed and Multiple Farming:** It refers to a system of growing agricultural crops as well as the raising of livestock. Whereas multiple farming refers to growing more than one crop in the same field. Usually, two different crops with varying periods of maturity are shown so that they compete with growth period and nutrients. For e.g. wheat and gram, wheat and mustard etc. This type of farming system is followed in regions where abundant rainfall is expected and good irrigation facilities are available. This farming system controls total loss from pests, diseases and drought. It also helps in maintaining the fertility of soil by nitrogen fixation.

k. **Dairy Farming:** Dairy farming involves the rearing of cattle for milk. The dairy farming is highly developed in Sweden and Denmark. However, it has spread to other parts of the world and is practised in areas near markets. It thrives in regions that enjoy temperate climate. It plays a vital part of the global food system and plays a prime role in the sustainability of rural areas.

INTEXT QUESTIONS 17.2

1. Write any two types of crops grown in wet farming?
2. Give any two examples of crops which may be commercial in one region and may provide subsistence in another region?
3. Name any two states where commercial agriculture is popular.
4. Write any two characteristics of subsistence farming.

17.3 CROPPING PATTERN IN INDIA

Cropping Pattern means the proportion of area under different crops at a point of time, changes in this distribution overtime and factors determining these changes. Cropping pattern in India is determined mainly by soil type and climatic factors i.e. rainfall and temperature. They are reflected in agricultural practices and cropping patterns of the country. India is geographically a vast country so it has various food and non-food crops which are cultivated in three main cropping seasons which are Rabi, Kharif and Zaid.

- **Rabi Crops:** The Rabi crops in the spring harvest or winter crop in India. It is sown every year in October and harvested every year in March. Wheat, Barley, Mustard, Sesame, Peas etc. are the major rabi crops in India.
- **Kharif Crops:** The crop from Kharif is India's summer crop or monsoon crop. Kharif crops are usually seeded at the beginning of July's first rain. India's major Kharif crops include Millets (Bajra and Jowar), Cotton, Soja, Sugarcane, Turmeric, Paddy (Rice), Maize, Moong (Pulses), Groundnut, Red Chillies etc.
- **Zaid Crops:** This crop is grown from March to June in some parts of the country. Prominent examples are Muskmelon, Watermelon, Cucurbitaceous family vegetables such as bitter gourd, pumpkin, ridged gourd and other crops.

17.4 MAJOR CROPS IN INDIA

A variety of food and non-food crops are grown in different parts of the country depending upon the variations in soil, climate and cultivation practices. Major crops grown in India can be classified into four categories:

- **Food Grains-** (Wheat, Rice, Maize, Millets and Pulses)
- **Cash Crops-** (Cotton, Jute, Sugarcane, Tobacco and Oilseeds)
- **Plantation Crops-** (Tea, Coffee, Coconut and Rubber)
- **Horticulture crops-** (Fruits and Vegetables)

A. Food Grains

The crops that are grown to feed the human population are known as food crops. There are a number of food crops grown in the country. Let's know some of the major food grains.

a. **Paddy :** India is an important centre of paddy cultivation. It is the staple food crop in a majority of regions in the country. paddy is a Kharif crop that requires high

Economic Geography of India

Notes

temperature, heavy rainfall and high humidity for proper growth. The areas with less rainfall use irrigation for rice cultivation. The paddy is cultivated on the largest areas in India. paddy cultivation in India extends from 8º to35ºN latitude and from sea level to as high as 3000 metres. Paddy crops need a hot and humid climate. The average temperature required throughout the life period of the crop ranges from 21º to 37º C. Deep fertile loamy or clayey soils are considered ideal for this crop. It requires considerable manual labour for sowing and transplantation. Total production of paddy during 2019-20 is estimated at record 117.94 million tons. It is higher by 8.17 million Tons than the five years' average production of 109.77 million tons. Major paddy producing states are shown in the given Map.

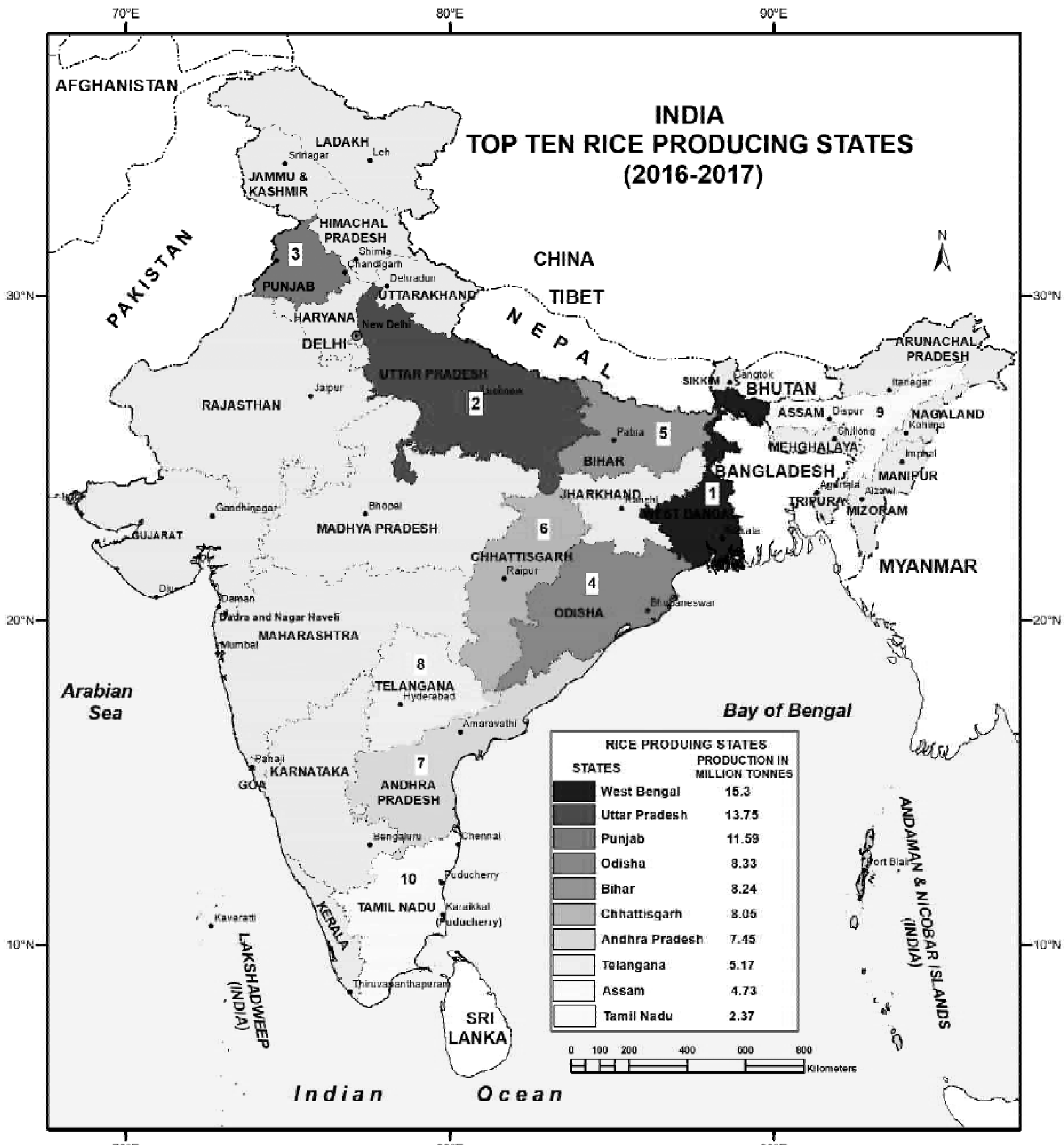


Fig 17.1 Major Rice Producing States of India

Notes

b. **Wheat:** Wheat is the main cereal crop of India. The total area under the crop is about 29.8 million hectares in the country. It can be grown not only in the tropical and sub-tropical zones, but also in the temperate zone and the cold tracts of the far north, even beyond the 60º N latitude. The best wheat is produced in areas favoured with cool, moist weather during the major portion of the growing period followed by dry, warm weather to enable the grain to ripen properly. The ideal temperature for the cultivation is about 15º-20ºC and requires moderate amounts of rainfall of 25-75 cms. The regions with a warm and damp climate are not suited for wheat growing. Production of wheat during 2019-20 was estimated at 107.18 million tons. It has increased by 3.58 million tons as compared to wheat production during 2018-19.The top four major wheat producing states of India are Uttar Pradesh, Punjab, Madhya Pradesh and Haryana.

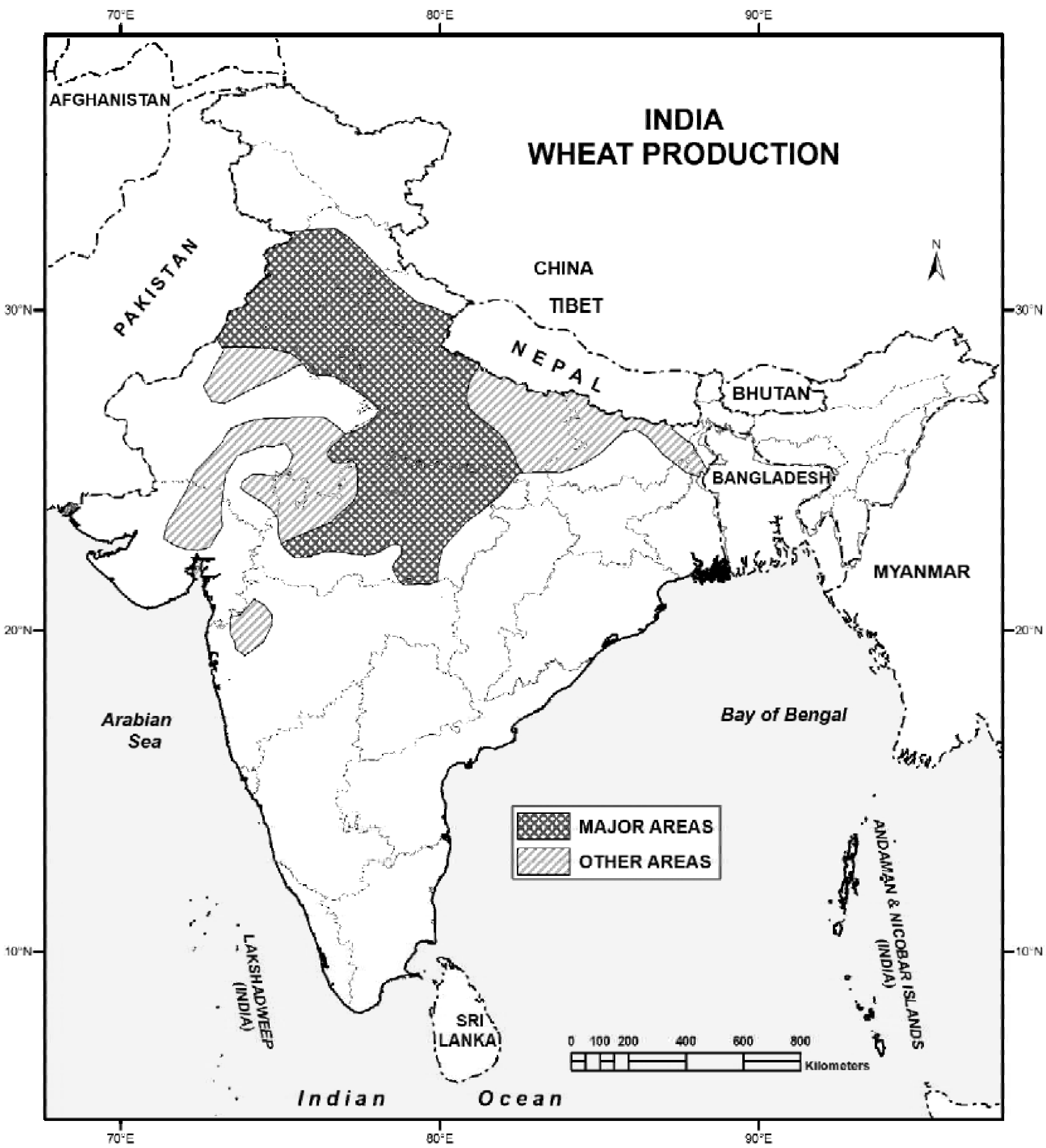


Fig. 17.2: Wheat Producing Areas

B. Cash Crops

a. **Sugarcane:** Sugarcane is a crop of tropical regions. Under rain fed conditions, it is cultivated in sub-humid and humid climates. Its cultivation is largely concentrated in Uttar Pradesh, Maharashtra and Gujarat. In southern India, it is cultivated in irrigated tracts of Tamil Nadu, Karnataka, Andhra Pradesh and Telangana. Uttar Pradesh produces about two-fifths of sugarcane of the country. India is the second largest producer of sugarcane after Brazil in 2015. It accounts for about 19 percent of the world production of sugarcane. But it occupies only 2.4% of the total cropped area in the country.

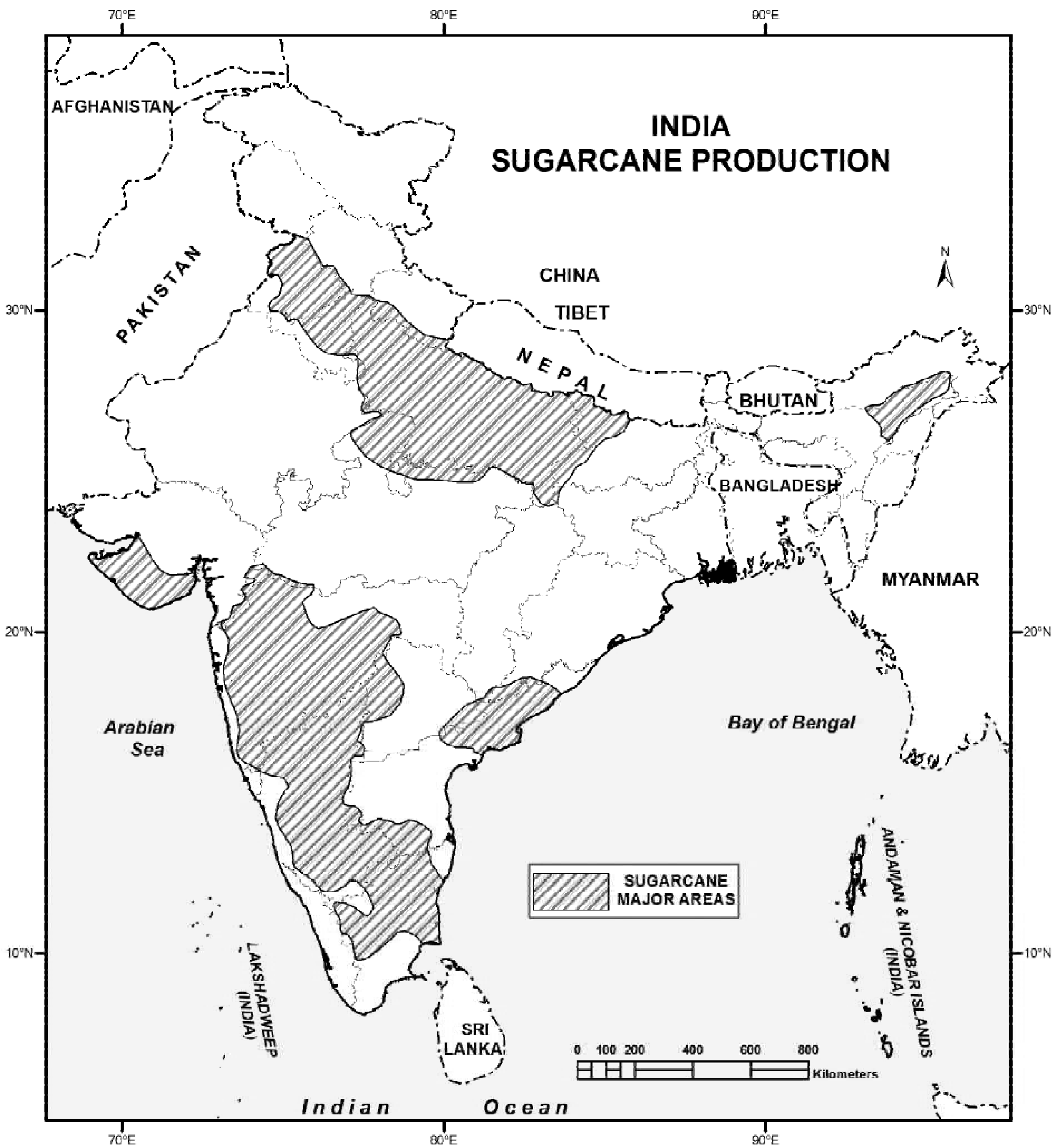


Fig. 17.3: Sugarcane Producing Areas

b. Cotton: Cotton is a Kharif Crop that grows in tropical and subtropical regions. India supports the growth of both short staple (Indian) and long staple (American) cotton called Narma in the north-western regions of the country. It grows in areas with a minimum of 210 frost free days in a year. It grows well in black soils of Deccan and Malwa plateau and also in Satluj-Ganga plain having red and laterite soils of the peninsular region. Leading producers of this crop are Gujarat, Maharashtra and Telangana.

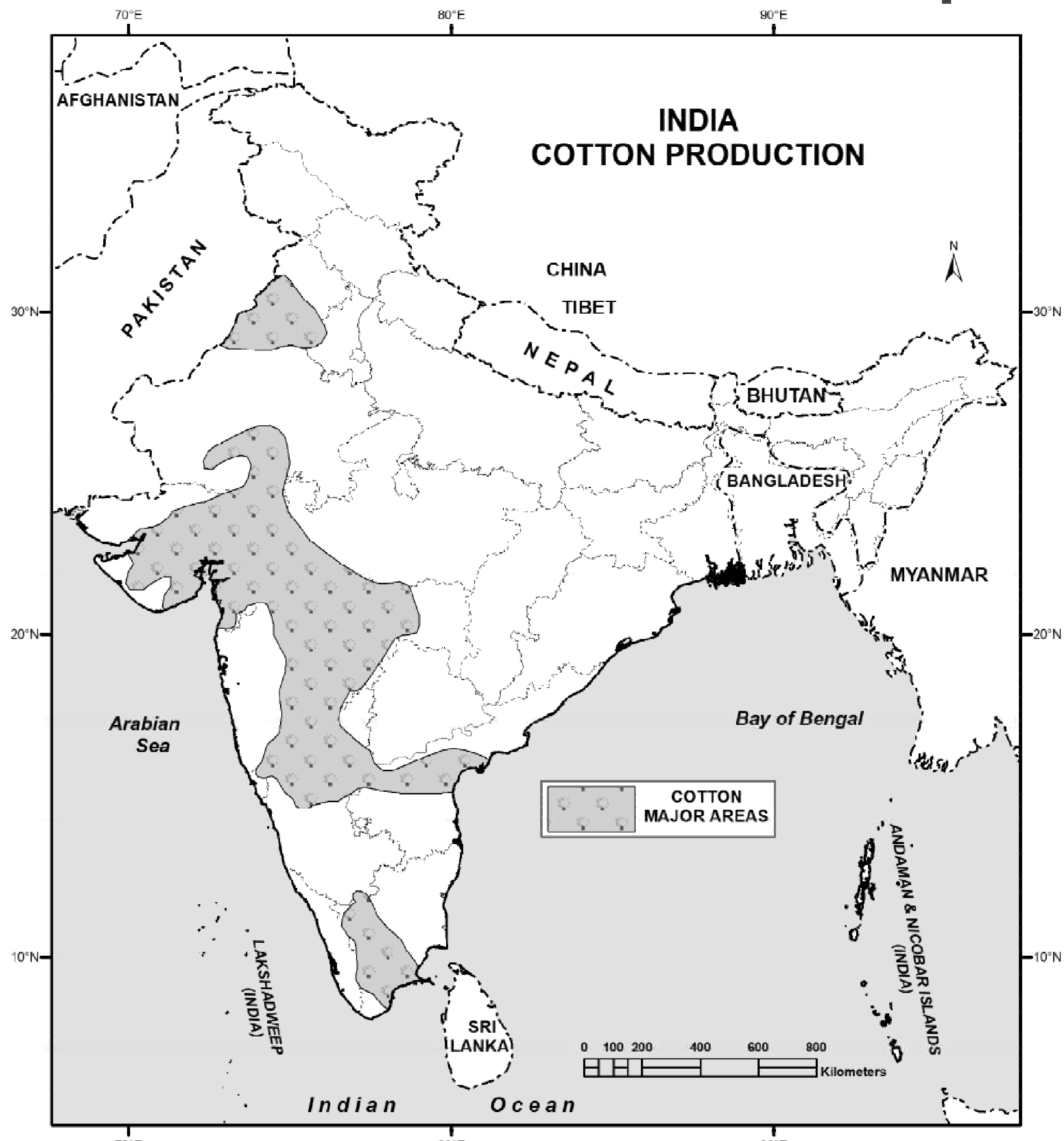


Fig. 17.4 : INDIA: Cotton Producing Areas

C. Plantation Crops

a. **Tea:** Tea is a plantation crop which is used as a beverage. Tea leaves are rich in caffeine and tannin. Tea is mostly grown in hilly areas and well drained soils in humid and subtropical areas. India is the world's largest black tea producer and consumer. Tea is grown in India in 16 states. Assam, West Bengal, Tamil Nadu, and Kerala make up around 95% of total tea production.

b. **Coffee:** Coffee is a tropical plantation crop. The seeds of coffee are roasted, ground and are used for preparing a beverage. Coffee needs a hot and humid climate ranging from 15°C to 28°C. Well-drained, rich loamy soil with humus and minerals is ideal for growing coffee. Coffee is cultivated in the highlands of Western Ghats in Karnataka, Kerala and Tamil Nadu which are the major coffee producing states in India.

D. Horticulture

a. **Fruits:** India accounts for about 10 percent of the production of fruits in the world. It leads the world in the production of mango, banana, sapota and lemons. A large variety of fruits are grown in India. Mango, bananas, citrus fruits, pineapple, papaya, guava, sapota, jackfruit, lichi and grapes are tropical and subtropical fruits. The fruits of temperate areas are apple, pear, peach, plum, apricot, almond and walnut which are grown mostly in the mountainous areas of the country. The important fruits of the arid zone of India are Amla, ber, pomegranate and figs.

b. **Vegetables:** India is the second largest producer of vegetables in the world next only to China. It contributes about 13 per cent to the world vegetable production. It occupies first position in the production of cauliflowers, second in onion, and third in cabbage in the world. Other major vegetable crops are potato, peas, tomato and brinjal. More than fifty varieties of vegetables are grown in India.

c. **Floriculture:** With breaking of trade barriers in the post-globalisation phase, international trade in vegetables, fruits and flowers has become lucrative. India can earn a sizable amount of foreign exchange by exporting flowers. Flowers such as rose, jasmine, marigold, chrysanthemum, tuberose, and aster are grown over large areas in Karnataka, Tamil Nadu, Andhra Pradesh, Rajasthan, West Bengal, Maharashtra, Delhi, Uttarakhand, Assam and Manipur.

Let's Do

- Collect different food grains and classify them according to seasons.

INTEXT QUESTIONS 17.3

1. Name two important fibre crops of India.
2. Which state is the largest producer of Rice in India?
3. Name two important sugarcane producing states in the country.
4. Name a major coffee producing state of India.

17.4 AGRICULTURAL DEVELOPMENT IN INDIA

Agricultural development is a must for the economic development of a country. "Agricultural progress is essential to provide food for growing non-agricultural labour force, raw materials for industrial production and saving and tax revenue to support development of the rest of the economy, to earn foreign exchange and to provide a growing market for domestic manufactures."Agriculture development implies giving assistance to farmers or crop producers by providing them various agricultural supports. Providing security, helping in the research area, employing advanced techniques, checking pests and facilitating diversity all fall under the category of agriculture development. In the colonial dominion, there was neither equity nor growth in the agricultural division. The strategy and rule makers of independent India addressed these problems through land reforms and advancing the use of 'High Yielding Variety' (HYV) seeds which guided in a revolution in Indian agriculture.

A. Land Reforms

Land reform means equity in agriculture, which also means the shift in the ownership of landholdings. Land reform normally relates to the redistribution of land from rich to the poor. More deeply, it involves control of operation, ownership, sales, leasing, and inheritance of land. In recent years the theory of land reforms has expanded in the identification of the strategic role of land and agriculture in development. Therefore, Land reform has become similar to agrarian change or rapid development of the agrarian structure. This structure includes the land tenure system, farm organisation, the pattern of cultivation, the scale of the farm operation, the terms of tenancy, and the system of rural credit, marketing, and education. It also deals with advanced technology.

B. Green Revolution

After independence India had to rebuild its economy. Over three-quarters of the population depended on agriculture in some way. But agriculture in India was faced with several problems. Firstly, the productivity of grains was very low and Indian agriculture was dependent on the monsoon due to lack of irrigation and other infrastructural facilities. India had previously faced severe famines during the British rule, who had only promoted cash crops instead of food crops. The idea was to never depend on any other country for food sufficiency. So in 1965, the government with the help of Indian geneticists M.S. Swaminathan, known as the father of Green Revolution, launched the Green Revolution. The movement lasted from 1967 to 1978 and was a great success.

Agriculture production was very less because of the practice of old technology. The Green Revolution started in 1965 with the introduction of High Yielding Variety (HYV) seeds in Indian agriculture. This was coupled with better and efficient irrigation and the correct use of fertiliser to boost the growth of the crops. This strategy of agriculture development increased the production of food grains in India. This also supported development of a large number of agro-inputs, agro-processing industries and small-scale industries. This method of agricultural development made India self-reliant in terms of food grain production.

Impact of the Green Revolution

a. **Increase in Agricultural Production:** Food grains in India saw a great rise in output. It was a remarkable increase. The biggest beneficiary of the plan was the Wheat crop. The production of wheat increased from 11 million tons in 1960 to 55 million tons in 1990.

b. **Increase in Per Acre Yield:** Green Revolution not only resulted in increased agricultural output, but has also caused increase in per hectare yield. In the case of wheat, the per hectare yield increased from 850 kg/hectare in 1960 to 2281 kg/hectare by 1990.

c. **Less Dependence on Imports:** After the green revolution, India was finally on its way to self-sufficiency. There was enough food production for the population and food stock for emergencies. We did not need to import grains or depend on other countries for our food supply. In fact, India was able to start exporting its agricultural produce.

d. **Employment:** It was feared that commercial farming would leave a lot of the labour force jobless. But on the other hand, we saw a rise in rural employment. This is because the supporting industries created employment opportunities. Irrigation, transportation, food processing, marketing all created new jobs for the workforce.

e. **A Benefit to the Farmers:** The Green Revolution majorly benefited the farmers. Their income saw a significant raise. Not only were they surviving, they were prospering. It enabled them to shift to commercial farming from only sustenance farming.

C. White Revolution

The revolution associated with a sharp increase in milk production in the country is called the White Revolution in India also known as 'Operation Flood'. White revolution period intended to make India a self-dependent nation in milk production. Today, India is the world's largest producer of milk and Dr. Verghese Kurien is known as the father of the White Revolution in India. During the year 1964-1965, the Intensive Cattle Development Programme was introduced in India in which the cattle owners were provided with a package of improved animal husbandry for promoting the white revolution in the country. Later on, the National Dairy Development Board introduced a new programme named "operation flood" to increase the speed of the white revolution in the country. Operation Flood started in the year 1970 and was aimed to create a nationwide milk grid. It was a rural development programme initiated by NDDB - National Dairy Development Board of India. Village milk producer's cooperatives laid the foundation of the operation flood. With the optimum use of modern technology and management, they procured milk and provided the services. White Revolution had the objectives as stated below:

- Creating a flood of Milk by Increase production
- Increase the incomes of the rural population
- Provide milk to consumers at fair prices

Significance of Operation Flood

a. The White Revolution in India helped in reducing malpractice by traders and merchants. It also helped in eradicating poverty and made India the largest producer of milk and milk products.

b. Operation Flood empowered the dairy farmers with control of the resource created by them. It helped them in directing their own development.

c. To connect milk producers with the consumers of more than 700 cities and towns and throughout the country, a 'National Milk Grid' was formed.

d. The revolution also reduced regional and seasonal price variations ensuring customer satisfaction and at the same time. Also, it ensured that the producers get a major share of the price that customers pay.

e. Improved the living standards of the rural people and led to the progress of the rural economy.

Let's Do

- Collect some dairy farming products with farm photographs.

D. Blue Revolution

The Blue Revolution was launched in India during the 7th Five Year Plan (1985-1990) during the sponsorship of the Fish Farmers Development Agency (FFDA) by the Central Government of India. Later, during the 8th Five Year Plan (1992-97), the Intensive Marine Fisheries Programme was launched, and eventually, the fishing harbours in Visakhapatnam, Kochi, Tuticorin, Porbandar, and Port Blair were also established over the time. The Nili Kranti Mission aimed to enhance the economic condition of India through the augmentation of fisheries and thus contributing towards food and nutritional security. The utilisation of the water resources for the development of fisheries was done by the Neel Kranti Mission in a sustainable manner.

The Blue Revolution in India along with the Fish Farmers Development Agency (FFDA) brought an improvement in the aquaculture and fisheries sector with the introduction of new techniques of rearing, marketing, exporting, and fish breeding. Some of the major outcomes of the Blue Revolution in India are mentioned below:

- Currently, the Indian Fisheries Sector reached a production of 4.7 million Tons of fish from a limit of 60,000 tons including 1.6 million tons of fish from freshwater aquaculture.
- India is recorded to achieve an average annual growth of 14.8% as compared to the global average percentage of 7.5% in the production of fish and fish products.
- The fishery has become India's largest agricultural export over the last five years with a growth rate of 6% - 10%.
- India has become the world's second-largest producer of fish with exports worth more than 47,000 crore rupees.
- The fisheries and aquaculture production contributes 1% and 5% to India's GDP and Agricultural GDP respectively.

E. Yellow Revolution

The term yellow revolution has been adopted to express the remarkable increase in oilseed production in India which started in 1986. The objective of the yellow revolution is to achieve self-reliance in the production of oilseeds. Oilseed's technological mission was launched to ensure optimum utilisation of production, processing, management and technology in oilseed crops. The impact of the yellow revolution and its success had a dramatic increase from 10.83 million tons in 1985-86 to 24.75 million tons in 1998-99. However, after that, we have not been able to achieve self-sufficiency in oilseeds. A second yellow revolution is the crying need of the hour. Also, a technical invention in dry land farming is required to maximise yield, productivity, and farm income. Achieving the aim of making the nation self-sufficient in oilseeds would have a significant impact on agriculture and the economy and would serve to reduce dependence on foreign markets.

17.5 ENVIRONMENTAL AND SOCIO-ECONOMIC IMPLICATION

The Green revolution was highly successful as agricultural production in most countries increased. India which was once dependent on import of food grains for satisfying the needs of its population gradually became an exporter of food grains. The green revolution has both positive and negative impacts on environments and socio-economic conditions.

A. Environmental Implication

a. **Loss of Biodiversity:** The spread of Green Revolution agriculture affected both agricultural biodiversity and wild biodiversity. There is a little disagreement that the Green Revolution acted to reduce agricultural biodiversity, as it relied on just a few high-yield varieties of each crop. For example, before the revolution, it is speculated that there were over 3000 variants of rice. Now it is estimated that only ten modified varieties of rice are used. This has led to concerns about the susceptibility of a food supply to pathogens that cannot be controlled by agrochemicals, as well as the permanent loss of many valuable genetic traits bred into traditional varieties over thousands of years.

b. **Dependence on non-renewable resources:** Most high intensity agricultural production is highly reliant on non-renewable resources. Agricultural machinery and transport, as well as the production of pesticides and nitrates all depend on fossil fuels. Moreover, the essential mineral nutrient phosphorus is often a limiting factor in crop cultivation, while phosphorus mines are rapidly being depleted worldwide. The failure to depart from these non-sustainable agricultural production methods could potentially lead to a large-scale collapse of the current system of intensive food production within this century.

c. **Salinization:** The continuous supply of moisture through irrigation during the summer and winter seasons have changed the soil chemistry. In the arid and semi-arid areas, owing to capillary action, the soils are becoming either acidic or alkaline. The saline and alkaline affected tracts, locally known as kallar or thur in Punjab and kallar or reh in Uttar Pradesh have expanded and increased in area According to one estimate, about 50 percent of the total arable land of Punjab and Haryana has been harmed by soluble salts.

d. **Soil Erosion:** Soil erosion is a universal phenomena. It may be observed to some extent in all parts of the country; its intensity, however, is more in the arid, semi-arid, and mountainous areas. The presence of forests reduces the danger of soil erosion significantly. In recent years, the agricultural area has been expanded by indiscriminate felling of trees. The increase in the rate of soil erosion is not only damaging the agricultural lands, it is also adversely affecting the areas where the eroded soil is deposited.

e. **Decline in soil fertility:** The High Yielding Varieties perform better if heavy doses of chemical fertiliser, insecticides, and pesticides are applied. Application of heavy doses of these inputs destroy the micro-organisms which are so necessary to maintain the fertility of the soil.

f. **Lowering of the Underground Water-Table:** The High Yielding Varieties of rice and wheat are water-relishing crops. The continuous lifting of water through tube-wells and pumping sets has lowered the water Table in the eastern districts of Haryana. Many farmers have to lower their tube-wells in the years of inadequate monsoon rainfall. If the cropping pattern is not changed, and irrigation of rice and wheat continues at the present level, the underground water-table may not be sufficiently recharged and may get substantially depleted.

In opposition to this, the underground water-table in western Haryana is rising as there is a gypsum layer in that part of the state which does not permit the percolation of water through this layer; the water-table in the Jhajjar District of Haryana has risen significantly. The crops of millets, bajra, arhar are damaged. Consequently, there are waterlogged conditions in several tracts in the western parts of Haryana. This rise in the water-table is resulting in capillary action, leading to the occurrence of saline and alkaline formations.

g. **Deforestation:** There had been heavy felling of trees to bring the forest area under cultivation. In Punjab and Haryana, less than 5 percent of their area is under forest. This is affecting the environment and ecology adversely.

B. Socio-economic implications

a. **Higher productivity and self- sufficiency in food grains production:** Agricultural productivity increased sharply and India became self-sufficient in food grain production in a decade.

b. **Increases inequality in rural society:** The larger and medium farmers only afforded the high input cost, small and marginal farmers could not afford this high input cost and were left unbenefitted. Farmers benefited most of those who were able to access land, capital, technology, and knowledge. Those who do not have much land are only able to produce for family consumption; those who were able to produce much are able to sell in the market and get benefitted most. Rich farmers become richer and poor farmers do not benefit much.

c. **Displacement of tenant cultivators:** Prior to the green revolution, the tenant cultivators got land as a lease from the landlord as landlords had too big land to do cropping by using the traditional agricultural tools. After the induction of new agriculture technology and modern agriculture tools, landlords get back their own land from the tenant which leads to tenant displacement.

d. **Displacement of Rural-Urban Migration:** Service cast groups such as tractors, threshers, and harvesters increase leads to rural-urban migration. Labour worker migration increased from drought-prone areas to irrigated areas as the demand for labour increased when the green revolution was introduced.

e. **The wage of rural workers does not increase despite high productivity:** The mode of payment also shifted from food grains to cash. The above two worsened the economic condition of most of the workers.

f. **Commercialization and dependency on market:** The second phase of the green revolution was introduced in the semi-arid region in India. Cropping pattern changes and cash crops such as cotton are grown for the market. Market-oriented single crops such as cotton and bananas are grown. Commercialization and dependency on the market increase livelihood insecurity; a fall in price or bad crops increases the insecurity. Mono crop culture also increases the chance of crop failure and leads to nutrient depletion in the soils.

g. **Increase regional inequality:** The first phase of the green revolution was implemented in the limited part of the country where assured irrigation was available as the result Punjab, Haryana, Western UP, and part of Tamil Nadu become more developed as compared to eastern UP, Bihar, Odisha, West Bengal, and other parts of the country. It leads to regional inequality.

INTEXT QUESTIONS 17.4

1. Who is called the father of the green revolution?

2. Write two key features of the green revolution.

3. In which five year plan the Intensive Marine Fisheries Programme?

4. Write any two environmental implications of the green revolution.

17.6 FOOD SECURITY IN INDIA

Ensuring food security ought to be an issue of great importance for a country like India. There have been many emerging issues in the context of food security in India in the last two decades. According to the Food and Agriculture Organization (FAO), food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Food security is the combination of the following three elements:

a. **Food availability-** food must be available in sufficient quantities and on a consistent basis. It considers stock and production in a given area and the capacity to bring in food from elsewhere, through trade or aid.

b. **Food access-** people must be able to regularly acquire adequate quantities of food, through purchase, home production, barter, gifts, borrowing or food aid.

c. **Food utilisation-** Consumed food must have a positive nutritional impact on people. It entails cooking, storage and hygiene practices, individual's health, water and sanitation, feeding and sharing practices within the household.

Food security is closely related to household resources, disposable income and socio-economic status. It is also strongly interlinked with other issues, such as food prices, global environment change, water, energy and agriculture growth. India's food security policy has a primary objective to ensure availability of food grains to the common people at an affordable price. It has enabled the poor to have access to food. The focus of the policy is on growth in agriculture production and on fixing the support price for procurement of wheat and rice, to maintain their stocks. Food Corporation of India (FCI) is responsible for procuring and stocking food grains, whereas distribution is ensured by public distribution system (PDS).

We already know that the consumers are divided into two categories: below poverty line (BPL) and above poverty line (APL), with the issue price being different for each category. However, this categorization is not perfect and a number of deserving poor have been excluded from the BPL category. Moreover, some of the so-called APL slips back to BPL, because of the failure of even one crop and it is administratively difficult to accommodate such shifts. Each district and block can be made self-sufficient in food grain production with the help of government by providing proper agricultural infrastructure, credit linkages and also encourages the use of latest techniques. Instead of concentrating only on rice or wheat, the food crop with a better growth potential in that particular area must be encouraged. Creation of necessary infrastructure like irrigation facilities, availability of electricity etc. may also attract private investments in agriculture.

There has been a gradual shift from cultivation of food crops to cultivation of fruits, vegetables, oil-seeds and industrial crops. This has led to the reduction in net sown area under cereals and pulses. With the growing population of India, the declining food production puts a big question mark over the country's future food security. The competition for land between non-agricultural uses such as housing etc. and agriculture has resulted in reduction in the net sown area. The productivity of land has started showing a declining trend. Fertilisers, pesticides and insecticides which once showed dramatic results, are now being held responsible for degrading the soils. Periodic scarcity of water has led to reduction in area under irrigation. Inefficient water management has led to water logging and salinity.

Role of Cooperatives in Food Security

The cooperatives are also playing an important role in food security in India especially in the southern and western parts of the country. The cooperative societies set up shops to sell low priced goods to poor people. For example, out of all fair price shops running in Tamil Nadu, around 94% are being run by the cooperatives. In Delhi, Mother Dairy is making strides in provision of milk and vegetables to the consumers at a controlled rate. Amul is another success story of cooperatives in milk and milk products from Gujarat. It has brought about the White Revolution in the country. These are a few examples of many more cooperatives running in different parts of the country ensuring food security of different sections of society.

Impact of Globalization on Agriculture

Globalisation is not a new phenomenon. It was there at the time of colonisation. In the 19th century when European traders came to India, at that time too, Indian spices were exported to different countries of the world and farmers of south India were encouraged to grow these crops. Till today it is one of the important items of export from India.

Under globalisation, particularly after 1990, the farmers in India have been exposed to new challenges. Despite being an important producer of rice, cotton, rubber, tea, coffee, jute and spices our agricultural products are not able to compete with the developed countries because of the highly subsidised agriculture in those countries. Today, Indian agriculture finds itself at the crossroads. To make agriculture successful and profitable, proper thrust should be given to the improvement of the condition of marginal and small farmers. The green revolution promised much. But today it's under controversy. It is being alleged that it has caused land degradation at some places due to overuse of chemicals, drying aquifers and vanishing biodiversity. The keyword today is "gene revolution". This includes genetic engineering. In fact organic farming is much in vogue today because it is practised without factory made chemicals such as fertilisers and pesticides. Hence, it does not affect the environment in a negative manner.

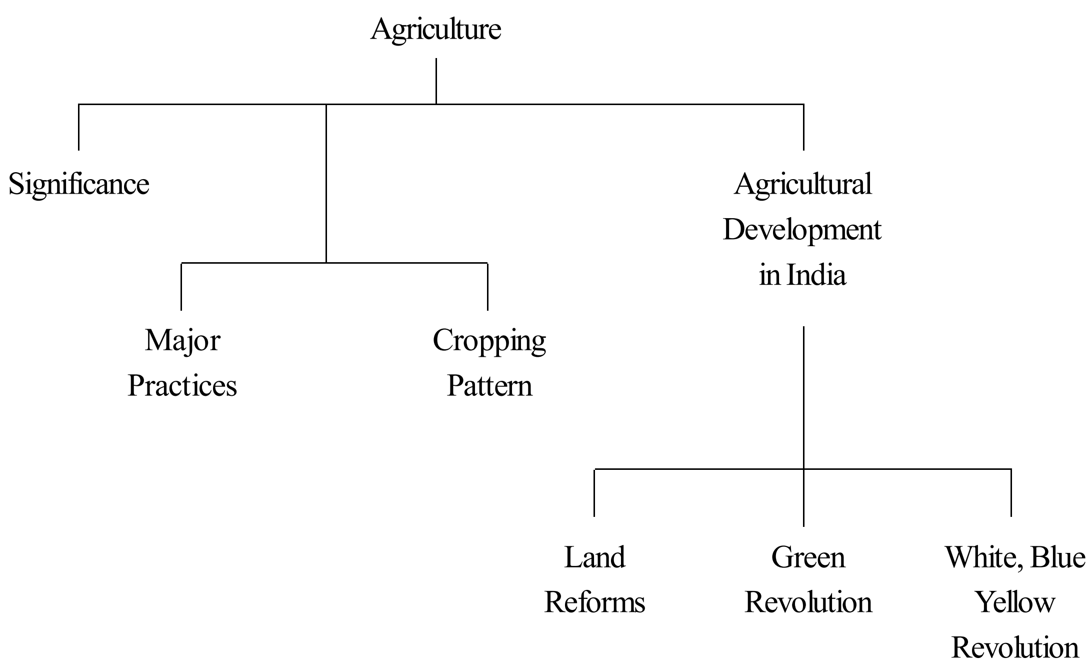
Notes

India's rural population is about 600 million which depends upon 250 million (approximate) hectares of agricultural land, an average of less than half a hectare per person. Indian farmers should diversify their cropping pattern from cereals to high-value crops. This will increase incomes and reduce environmental degradation simultaneously. Because fruits, medicinal herbs, flowers, vegetables, biodiesel crops like jatropha and jojoba need much less irrigation than rice or sugarcane. India's diverse climate can be harnessed to grow a wide range of high-value crops.

INTEXT QUESTIONS 17.5

1. Name the organisation responsible for procuring and stocking food grains in India.
2. Give any one example of cooperative organisation.

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. What are the sustainability principles in food and agriculture?
2. How to achieve sustainable agricultural productivity?
3. What is the minimum support price?
4. Explain the major dimensions of food security with suitable examples.
5. How is food security ensured in India?
6. What do you mean by 'Operation Flood'?
7. Describe the geographical conditions required for the growth of rice and wheat.
8. Describe the impact of globalisation on Indian agriculture.

ANSWERS TO INTEXT QUESTIONS

17.1

1. 18.1
2. Sugar, Jute, Cotton

17.2

1. Rice, Jute, Sugarcane
2. Wheat, Corn
3. Gujrat, Punjab, Haryana etc.
4. i) Farmer works with family

   ii) Traditional methods are used

17.3

1. Cotton , Jute
2. West bengal
3. U.P., Maharashtra, Tamilnadu
4. Karnataka, Kerala

Notes

17.4

1. M.S. Swaminathan
2. i) Increase in Agriculture Production

   ii) Increase in per Acre Yield

3 Five year plan

4. i) Loss of Biodiversity

   ii) Salization.

17.5

1. Food Corporation of India
2. Amul

18

MINERAL AND ENERGY RESOURCES

In the previous lesson you learned about the agricultural resources of India and how it is providing food security to its people. Prosperity of a country is based on the availability of resources. You have also learned how India is rich in its natural resources. The development of a country can not be imagined without optimum use of resources. The resources may be of various kinds. Minerals like land and water are invaluable treasures of the earth. Without these resources, we cannot think of industrialisation and hence the development of our economy. The social and economic development of a nation depends on its capacity to utilise its natural resources, reducing the misuse to the extent possible. The most important characteristics of minerals which have bearing on our present and future well-being is that they are not permanent and can disappear with time after use. These resources are non-renewable. Therefore, there is now more emphasis on judicious use of these resources to conserve and to recycle them.

In this lesson, you will study some of the important minerals and energy resources, their significance and distribution along with the need and way of conservation.

OUTCOMES

After studying this lesson, learner:

- states the significance of mineral and energy resources in the national economy;
- describes the spatial distribution of different types of mineral resources;
- differentiates between conventional and non-conventional energy resources;
- describes the spatial distribution of different types of energy resources and
- asseses the development of non-conventional energy resources.

18.1 MINERAL AND ENERGY RESOURCES: SIGNIFICANCE AND ROLE IN ECONOMY

India is rich in minerals possessing diverse varieties of minerals. But do you know that all minerals are not economically significant. Out of these minerals, about 30 minerals have economic significance. Some of the major minerals are iron ore, coal, manganese, bauxite, mica etc. Felspar, florides, lime- stones, dolomite and gypsum etc are some other important minerals. But there are some minerals which are not abundant in India i.e. petroleum and some non-ferrous metallic minerals especially copper, lead, zinc, tin and graphite. Country fulfils internal demands for these minerals by importing them from other countries.

Before independence, India was least industrialised if we talk about the modern industries and these minerals were less in demand. Hence, most of the minerals were exported during the British period. After independence, situations begin to change. However, the exports of these minerals were continued but also mineral production has picked up in consonance with the increasing industrial demands in the country.

India produces more than 90 minerals, which are suitable for the growth of the country. The total value of all minerals produced in the country in 1950-51 was Rs 892 million. We have seen multiple times growth in the production and utilisation of minerals in the last 75 years after independence. As per the Annual Report- 2021-22 of Ministry of Mine, Govt. of India, the total value of minerals produced (excluding atomic, fuel minerals and minor minerals) during 2021-22 was estimated at Rs.1,90,389 crores. Out of this total estimated value, 55.2% was from metallic minerals and 44.8 were from non-metallic minerals.

In metallic mineral category, iron ore, chromite, manganese, zinc, bauxite, copper, gold are important minerals whereas in non-metallic category lime- stone, phosphorite, dolomite, kaolin, magnesite, barytes and gypsum are important. India's contribution in the production of these minerals in the world is also significant as it holds very high ranks in world order. For example India ranks 3rd in Chromite, 5th in Bauxite, 4th in Iron ore, 7th in manganese ore and the list goes on. The huge reserves and production in big quantities has made India self-sufficient or partially self-sufficient in many minerals. For example, in the year 2019-20 India was self-sufficient in bauxite, chromite, iron ore, limestone and sillimanite. While in some minerals it was not totally self-sufficient and the remaining portion was imported. For example, we were 75% self-reliant in magnesite, 15% in rock phosphate and 51% manganese ore and remaining percentages were imported. The availability of these resources has helped in the growth of industry. Iron and steel Industries, petroleum industry, fertilisers industry, aluminium industry etc. has grown tremendously by using these resources. But in certain cases if minerals are imported then a large amount of foreign reserves are spent on such imports. India expends a huge amount on petroleum products as its reserves are not sufficient in India. The availability and concentration of these minerals also influence the concentration of industries in any specific area.

The same was with energy resources. Energy resources are the fuel for the development of any country. It may have varied form as per the utilisation. With changes and development in technologies, the form of energy has also been changed. It is useful for day to day life and we can not think about industrial development without optimum availability of energy resources. The total installed power generation capacity of India in 2022 was 410,339 MW. It includes 2,35,809 MW (57.5%) from fossil fuels and 1,74,530 MW (42.5%) from non-fossil fuels.

Till now we have discussed in detail about the minerals and energy resources that are found in our country and how they are significant to our economic growth. In the next section, we will find out their geographical distribution.

INTEXT QUESTIONS 18.1

1. The value of minerals produces in 1950-51 was:

   a. Rs 756 million

   b. Rs 852 million

   c. Rs 892 million

   d. Rs 1050 million

2. What was India's installed power generation capacity in 2022 ?

   a. 510,330 MW

   b. 410,339 MW

   c. 673,545 MW

   d. 234,534 MW

3. In which of the following minerals, India is not self - sufficient?

   a. Rock phosphate

   b. Bauxite

   c. Chromite

   d. Iron ore

18.2 SPATIAL DISTRIBUTION OF MAJOR MINERALS

If you observe the distribution of mineral and energy resources, you will find that they are not equally distributed. The reason behind it is that these are associated with certain types of geological formation. For example, coal deposits are mostly associated with the Gondwana system while major metallic minerals are found in the area of Dharwad and Cuddapah. Most of the mineral bearing states are located in the peninsular plateau region of India. We can find three specific belts of mineral distribution in peninsular plateau region:

- **The North eastern plateaus:** It covers chota nagpur plateau, Odisha plateau and eastern Andhra plateau. This belt contains rich deposits of a variety of minerals, especially used for metallurgical industries. Prominent minerals that are large and widely distributed are iron ore, manganese, mica, bauxite, limestone, dolomite etc. This region also has rich deposits of coal, along the river valleys of Damodar, Mahanadi, Son etc. This region also has substantial deposits of copper, uranium, thorium, phosphate etc.
- **South-western plateaus:** This region extends over Karnataka plateau and adjoining Tamil Nadu plateau and is rich in metallic minerals particularly in iron ore, manganese and bauxite and in some non-metallic minerals. All the three gold mines of India are found in this region. However, coal is not found in this plateau region.
- **North-western region:** This belt extends from the gulf of Khambhat in Gujarat to the Aravalli range in Rajasthan. Petroleum and natural gas are principal resources of this belt. Deposits of other minerals are small and scattered. However, it is known for reserves and production of several non-ferrous metals particularly copper, silver, lead, and Zinc.

Minerals are broadly divided into two groups metallic and non-metallic minerals. Metallic minerals are further subdivided into ferrous and non ferrous minerals. Let's find some of the important minerals of India, their occurrence and distribution.

A. Metallic Minerals

The minerals under this category sufficiently contain metal content. It can be further subdivided into ferrous metallic and ferrous non-metallic minerals.

a. **Ferrous Metallic Minerals:** Ferrous minerals constitute one of the most important mineral groups. Iron, manganese, chromite, pyrite etc are included in this category. These minerals provide a strong base for the development of metallurgical industries, particularly iron, steel and alloys.

i. **Iron Ore:** India has vast reserves of good quality iron ore and comes among the one of the top countries of the world. It is estimated that India possesses over 20 percent of the world's total reserves of iron ore. The quality of ore found in India is very high, containing above 60% iron content.

India's reserves contain three types of iron ore- Haematite, magnetite and limonite. Haematite ore, referred to as 'red ore' due to its red colour, contains up to 68 percent of iron. The magnetite ore with dark brown to blackish in colour, and often referred as 'black ores' contains up to 60 percent of the iron. Third one is limonite which has an iron content of 35-50 percent and is yellow in colour.

DO YOU KNOW?

The classification of reserves/resources of various minerals is mostly based on United Nations Framework Classification (UNFC) and was done in April, 2010. It consist of three dimensional system with three axes - economic viability, possibility assessment and geological assessment.

As per UNFC system total estimated resources of hematite (as of 2015) are estimated at 22,487 million tonnes which includes 5442 million tonnes as reserve category while balance 17,045 million tonnes are under the remaining category. Another main iron ore is magnetite, which has a total resource of 10,789 million tonnes. Out of this resource 53 million tonnes is under reserve category while 10,736 million tonnes are under the remaining category. India was the 4th major iron ore producing country of the world in the year 2019-20 and its contribution was 8.09% of the total world's production.

Table 18.1 Production of iron ore in India

Year	Production (In million tonnes)
1950-51	3.0
1960-61	11.0
1970- 71	32.5
1980-81	42.2
1990-91	53.7
2004-05	140.46
2019-20*	246.0

* - As per Annual Report- 2021-22, Ministry of Mines, Govt. of India

Notes

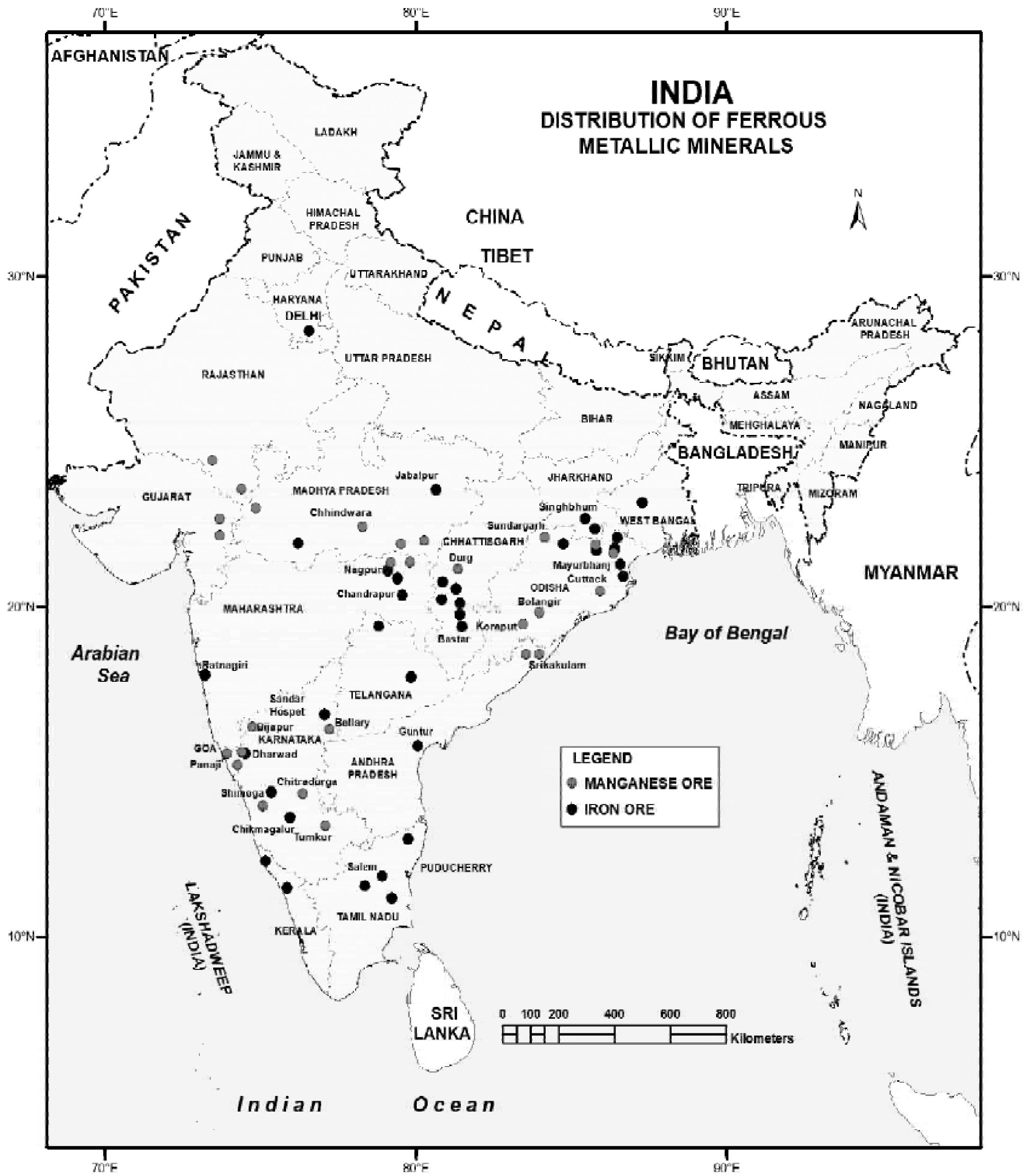


Fig. 18.1 INDIA : Distribution of ferrus metalic minerals

Distribution

We can find Iron ore deposits in almost every state of India. However, 96 percent of the total reserves are in Odisha, Jharkhand, Chhattisgarh, Karnataka and Goa. These states also account for 96 percent of the total production of iron ore in the country. About 3 percent of the country's total production comes from Tamil Nadu, Maharashtra and Andhra Pradesh.

Odisha and Jharkhand together possess about 50 percent of India's reserves of high-grade iron ore. The principal deposits are located in Sundargarh, Mayurbhanj and Keonjhar districts of Odisha and Singhbhum district of Jharkhand. The other important states are - Assam, Bihar, Madhya Pradesh, Meghalaya, Rajasthan and Uttar Pradesh.

ii. Manganese Ore: India ranks seventh (in 2019) in the production of manganese ore in the world contributing 5.13% of world's total production. A large part of the total production of India exported.

Manganese ore is an important ingredient for the manufacture of iron and steel. It is also extensively used for manufacturing dry batteries, in photography, leather and match industries. About 85 percent of total manganese consumption in India is used by metallurgical industries.

Distribution

The important areas of production are in Odisha, Madhya Pradesh, Maharashtra, Karnataka and Andhra Pradesh. Over 78 percent of total reserves of manganese ore of India occur in a belt stretching from Nagpur and Bhandara districts of Maharashtra to Balaghat and Chhindwara district of Madhya Pradesh. But these two states contribute only 12 and 14 percent of total production respectively. The remaining 22 percent of reserves are distributed in Odisha, Karnataka, Gujarat, Rajasthan, Goa and Andhra Pradesh.

b. Non-Ferrous Metallic Minerals: The second category of minerals are Non ferrous minerals. These minerals do not contain iron. Gold, silver, copper, tin, lead, zinc etc. are some of the important non ferrous minerals. These metallic minerals are highly important in day to day life. However, India is quite deficient in such minerals

i. Bauxite: Bauxite is a non-ferrous metallic mineral. It is the ore from which aluminium metal is produced. India's resources of bauxite are sufficient to keep the country self-reliant. Aluminium extracted from the ore is used in making aeroplanes, electrical appliances and goods, household fittings, utensils etc. Bauxite is also used for manufacturing of white colour cement and certain chemicals. India's resources of bauxite of all grades have been estimated at 3,897 million tonnes (in 2015).

Table 18.2 Production of Bauxite in India

Year	Production (in thousand tonnes)
1951	68.1
1961	475.9
1971	1,517.1
1981	1,954.6

1991	4,977.0
2004-2005	11598.0
2019-20*	21,824.0

* - As per Annual Report- 2021-22, Ministry of Mines, Govt. of India

Distribution

Bauxite has a wide occurrence in the country. Major reserves occur in Jharkhand, Maharashtra, Madhya Pradesh, Chhattisgarh, Gujarat, Karnataka, Tamil Nadu, Goa and Uttar Pradesh.

India exports bauxite to a number of countries. The leading importer of Indian bauxite is Italy, followed by the U.K., Germany and Japan.

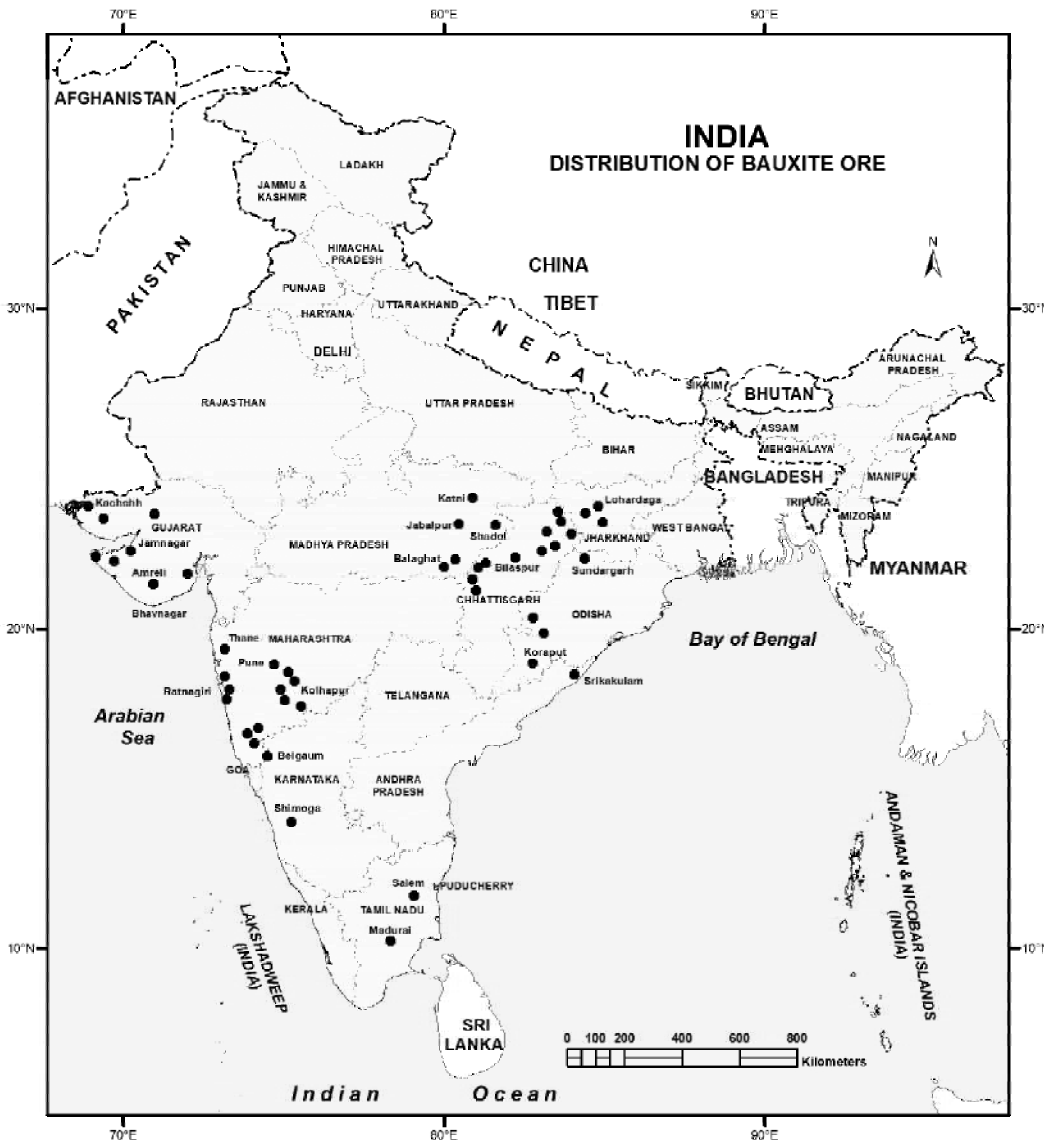


Fig. 18.2 INDIA : Distribution of Bauxite ore

B. Non-metallic Minerals

India is also rich in non-metallic minerals as many are found in India. However, only a few of these are commercially important. Some of the important non-metallic minerals are limestone, dolomite, mica, kyanite, sillimanite, gypsum and phosphate. These minerals are used in a variety of industries such as cement, fertilisers and electrical goods. In this lesson we will be studying about mica and limestone. Lets learn about some of the important non-metallic minerals:

i. **Mica :** India is the leading producer in sheet mica. It was one of the indispensable minerals used in electrical and electronic industries till recently. As estimated in 2015, the total resource of mica in the country is 635,302 tonnes.

Distribution

Although mica is widely distributed, workable deposits occur in three principle belts. Andhra Pradesh has the highest share of mica resources with 40% followed by Rajasthan, Odisha, Maharashtra, Bihar, Jharkhand and Telangana.

ii. **Limestone:** Limestone is useful in a wide range of industries. Approximately two thirds of the country's total consumption is used in the cement industry. Iron and steel industry, chemical industries, sugar, paper, fertilisers and ferromanganese industries are some of the other areas where it is used in large quantities. Limestone with high silica content is preferred in the cement industry. It is estimated (in 2015) that India has 203,225 million tonnes of limestone resources.

Distribution

The major producing states are Madhya Pradesh, Karnataka, Chhattisgarh, Andhra Pradesh, Telangana, Gujarat, Rajasthan, Tamil Nadu, Maharashtra, Himachal Pradesh, Odisha, Bihar, Jharkhand, Uttarakhand and Uttar Pradesh. The remaining part comes from Assam, Haryana, Jammu & Kashmir, Kerala, and Meghalaya.

INTEXT QUESTIONS 18.2

1. Which of the following is not a belt of mineral distribution in India?

   a. North eastern plateaus

   b. South-western plateaus

   c. North-western region

   d. South-eastern plateaus

2. Which of the following mineral is a non ferrous mineral-

   a. Manganese,

   b. Bauxite

   c. Chromite

   d. Pyrite

3. The ore termed as 'red ore' is-

   a. Haematite

   b. Pyrite

   c. Magnetite

   d. Limonite

4. What was India's rank in producing iron ore in the world?

   a. 1st

   b. 7th

   c. 3rd

   d. 4th

18.3 ENERGY RESOURCES

Optimum availability of energy resources is essential for economic development and improving the quality of life. It is very difficult to imagine modern living without the use of energy resources. Day by day the consumption of energy has been increasing. It is available in various forms in India.

There are several sources of energy. They are classified in different ways. One way of classification is based on their longevity. For instance mineral resources such as coal, petroleum etc are all non-renewable or exhaustible resources while water, the sun, wind, tides, hot springs and biomass are all inexhaustible or renewable sources of energy.

Yet another classification of energy is based on conventional and non- conventional sources. The former includes coal, petroleum, natural gas etc. The non-conventional sources of energy include sun, wind, water, tides, hot springs and biomass. Let's learn about some forms of energy resources in India.

A. Conventional Source of Energy

Conventional energy resources includes coal, petroleum, natural gas etc

a. **Coal:** In India, coal is the primary source of commercial energy. It is used as fuel in industries, thermal power stations and also for domestic purposes in some parts of the country. It is also used as a raw material in chemical and fertiliser industries and in the production of thousands of items of daily use.

The Geological Survey of India has estimated the total coal reserves of the country stand at 326.496 billion tonnes. The total production of coal was 729.10 million tonnes in 2019-20. A large part of the Indian coal reserves are of rather poor quality. Therefore, coking coal is imported to meet our requirements. In India, emphasis is being laid on setting thermal and super thermal power stations on or near the coal fields and electricity generated is supplied to far off places through transmission lines. At one time Indian railways were the largest consumer of coal. Since they have switched on to the use of diesel and electricity they are no more the direct consumer of coal.

Distribution

Coal in India occurs in two important types of coal fields. They are the Gondwana coal fields and Tertiary coal fields. Out of the total coal reserves and production in India, Gondwna coal fields contribute 98% and the rest 2% is produced by tertiary coal fields. The Gondwana coalfields are located in the sedimentary rock systems of the lower Gondwana Age. They are distributed chiefly in the river valleys of the Damodar (Jharkhand - West Bengal); the Son (Madhya Pradesh-Chhattisgarh); the Mahanadi (Odisha), the Godavari (Andhra Pradesh and Telangana) and the Wardha (Maharashtra). Tertiary coalfields occur in the extra-peninsular areas which include Assam, Meghalaya, Nagaland, Arunachal Pradesh, Jammu & Kashmir and Sikkim. Besides lignite or brown coal are found in coastal areas of Tamil Nadu, Gujarat and in land basins of Rajasthan.

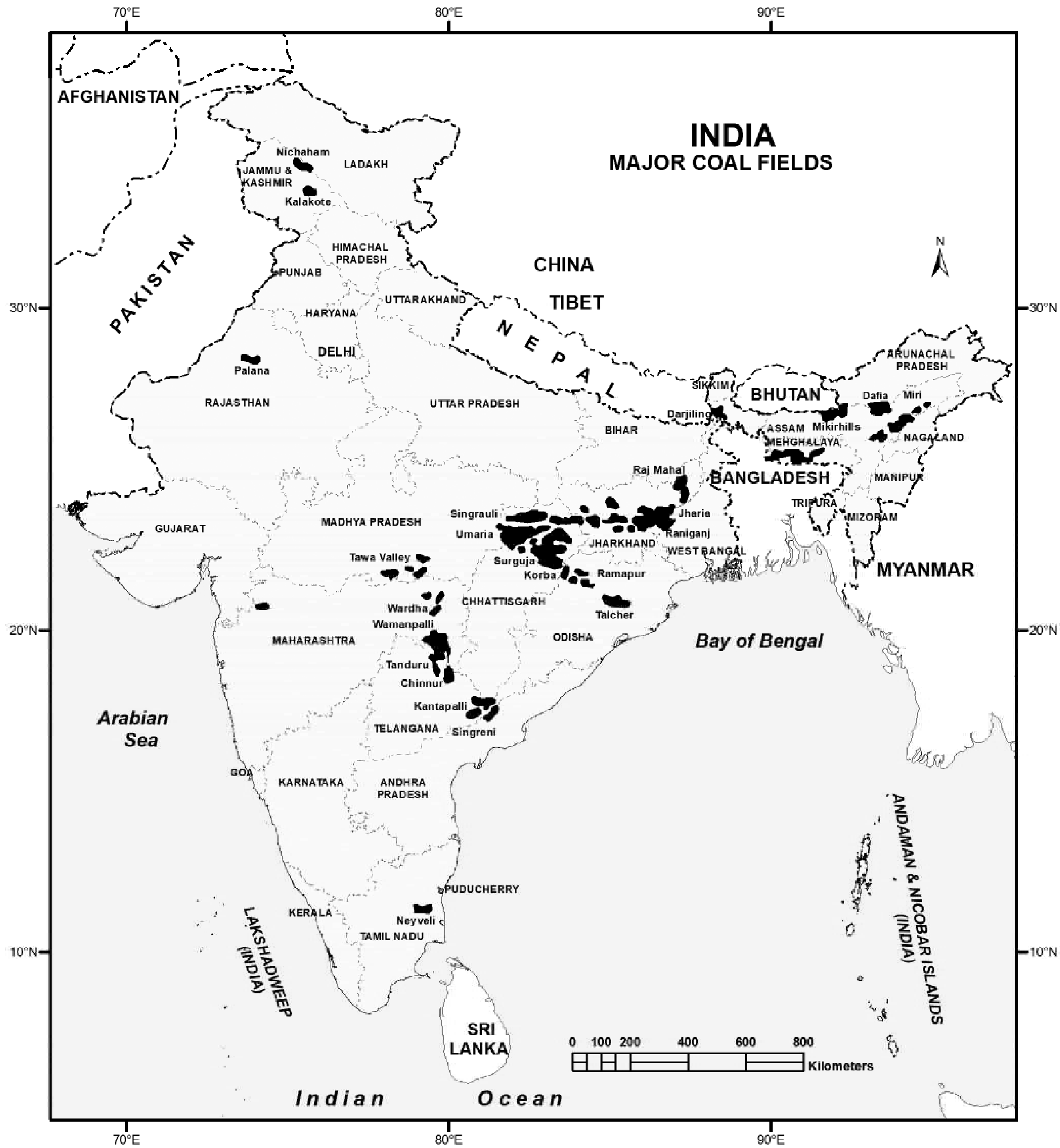


Fig. 18.3 INDIA : Major Coal Fields

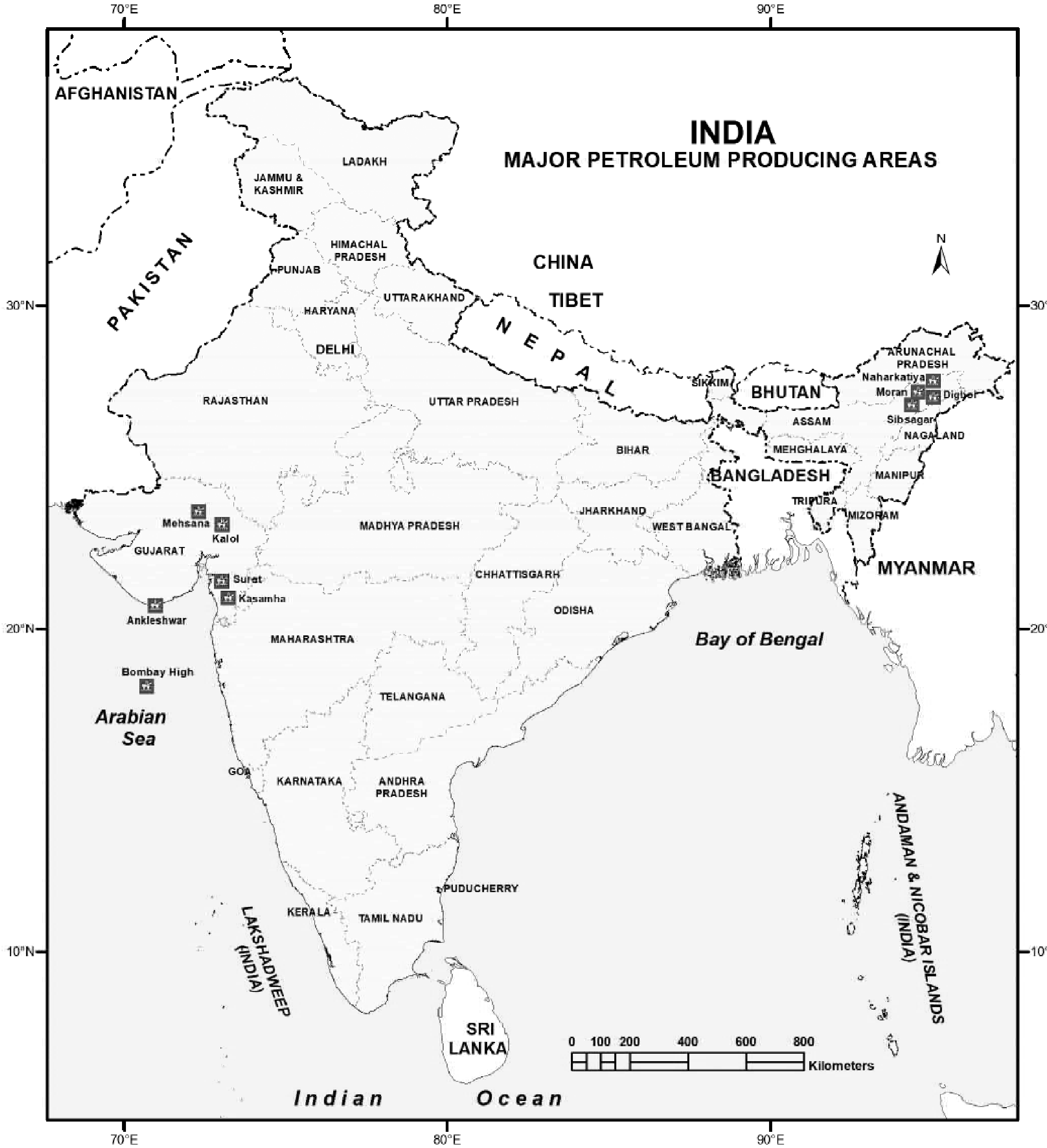


Fig. 18.4 INDIA : Major Petroleum Producing Areas

b. Petroleum: Petroleum is one of the most important minerals in our modern civilization and is called liquid gold because of its value. Our agriculture, industry and transport system depend on petroleum in several ways.

The crude petroleum is a mixture of combustible hydrocarbons in solid, liquid and gaseous forms. Petroleum products used as fuel, lubricant, material for manufacturing synthetic derivatives and chemicals required in industries. Petrol, kerosene, diesel, detergents, synthetic fibres, plastics, cosmetics etc. are important products derived from petroleum.

Distribution

Petroleum occurs in anticlines and fault traps. In India, it is found in the sedimentary rock formation. Most of such areas lie in the Assam, Gujarat and off shore areas along the western coast.

The entire production of India till today comes from the Assam belt, Gujarat- Cambay belt and Bombay High. The Assam belt extends from Dehang basin in the extreme north-east of Assam along the outer flanks of hill ranges forming the eastern border of Bhitra and Surma Valley. The Gujarat-Cambay belt extends from Mehsana (Gujarat) in the north to the continental shelf off the coast right up to Ratnagiri (Maharashtra) in the south. It covers Bombay High which is the largest producer of petroleum in the country. In Assam, the oil producing area is located in the Lakhimpur and Sibsagar districts. The oil wells are located mainly around Digboi, Naharkatiya. Sibsagar and Rudrasagar. In Gujarat, the oil producing area covers Vadodara, Broach, Kheda, Mehsana and Surat Districts. Recently petroleum reserves were discovered in the state of Rajasthan covering major areas of Bikaner, Barmer and Jaisalmer and gas has been discovered along the east coast in the Godavari and Krishna deltas. The prospective areas lie in the Bay of Bengal, which covers the coastline along the state of West Bengal, Odisha, Andhra Pradesh, Tamil Nadu and Andaman and Nicobar Islands.

Oil Refineries in India

The crude petroleum taken from oil fields needs to be refined before it can be used. Oil refining is really a big chemical engineering industry involving a complicated process. Presently, there are a total 23 oil refineries in India. Out of these 18 are in the Public Sector, 2 in the Joint Venture and 3 in the Private Sector. India is becoming a global refining hub with the capacity of 248.9 MTPA and is the fourth largest refiner in the world after the United States, China and Russia. Although the annual production shows an increasing trend, the country has to import petroleum and petroleum products to meet its requirements.

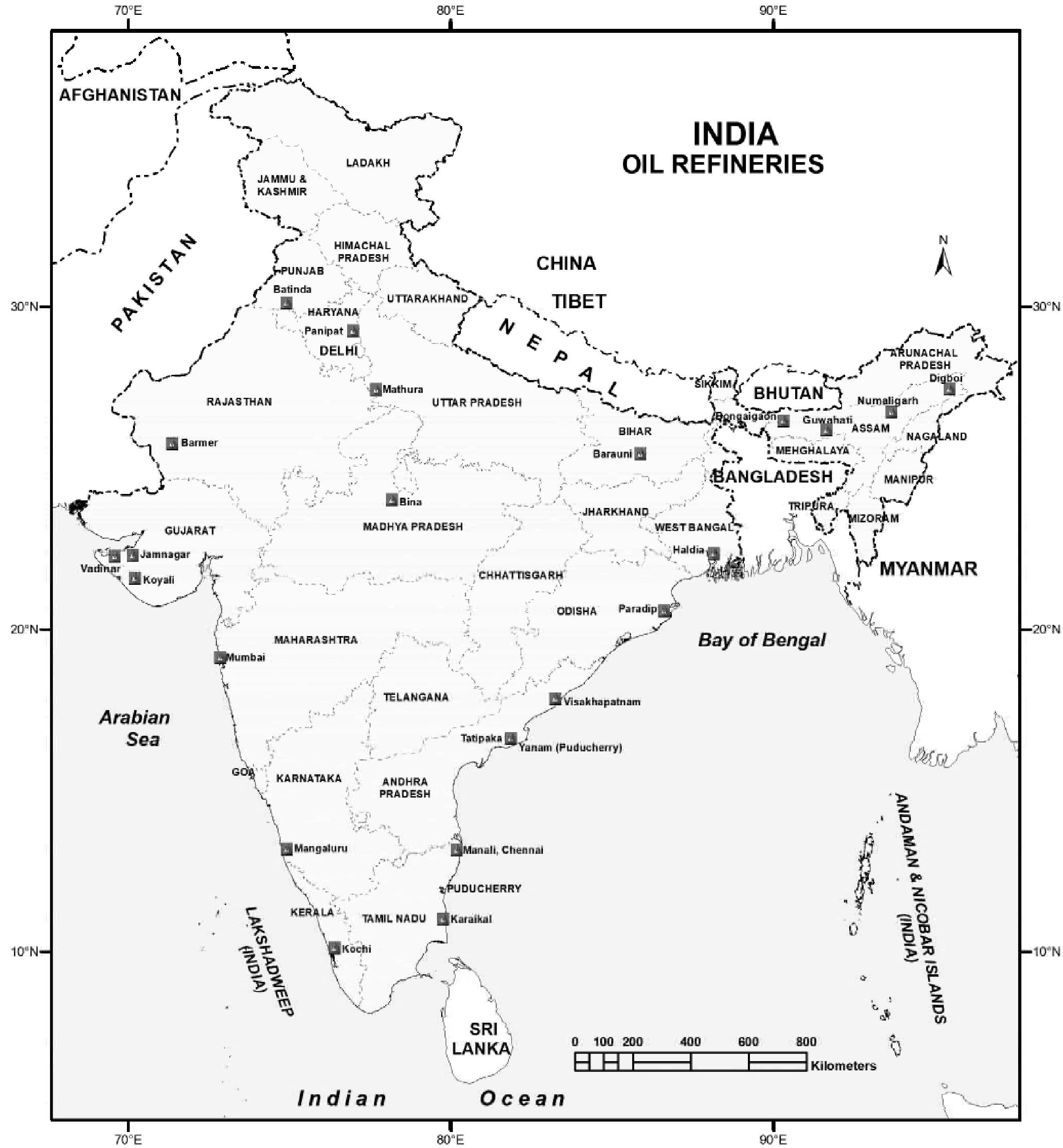


Fig. 18. 5 India: Oil Refineries

c. **Natural Gas:** Natural gas is emerging as an important source of commercial energy. Most of the time it is found in association with petroleum.. But this quantity may be increased as more and more reserves are being discovered. Production of natural gas in 2020-21 was 23,579.54 MMSCMD.

d. **Atomic Minerals :** Atomic energy can be produced by fission or fusion of the atoms or rather the nuclear parts of radio-active minerals like uranium thorium and radium. India possesses the world's largest reserves of monazite, the principal source of thorium and some reserves of uranium.

i. **Uranium:** In India, uranium is embedded in the igneous and metamorphic rocks in Jharkhand, Rajasthan, Andhra Pradesh and some parts of Himalaya. A substantial source of uranium deposits is also found in the monazite sands along the Kerala coasts.

The production of uranium at present is confined to the mines at Jaduguda in Singhbhum district of Jharkhand. The total reserves of uranium in the country are enough to support more than 5,000-10,000 mw of electricity generating capacity.

ii. **Thorium:** Thorium is principally obtained from monazite. The beach sands of Kerala in Palakkad and Quilon district contain the world's richest monazite deposits. It also occurs on the sands of Visakhapatnam in Andhra Pradesh.

On the basis of the availability of these resources, electricity production has been transformed in India. Let's have a look at thermal power production in India.

Thermal Power

The thermal power includes the energy generated from coal, diesel and natural gas. It is the main and largest source of power supply in the country. Presently, the installed capacity of thermal power stations is four times more than the installed capacity of hydel power. During 2022-23, India has installed generation capacity of 2,36,469 MW thermal power out of 4,11649 MW of total capacity. This is approximately 57% of the total installed capacity in India. Thermal energy has shown a rapid growth in India after the creation of the National Thermal Power Corporation (NTPC) in 1975. Presently, NTPC has 26 coal based power stations. The company has a coal based installed capacity of 51,150 MW. It also has 7 coal based joint ventures and subsidiaries with a commissioned capacity of 7,004 MW.

Super Thermal Power plants have been established mainly very close to big coal mines i.e. Singrauli (U.P.), Korba (Chhattisgarh), Ramagundam (A.P.) etc. Most of these power plants have improved their efficiency and profitability through improved plant load factor (78% against the national average of 63%) with the electrification of trunk routes railways have also set up their own super thermal power stations in the regions lying away from major coal fields. In Tamil Nadu there is a big thermal power plant at Neyveli which is fed by local lignite coal fields.

Besides coal based thermal power plants, the latest trend is to encourage diesel and natural gas based thermal power plants. Such plants can be set near the distribution or market centres. The gestation period of oil or gas based plants is generally the shortest. These plants are also found to be more efficient than coal based plants. The oil and gas pipes have to be laid for continuous supply of petroleum and natural gas for such power plants. As India has very limited resources of mineral oil and proven gas resources, it has to import these raw materials including naptha etc. from other countries.

Petroleum based power units have been set up in the remote areas of North East and Himalaya region.

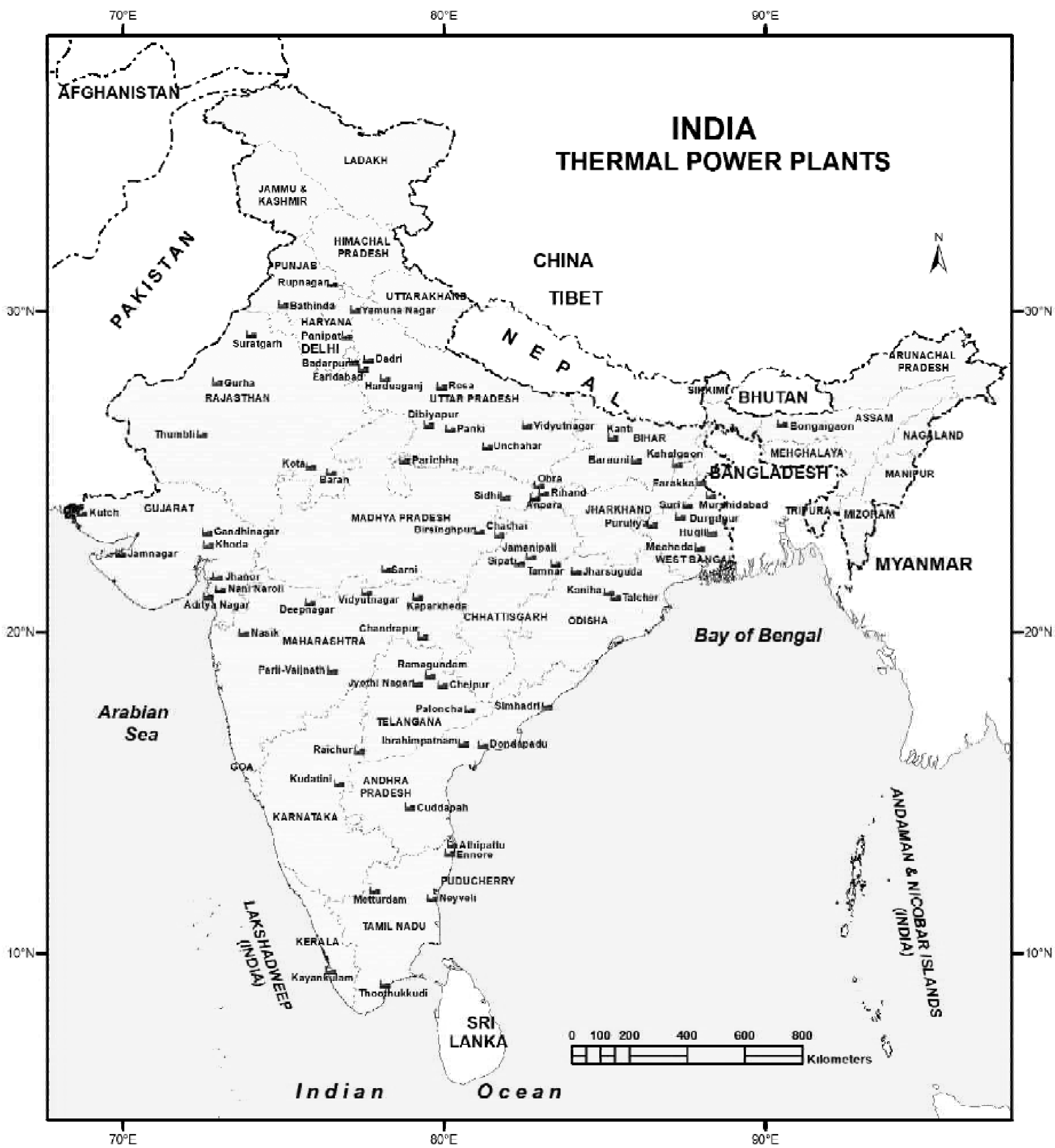


Fig. 18.6 INDIA : Thermal Power Plants

Nuclear Power

India had developed the technology of generating energy from nuclear minerals such as uranium and thorium. Installation of nuclear reactors for generating power requires huge capital and sophisticated technological skills. The share of nuclear power in the total energy produced in the country is hardly 1.6%. India has a total of 6,780 MW installed generation capacity for the nuclear sector. Nuclear power is a promising source of energy for the future. It would play a complementary role when the other sources of power like coal and petroleum would be exhausted.

Nuclear power programme was initiated in the 5th decade of the last century and an apex body for decision-making regarding atomic programmes, the 'Tata Atomic Energy Commission' was incorporated in August 1948. But progress in this direction could be made only after the establishment of the Atomic Energy Institute at Trombay in 1954. Which was renamed as the 'Bhabha Atomic Research Centre' (BARC) in 1967. Consequently, the first nuclear power station with 320 MW capacity was set up at Tarapur near Mumbai in 1969. Later, atomic reactors were installed at Rawatbhata in Rajasthan, Kalpakkam and Kudankulam in Tamil Nadu, Narora in Uttar Pradesh, Kaiga in Karnataka and Kakrapar in Gujarat also have nuclear energy plants. Thus at present, nuclear energy is produced at 7 centres. Requirements of fuel and heavy water of these power reactors are fulfilled by the Nuclear Fuel Complex located at Hyderabad and heavy water plant at Vadodara.

B. Non- Conventional Source of Energy

Conventional sources of power like coal, petroleum and natural gas are likely to exhaust in the near future. Therefore, there is a need to find and develop alternative sources of power. Hydel power is also a non-conventional energy resource. However, it needs to be utilised judiciously. Sun, wind, tides, biological wastes and hot springs are such sources which can be developed as the alternative sources of power. They are called the non-conventional sources of energy. These sources of energy are renewable and pollution free. Let's discuss some important non-conventional sources of energy. Around 40% generation capacity was from non conventional sectors in 2022.

a. **Hydroelectric Power:** Development of hydroelectric power started in the last decade of the 19th century with the establishment of a hydroelectric plant for supplying electricity to Darjeeling in 1897. In 1902, another hydropower plant was established at Shivasamudram waterfall on Kaveri river in Karnataka. Later, a few plants were established in the Western Ghats to meet the requirements of Mumbai. Hydropower plants were also commissioned in Uttar Pradesh, Himachal Pradesh in the north, and Tamil Nadu and Karnataka in the south in the 1930s. Total generation capacity reached 508 MW in 1947. Massive efforts were made

Notes

to develop waterpower during the Five Year Plans and several multipurpose projects were commissioned.

India has impressive shares of hydel electricity generation capacity in total installed capacity in India. The total installed capacity of hydel power in 2022 was 46,850 MW which was approx 11.4% in total installed capacity.

In spite of being a cheaper, pollution-free and renewable source of power, the significance of hydroelectricity has declined in the post-independence period. Its share in total power generation declined from 49 percent in 1950-51 to only 11.4 percent in 2022-23. Nevertheless, hydroelectricity plays a very significant role in northern, western and southern grids.

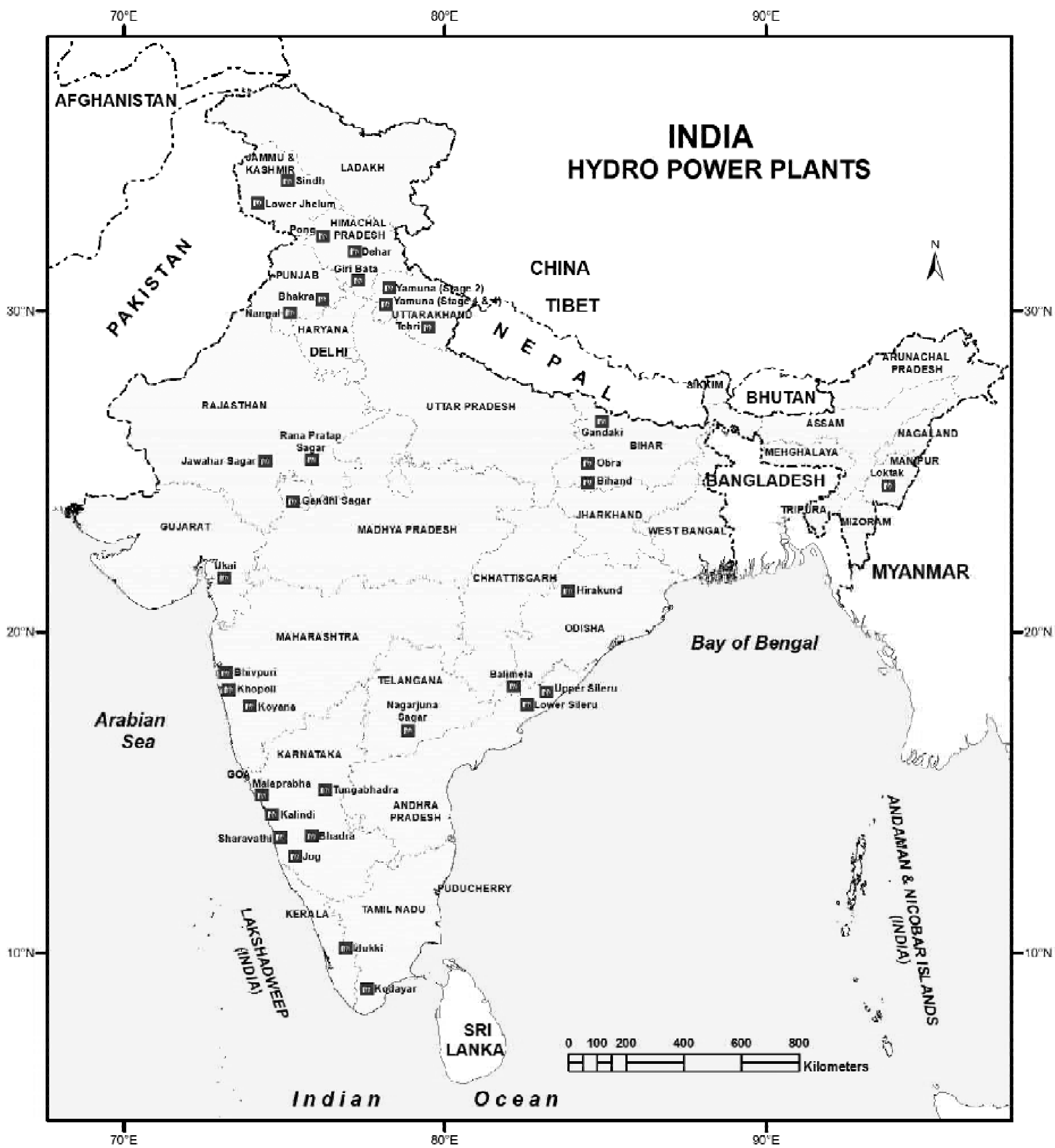


Fig. 18.7 INDIA: Hydro Power Plants

b. **Solar energy:** The Sun is the primary source of all energy on planet earth. Sun is the most vital, abundant and direct source of energy. India lies in the tropical zone and has plenty of sunshine, for long hours of the day and has large possibilities to develop solar energy. Solar energy is tapped through the system of Solar PhotoVoltaic (SPV) cells. The thermal heating system can be used for water heating, solar cookers for cooking meals and drying food grains etc. Solar energy can be developed in almost every part of the country but more so in hot, dry and cloud free areas. Karnataka is presently tops with most installed capacity. Other important states are Rajasthan, Madhya Pradesh, Telangana, Andhra Pradesh, Tamil Nadu etc. India has 63,894 MW installed capacity sharing 15.1% of total installed capacity.

c. **Wind Energy:** Wind can be used as a source of energy in those regions where strong and constant winds blow throughout the year. Wind energy can be used for pumping water for irrigation and also for generating electricity. India has about 41,983 MW installed generation capacity in 2022-23. Tamil Nadu tops with installed capacity followed by Gujarat, Maharashtra, Karnataka and Andhra Pradesh.

d. **Bio Energy :** Biomass is also an important source of energy for the country. It is a renewable resource, widely available and carbon-neutral also. It may also be useful in generating employment in the rural areas. The sources of Biomass are biogas, rice husk, straw, cotton stalk, coconut shells, soya husk, de-oiled cakes, coffee waste, jute wastes, groundnut shells, saw dust etc. The total installed capacity was 10,210 MW in 2022-23.

e. **Tidal Energy:** Energy can also be generated from high tidal waves. Some of the important sites identified for generating tidal energy are located in the Gulf of Kachchh and Cambay in Gujarat state and the coast of Kerala.

f. **Geothermal energy:** The potential of geothermal power is very limited in India. Important sites selected for generating geothermal power are situated in Himachal Pradesh (Mani Karan) and Laddakh (Puga valley in Ladakh). Assessment of geothermal energy potentials of selected sites in Himachal Pradesh, Jammu and Kashmir, Uttarakhand, Jharkhand and Chhattisgarh is being undertaken.

INTEXT QUESTIONS 18.3

1. The river valley which is not included in Gondwana coal field-

a. Godavari   b. Jhelum

c. Son   d. Damodar

2. The mineral termed as 'liquid gold' -

   a. Coal

   b. Natural Gas

   c. Petroleum

   d. Thorium

3. How many oil refineries are established in India?

   a. 26

   b. 29

   c. 23

   d. 32

4. In which state Uranium is produced?

   a. Rajasthan

   b. Chhattisgarh

   c. Jharkhand

   d. Himachal Pradesh

5. The share of hydel power in total installed capacity was:

   a. 15.4 %

   b. 11.4 %

   c. 22.0 %

   d. 16.5 %

18.4 ENERGY CONSERVATION

As we learnt that many energy resources are not abundant and if we continue to extensively use them, these may be exhausted in near future. That is why the use of alternative sources of energy were explored. Even, the alternative resources of energy are non- exhaustible but still they require to be used wisely. Therefore, it's essential to use appropriate methods to conserve energy resources. Some of the ways can be adopted to conserve it:

i. Reduce; recycle and reuse are one of the most effective ways to conserve energy resources. Reducing the consumption has the direct impact on the utilisation of resources

ii. Some change in lifestyle may also reduce the uses. For example reduced use of electrical appliances, use of sunlight instead of artificial lights may reduce the demand causing reduced production.

iii. More efforts in exploring non-conventional energy resources. As a diverse country, India has a great potential to find alternative non-conventional sources of energy.

iv. A huge part of electricity is lost during transmission. By improving the efficiency of energy supply systems, it can be saved which will reduce the pressure on energy resources.

v. It can also be conserved by promoting effective public transport and public services. This will reduce individual consumption.

vi. Efforts should be made to spread awareness in schools and among the youth for the conservation of various energy resources.

As an individual we can also make some efforts to reduce the use of electricity, which finally saves precious energy resources. Some of these efforts are:

- Switching off electricity when not in use.
- Try to use public transport.
- Carpooling may also be used in place of private vehicles.
- Shut lights and television when leaving the room.
- Use the sunlight at home during day time instead of turning on the lights.
- Dry clothes in the sun instead of using the dryer during sunny days.
- Turn off the dishwasher right before the drying cycle and let the dishes air dry.
- Don't leave the refrigerator door open.
- Use compact fluorescent lights (CFLs) or other efficient bulbs.
- Cool the rooms to no less than 24°C as it will give you the most comfort.
- Use sleep mode in computer Computers instead of screensavers as it uses up to 70% less electricity.

18.5 NATIONAL ENERGY POLICY-2017

The National Energy Policy (NEP) has been drafted by the NITI Aayog in 2017. It has extended to reforms and provisions further from the 2006 Integrated Energy Policy (IEP) to excel in the energy sector and continue the growth rapidly. There are four key objectives of National Energy Policy-

- Access at affordable prices
- Improved security and Independence
- Greater Sustainability and
- Economic Growth

Aims of National Energy Policy

- The National Energy Policy has been framed with the intention to devise a broad framework for the overall energy sector. It has talked about effective use of technology and fuel options.
- The National Energy Policy aims to electrify all the Census villages by 2018, and to achieve universal electrification with 24×7 electricity by 2022.
- The share of manufacturing in our GDP is to go up to 25% from the present level of 16%, while the Ministry of Petroleum is targeting reduction of oil imports by 10% from 2014-15 levels, both by 2022.
- NDC (Nationally Determined Contributions) targets a reduction of emissions intensity by 33 percent-35 percent by 2030 over 2005.
- Achieving a 175 GW renewable energy capacity by 2022, and share of non-fossil fuel based capacity in the electricity mix is aimed at above 40% by 2030.
- Mainstream emerging energy technologies and provide consumer energy choices.

INTEXT QUESTIONS 18.4

1. Who drafted National Energy Policy 2017?

   a. Niti Ayog

   b. NTPC

   c. BEE

   d. Ministry of Mines

2. National Energy Policy 2017 was based on -

a. Integrated Energy Policy 2003

b. Integrated Energy Policy 2002

c. Integrated Energy Policy1998

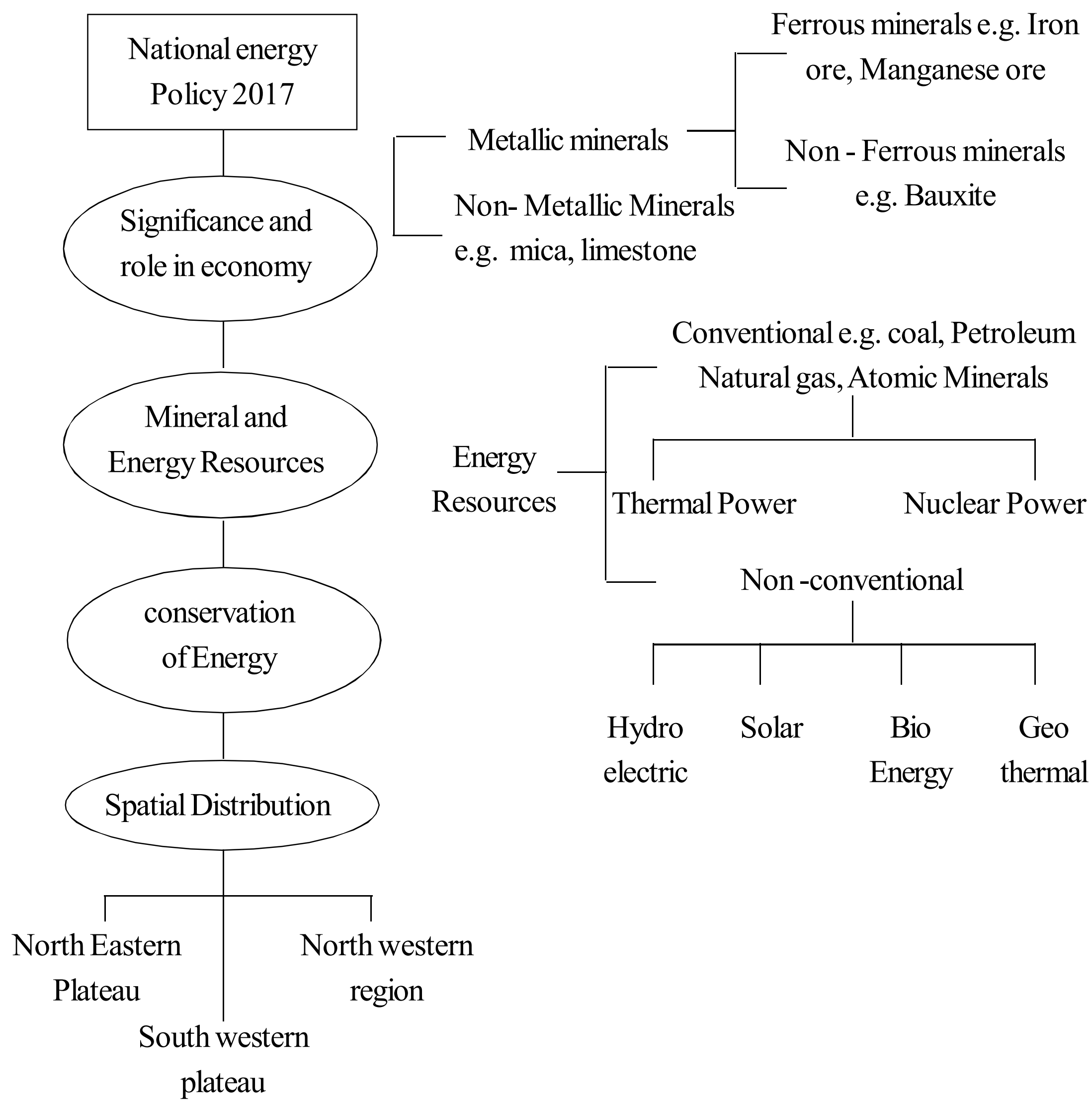
d. Integrated Energy Policy 2006

3. National Energy Policy 2017 aimed to achieve universal electrification with 24×7 electricity by:

a. 2018 b. 2019

c. 2025 d. 2022

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Why are mineral and energy resources significant for the Indian economy?
2. Describe the distribution and production of the following minerals and mineral fuels in India:
   (a) Bauxite
   (b) Iron ore
   (c) Petroleum
3. Differentiate between conventional and non-conventional energy with suitable examples.
4. Give any two reasons why we should prefer non-conventional energy resources.
5. Distinguish between wind and solar energy.
6. On an outline map of India show the following
   (i) Jharia and Raniganj coal fields.
   (ii) Ankaleswar and Digboi oil fields.
   (iii) Mathura and Panipat oil refineries.
   (iv) Talcher and Korba thermal power plants.
   (v) Kaiga and Kota atomic power plants.
   (vi) Bhakra and Nagarjuna Sagar hydro-electric plants.
7. On an outline map of India show the following
   (vii) Singhbhum iron ore fields
   (viii) Bauxite producing area of Tamil Nadu
   (ix) Tawa Valley and Neyveli coal field
   (x) Bombay High and Sibsagar oil fields.
   (xi) Bina and Tatipaka oil refineries.
   (xii) Talcher and Korba thermal power plants.

Notes

ANSWERS TO INTEXT QUESTIONS

18.1

1. c
2. b
3. a

18.2

1. d
2. b
3. a
4. d

18.3

1. b
2. c
3. c
4. c
5. b

18.4

1. a
2. d
3. d

19

MAJOR INDUSTRIES AND INDUSTRIAL COMPLEXES

Can you identify a few things in your house that don't occur naturally and are manufactured with the help of machines. Have you ever thought where these have been manufactured? Products such as clothes, utensils, paper, plastic boxes, notebooks, books, pens and pencils, etc. are manufactured in industries. Industries are the places where goods are produced or manufactured in large quantities. This sector includes mining and quarrying, manufacturing (Registered and Unregistered), gas, electricity, construction, and water supply. This is also known as the secondary sector of the economy. Many of these resources are used in industries to manufacture goods. Industries also provide employment to a large number of the population. Those engaged in agricultural activities are said to be involved in primary activities. Similarly, those engaged in manufacturing and industries are said to be engaged in secondary activities.

OUTCOMES

After studying this lesson, learner:

- highlights the role of industries in national development;
- differentiates between agro based and mineral based industries;
- describes spatial distribution of major industries and their production and
- identifies the major industrial complexes and regions.

19.1 SIGNIFICANCE AND ROLE OF INDUSTRIES IN NATIONAL DEVELOPMENT

Learners, as discussed in the previous lesson, agriculture, industries and services provide employment to the people of a country. Industries are considered as the backbone of development especially, economic development. This is because of the following reasons:

1. Manufacturing industries help in modernising agriculture which is the backbone of the Indian economy.

Notes

2. They reduce heavy dependence of people on agriculture by reducing the human burden on it by providing jobs.

3. As industries employ a large number of the population, industrial development is one of the preconditions for eradication of unemployment and poverty from our country. This philosophy was responsible for the development of public sector industries in India.

4. Industrial development in backward areas also aims at bringing down regional disparities.

5. Export of manufactured goods helps in expanding trade and commerce and inviting foreign exchange.

6. Transformation of raw material into finished goods adds value to the product and the skilled labour.

In India, industries employ around 12 percent of the total population. This sector has contributed 29.8 percent, 29.3 percent and 29.1 percent in GDP (Gross Value Added or GVA) for 2015-16, 2016-17 and 2017-18, respectively. The contribution of agriculture and related activities was 17.7 percent, 17.9 percent and 17.1 percent for the same three time periods.

DO YOU KNOW?

It is very important to mention here that the importance of agriculture is to provide the basic need of humankind i.e. food and cannot be seen just in terms of contribution to GDP. The comparative figures given here are in order to show how important the role industries play in the GDP of India.

In addition to its direct contribution to the economy, the secondary sector has a multiplier effect for job creation in the service sector. According to National Manufacturing Policy 2011, every job created in the manufacturing sector creates two-three additional jobs in related activities.In general, different amounts of labour and different types of skills are required in different industries. Some of the industries such as, textile, leather and food processing employ a larger number of labour as compared to machinery industry and are therefore, called labour intensive industries.

Industries add value to the existing goods and also to the skill of labour employed in it therefore, this sector is also considered as a transformational sector. In a country like India, where the agriculture sector is burdened with a large amount of surplus labour, the industrial sector can act as a good option for absorbing this surplus. As can be seen in Figure manufacturing and other industries have a larger share in the GDP as compared to the percentage of workforce employed in it as compared to the agricultural sector.

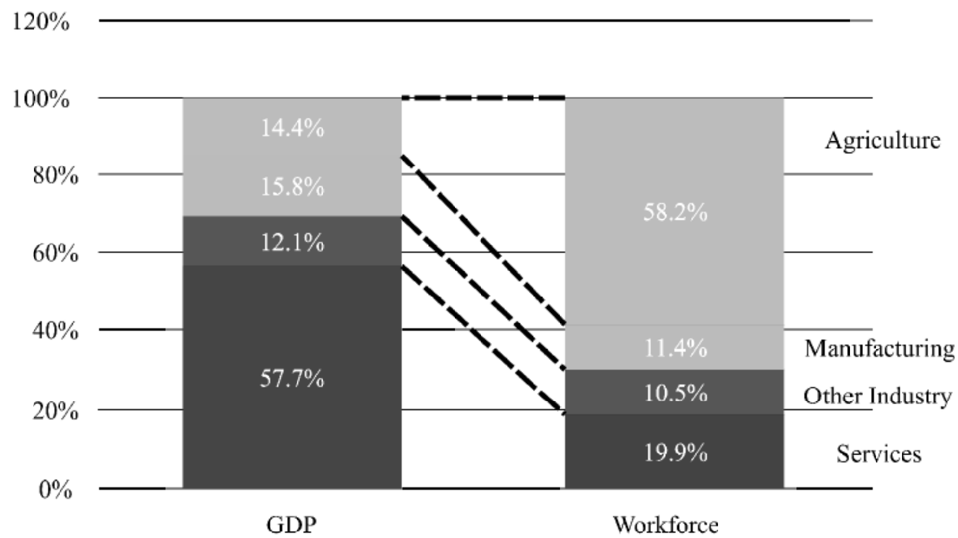


Fig. 19.1: Distribution of labour in different sectors of India and the share in GDP of economy 2017-18

Source : https://www.indiabudget.gov.in/budget, 2019-20

The demography of India having an expanding population i.e. large percentage of population in the working age-group supplements the importance of the industrial and service sector other than agriculture. The importance given to the secondary sector in several Five Year Plans and growth of this sector in the future can provide a potential for employment to a large number of the population in the coming years.

LET'S DO

Prepare a list of five countries in the world and try to find out the contribution of agriculture, manufacturing and service sector in their national economy.

In order to know how much you have understood about the industries and their importance in national development, let us go through some of the questions.

INTEXT QUESTIONS 19.1

1. What activities can be classified under secondary activities?
2. The percentage of labour force engaged in industries in India is__________.
3. Why are industries important in the Indian economy? Choose the correct answer from the given options.

i. As they are huge

ii. Because they are found everywhere

iii. As they provide employment to large number of people, modernise agriculture and reduce heavy dependence of people on agriculture

19.2 LOCATION OF INDUSTRIES

After knowing how important industries are in the national development, it is important to know whether industries can be set up anywhere or there are certain requirements for setting them up.

LET'S DO

Is there any industry near your place of residence or does anyone in the family is engaged in any industry? Talk to them and people near you and try to find out what are the factors responsible for that particular industry to be located there.

For setting up an industry it is important to keep in mind the manner in which profit can be maximised. Industries maximise the profit by reducing costs. Therefore, industries are located in the areas where they can reduce or minimise their cost of production. Some of the factors that determine location of industries are the following:

A. **Raw material -** Raw materials used in industries are the prerequisite for any type of industry and that should be available at low price or should be cheap and easy to be transported to the site of industry. Industries which are dependent on bulky, weight-loosing, perishable raw materials are located near to the source of raw materials e.g. agro-based industries and dairy industries, etc.

B. **Market -** Access to markets for selling of manufactured goods is required. Here the market means people who have a demand for these goods and have the purchasing power (ability to purchase) to buy the finished goods from the manufacturer. Remote or secluded areas with low population and lower purchasing power are considered as small markets and vice-versa.

C. **Labour supply -** Labour or human power to work in the industries is another important factor that determines the location of industries. In recent years, mechanisation of industries has reduced the importance of labour supply as a determining factor but, still there are many industries which are labour intensive or require large amounts of labour.

D. **Source of energy -** Those industries which are dependent on heavy supply of energy are located near its source. Earlier coal was the source of energy for industries therefore; industries were located near the source of coal. Later, hydroelectricity and petroleum became the source of energy.

E. Transportation and communication facilities - An efficient and speedy transportation is required for transferring raw material from its source to the factories. Similarly, it is required for supply of finished goods from factories to the markets. Cost of transportation is an important factor for determining the location of industries. Industries all over the world have been concentrated where easy and efficient transportation and communication facilities are available. Good communication facility is required for exchange and management of information within and outside the industry. Can you find out why there is a concentration of industries in Western Europe and East North America?

F. Government policies - Favourable policies of the government in compliance with industrial growth is an important factor. In India, the government has adopted regional policies and target area approaches in its various Five Year Plans to propagate industrial growth in particular regions of the country.

G. Agglomeration economies - Many times industries benefit from their nearness to each other. This is in the manner that either they share the infrastructure or the finished goods of one industry are used as raw materials for another. Such industries are known as agglomeration economies.

The above factors are responsible for the location of most of the industries. But, there are few industries which are not dependent on these factors and can be located anywhere or at a variety of places. This is because they are not dependent on any specific raw material and are largely dependent on component parts which can be obtained from anywhere. This gives them the liberty to get established anywhere. Such industries are known as Footloose industries. The only important factor that has been found to affect them is accessibility through roadways. Foot loose industries have generally been found to be non-polluting. Examples of Footloose industries are, mobile manufacturing industry, computer chip producing industries, etc. Let us now try to find out how much you have understood about the factors affecting the location of industries.

INTEXT QUESTIONS 19.2

1. Raw material, Market, Labour supply, Source of energy, Transportation and communication facilities, Government policies & Agglomeration economies are the factors responsible for ____________________?

2. If there is perishable raw material then where do you think that particular industry will be located?

3. Industrial units benefit each other from ______________________________.

4. Industries are based on cost maximisation or profit maximisation? Choose the correct option.

19.3 TYPES OF INDUSTRIES

In the previous sections we talked about various goods produced in industries. What do you think are all industries the same? All industries are not the same. They utilise different raw materials and manufacture different types of goods and in different quantities. In this manner, industries can be of different types depending upon various bases. Table 19.1 gives an idea about the classification of industries.

Table-19.1: Classification of industries

Sl.No.	Criteria	Types of Industries	Main characteristics	Examples
1.	Sources of Raw Material	(i) Agro-based Industries	Agricultural products used as raw materials	Cotton textile, jute, sugar and paper industry
		(ii) Mineral based Industries	Minerals are used as raw materials	Iron and steel, chemical and cement industry
2.	Ownership	(i) Public Sector	Owned and managed by Government	Bokaro iron and steel plant, Chittaranjan locomotive works.
		(ii) Private Sector	Owned and managed by an individual or a group as a company	Tata Iron and Steel J.K. cement industry Appolo Tyres.
		(iii) Joint Sector	Owned jointly by public and private sectors	Maruti Udyog
		(iv) Cooperative Sector	Owned by cooperative society of raw material producers	Sugar industry in Maharashtra, Amul (Gujarat) and IFFCO (Kandla)
3.	Function or Role	(i) Basic Industry	Finished products of basic industry are used as raw material for other industries	Iron and Steel and petro-chemical industries.
		(ii) Consumer Goods Industry	Finished products of this industry are directly used by individuals.	Toothpaste, soap, sugar industry
4.	Size of Industry	(i) Large Scale Industry	Huge investment, heavy machinery, large number of workers, large factory, 24 hour's operation.	Iron and steel, oil refineries,
		(ii) Small Scale Industries	Small investment, small factory, few factory workers	cycles, electrical goods industry
		(iii) Rural and Cottage Industries	owned by family members, small machine at homes	Jewellery, handicrafts, handlooms, art work
5.	Weight of Raw Materials and Finished Products	(i) Heavy Industries	Both raw material and finished products are heavy and bulky, high transport cost	Iron and steel, BHEL (Hardwar): heavy electrical like generator.
		(ii) Light Industries	Both raw material and finished products are light in weight, low transport cost.	Watches, readymade garments, toys, fountain pens.

INTEXT QUESTIONS 19.3

1. What are the five criteria based on which industries can be classified?
2. Cosmetics is a ________________________ industry.
3. Industries owned and managed by Government are known as _________________ and those owned and managed by an individual or a group as a company are known as ____________________.

LET'S DO

Have you ever thought in what kind of industry the paapad or market pickles are manufactures in, small-scale industry or large-scale industry? Try to find out.

19.4 AGRO-BASED INDUSTRIES

As you have read earlier that like manufacturing or industry, agriculture is also an integral sector of the Indian economy. Both these sectors complement and supplement each other in boosting the national economy. Agricultural products are used in industries as raw materials to produce various goods whereas, industries provide agricultural tools and fertilisers, etc. for growing crops and for making processed items like jams and jellies, etc.

Amul

The story of Amul started more than 70 yrs. ago in a small town of Gujarat, India. The exploitative trade practices followed by the local trade cartel triggered off the cooperative movement. When people approached Shri Sardar Vallabhbhai Patel for a solution, he advised them to get rid of the middlemen and form their own co-operative for procurement, processing and marketing. With the inspiration of Sardar Patel and under the guidance of Morarji Desai and Tribhuvandas Patel, farmers formed their own cooperative in 1946. This was known as Kaira District Co-operative Milk Producers Union Ltd. It began with just two village dairy co-operative societies and 247 lites of milk. Now this dairy is known as Amul Dairy. Dr. Verghese Kurien was appointed as the Chairman of the co-operative.

The approach of Amul Dairy formed the basis of the National dairy Development Policy.

Source - https://www.amul.com/m/about-us

Like many other industries in India, there are two important agro-based industries that play a major role in the Indian economy. These are: Sugar and Cotton industries. Let us try to know more about these industries.

a. **Sugar industry -** Sweet dishes and chocolates are loved by all. Festivals are awaited by all of us so that we can relish sweets. Even milk, tea and coffee taken every day have sugar in it. Gur is also used in many households everyday as a sweetener. It also holds a special place in some of our festivals and religious rituals. Do you know, India stands second in the world in producing sugar and first place in the production of gur and khandsari. The raw material used in the sugar industry is sugarcane which is a bulky raw material. The amount of sucrose present in sugarcane gets reduced during transportation. Therefore, the sugar mills to churn out sugarcane juice from sugarcane and to produce sugar, gur and khandsari are generally located near the sugarcane fields or where the raw material is produced.

DO YOU KNOW?

During Makar Sankranti also known as, Pongal, Suggi Habba, Pongal, Uttarayan, Maghi and Bihu in different parts of India gur is used as one of the important ingredients for performing rituals. For example, in parts of East India yoghurt, chuda or poha is eaten with gur; during Ellu Birodhu in Karnataka bella or gur is used; Chikkis and laddoos made of til and gur are prepared all over North India, appalu is prepared in Andhra Pradesh and Telangana; Gulachipoli/puranpoliis prepared in Maharashtra and likewise.

Distribution- Have you ever visited a place where you have seen sugarcane fields? Can you recall and list down some of the places and states producing sugarcane? Now, look at the map given below showing distribution of sugar mills in India.

Fig. 19.2 Sugarcane

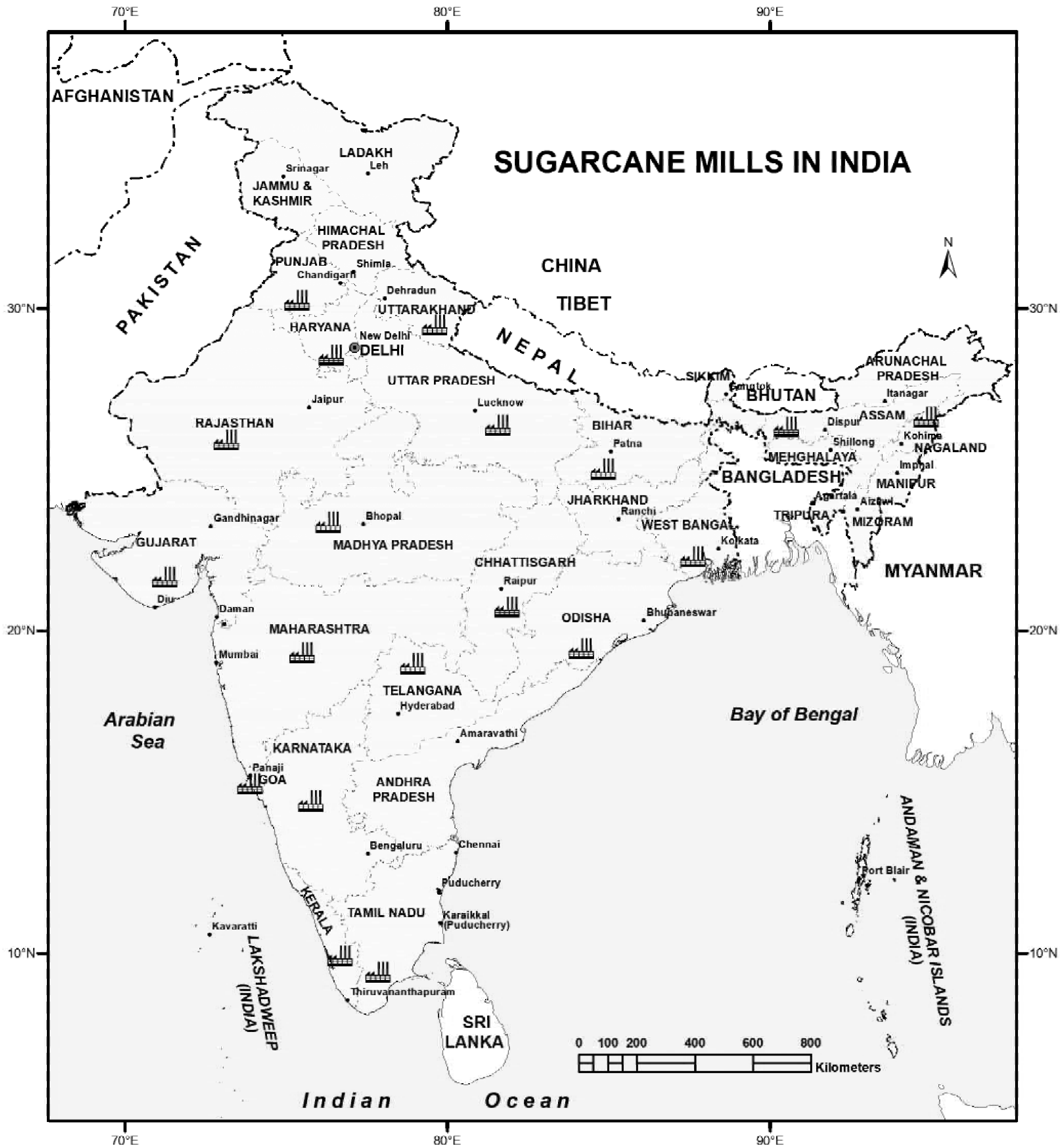


Fig. 19.3: Distribution of Sugarcane mills in India

Factors responsible for distribution of sugar industry- As you know sugarcane is one of the important cash crops of India. The production of sugarcane has grown dramatically over the past several years. Sugarcane growing area in India may be broadly classified into two agro-climate regions: i) Sub-Tropical region comprising Uttar Pradesh, Bihar, Punjab and Haryana ii) Tropical region comprising Maharashtra, Gujarat, Tamil Nadu, Andhra Pradesh and Karnataka. Since sugarcane is a perishable item and the sucrose content is lost after sometime, therefore, sugar industries are located near to the sources of sugarcane fields in these regions.

Sugarcane industry was initially set up in the subtropical region of India. Till 1950's - 90% of area under sugarcane was in this region. With the commencement of the planning process, sugarcane found its route in tropical areas. Sugarcane being a tropical crop finds favourable agro-climatic conditions for its growth in this region - i.e. higher yields. Growth after 1950's was more in this region and by 1994-95 the subtropical region sugarcane area was 65% and cane production was 55% of the total cane produced.

The recent trends show that the tropical region is already developed and reached near saturation level. This is because the biggest state in this region-Maharashtra faces an acute problem of lack of water which affects cultivation of sugarcane. The subtropical belt, with fertile land, high water table and irrigation, appears to be the area for future growth.

Production- Sugar industry usually experiences over-production for 3-4 years followed by low production for a year or two. The sugarcane crop is sturdy and can withstand fluctuations in weather. Compared to many other crops, cane farmers have to put in little effort by way of inputs and human hours in growing their crops and therefore, it is often considered the 'lazy crop'.

DO YOU KNOW?

Did you know, the history of sugar and sugarcane in India goes back to several thousand years B.C? Old scriptures of India contain some legends depicting the origin of sugarcane. It is believed that sometimes in 4/6th century art of sugar making was discovered but, the method of producing sugar was crude. Cane was cut in pieces, crushed under heavy weight and the juice thus obtained was boiled and stirred, till it turned solids. Solids of uneven shape and size were called Sarkaran, a Sanskrit term of 'gravel'. Modern word 'sugar' is derived from the word Sarkara. Thus, it could be rightly said that India has been the original home for sugarcane as well as sugar manufacture.

Before the mid 1920s, India imported sugar to fulfil its demands. The number of sugar mills sprang up in UP and Bihar during the 1920s. By 1930-31, there were 29 sugar factories producing 1,00,000 MT of sugar. Sugar industry found adverse competition from Japanese sugar which was ruling the Indian market. Details of the number of sugar mills, production of sugarcane, etc. from 2015-16 to 2020-21 can be seen in the following table.

Table- 19.2: Details of number of sugar mills, production of sugarcane, etc. from 2015-16 to 2020-21

Particulars	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
No. of factories in operation	526	493	525	532	461	506
Cane average (000 HA)	5284	4945	5042	5502	4841	5288
Sugarcane Production (Lakh tons)	3369	3036	4110	4142	3440	4018
Molasses Production (000 tons)	10873	9026	14063	13788	11526	14906

According to the Indian Sugar Mills Association (ISMA), the opening stock at the start of the 2021-22 sugar season from October was anticipated to be nearly 8.7 million tonnes.

b. **Cotton industry or Cotton textile industry:** Cotton industry has been an important part of Indian history. We all know Mahatma Gandhi used to spin cotton yarn out of Charkha. Even before independence cotton was produced through hand spinning tools and through handloom. Later, power-looms came which gave a setback to the existing hand spinning and handloom techniques. Many Hindi movies have shown the difficult situations through which the former went through. Do you know where the first mill was established in India? It was in Mumbai in 1854. This was because the cotton growing belt was located in Gujarat and Maharashtra.

Distribution-You must have read about the requirements for growing cotton in the module on agriculture. Can you recall a few of them? Apart from the climatic and soil conditions required for growing cotton crops, this region of India had a market, transportation facilities including port facility and labour supply, etc. All these conditions favoured establishment of the cotton textile industry in this region.

Cotton industry is closely linked with agriculture as it is an agro-based industry using cotton as a raw material. It is also a good absorber of labour in the manner that from picking of cotton pods from the plant to ginning and weaving, etc. requires labour. The industry also supports other industries like, chemicals, dyes, packaging material, machines and fashion.

Presently, cotton textile industries are located mostly in western India: Gujarat, Maharashtra;

western part of Madhya Pradesh; Tamil Nadu, West Bengal and Uttar Pradesh. By looking at the map try to recall and relate the climatic and other requirements of growing cotton and establishing the cotton industry. The production of yarns etc. is done in a large number of small units catering to local markets as well as in large factories with modern equipment.

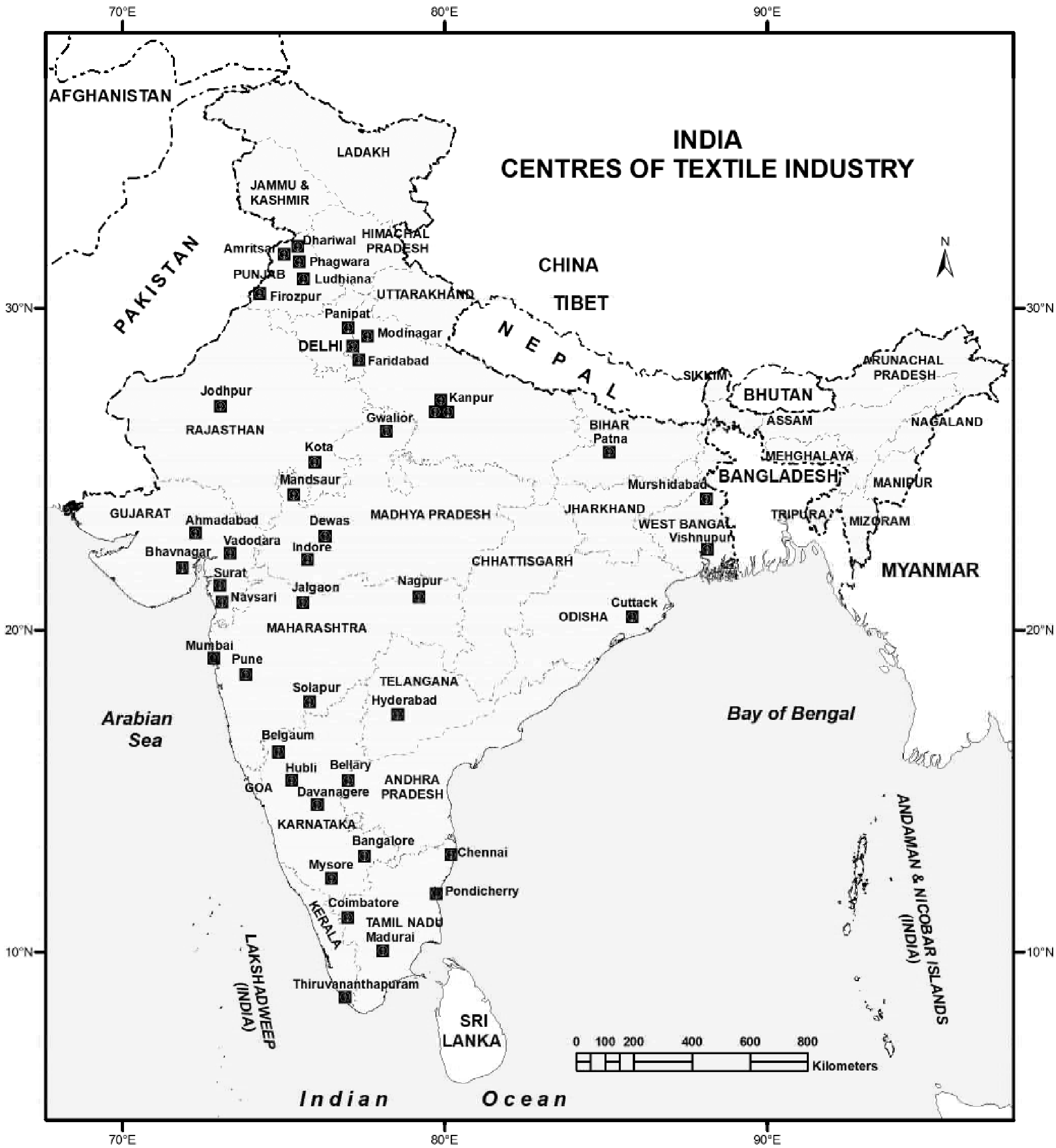


Fig. 19.4: Centre of textile industries in India

Factors responsible for distribution- Maharashtra is the leading producer of cotton textile in the country. Mumbai has been the major centre of textile mills. About a half of the Cotton textile mills are still located in Mumbai alone. Because of this reason, it is also called as 'Cottonpolis' of India. Sholapur, Kolhapur, Nagpur, Pune, Aurangabad and Jalgaon are other important centres in Maharashtra. Can you think of the reason why so many cotton textile mills are located in this region? The following are the factors for the localization of textile industry in Ahmedabad- Mumbai - Pune region.

A **Raw material -** A large amount of cotton is grown in this belt.

B **Capital -** Mumbai, Ahmedabad and Pure are the places where capital for investment is easily available.

C **Means of transport -** This region is well connected with the rest of India by roads and railways. This facilitates transportation of finished products.

D **Accessibility to the market -** Maharashtra and Gujarat have a large market to sell textile products. Developed means of transportation help in movement of textile products to other market centres and to foreign markets. Nowadays the market has become a dominant factor in determining the location of the cotton textile industry.

E **Nearness to ports -** Mumbai port facilitates the import of machinery and good quality of cotton from abroad and export of the finished products.

F **Cheap labour -** Cheap and skilled labour is easily available to this region from the surrounding areas.

G **Power supply-** Cheap and sufficient power is also available here.

Production- India exports products of the cotton industry to various countries. For example, it exports yarns to Japan, U.S.A., U.K., Russia, France, East European countries, Nepal, Singapore, Sri Lanka and African countries as well.Though significant improvement has been done in quality of yarns produced in India but, the need is to integrate the smaller units to the larger ones.

India produced 4,182 million kg.s of cotton yarn during 2018-19. Production of cotton yarn in the last few years can be seen in table.

Table- 19.3 Production of cotton yarn from 2015-16 to 2018-19

Year	Production (in million kg)
2015-16	4138
2016-17	4055

2017-18	4064
2018-19	4182

Source: http://texmin.nic.in

INTEXT QUESTIONS 19.4

1. What are the factors responsible for the location of the cotton textile industry?
2. Why are sugar industries found mostly in humid areas?

19.5 MINERAL-BASED INDUSTRIES

Apart from agro- based industries there are industries that use minerals as raw materials. These are called mineral-based industries.Can you think of any such industry?

Iron and steel industry- Iron and steel is also known as the basic industry. This is because all other industries depend on it and the products of this industry form the basis of these industries. Steel is used in manufacturing of various industrial goods, equipment, machinery, automobiles and scientific equipment, etc.

Iron and steel industry is also known as heavy industry as the raw materials used and the finished goods manufactured are heavy and bulky. The raw materials used in the iron and steel industry are iron ore, coking coal, limestone and manganese. Can you make out these characteristics of the iron and steel industry where it should be located? Find out a clue to the answer in the given box.

Distribution- The first modern steel plant in India was set up at Kulti, Bengal in 1870 and production began in 1874. Today, there are 10 major steel plants in India.

Finished products of Iron and steel industry need efficient transport network for their distribution in markets so that, consumers can use it.

By looking at the map can you identify why the steel plants are located in particular regions? Chotanagpur region has the maximum concentration of iron and steel industries in India. Make a list of the factors that are available for setting up these plants at their particular locations.

Steel industry was delicensed in 1991 and de-controlled in 1992. Steel Authority of India Ltd. (SAIL) is the authority through which public sector undertakings market their steel.

Surrounded by the existing large mother plants of Iron and Steel, a National Investment and Manufacturing Zone (NIMZ) is being developed at Kalinganagar, Odisha. Spread over 160 sq km, the zone is envisaged to become a self contained ecosystem along with residential, commercial and social amenities and will enable the potential investors for setting up value added downstream facilities. It is expected that the Kalinganagar industrial complex in Odisha can contribute 20 percent of the country's targeted 300 million tons steel capacity by 2030.

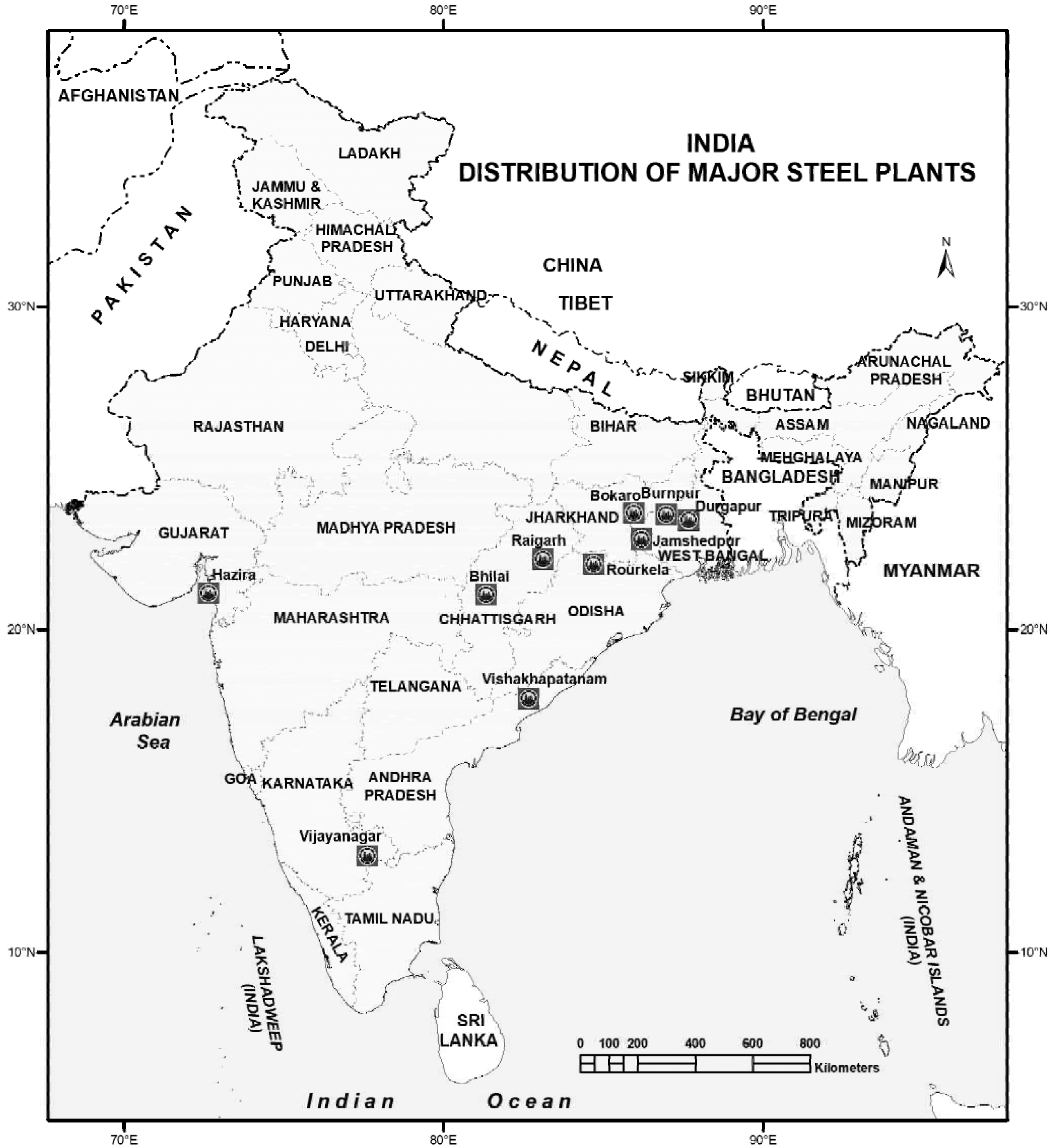


Fig 19.5: Distribution of major steel plants in India

Production- India is one of the largest producers of steel in the world and with 101.28 million tons of finished steel it ranked second in the world after China in the year 2018-19 following Table gives a brief idea of production in the iron and steel industry of India.

Table - 19.4: Production of various components of Iron and Steel Industry in India during 2018-19

S. No.	Product	Production
1	Finished steel (alloy/stainless + non alloy)	101.287 million tonnes (mt)
2	Pig Iron	6.414 mt
3	Sponge Iron	34.71 mt

Source : https://stccl.gov.in/ovcriow-steel-sector, Ministriy of Steel, govt. of India

In spite of the fact that India produces large amounts of iron and steel, it is also an importer of it. Inadequate and costly supply of coking coal, lower productivity of labour, poor infrastructure and irregular supply of adequate power are some of the factors responsible for it. Investment by the public and private sector has given a boost to the industry in the recent past but more research and development is needed. After knowing about the major agro-based industries and Iron and Steel industry, let us now try to assess our understanding with the help of a few questions.

INTEXT QUESTIONS 19.5

1. Why is iron and steel considered a basic industry? Choose the correct answer from the given options.
   i. It uses basic things
   ii. It was the first industry that was set up in India
   iii. All other industries depend on it and the products of this industry form basis to these industries
2. ____________________ has the maximum concentration of iron and steel industries in India.
3. India is ____________________ producers of steel in the world.

19.6 INDUSTRIAL REGIONS AND COMPLEXES

Now you know about various factors determining location of industries and about few important industries of India. Let us learn about various industrial regions and complexes of India.

Industries in India are not evenly located rather they are concentrated in particular regions forming complexes. Can you think of why? Yes, they tend to concentrate because of favourable conditions such as availability of raw material, market, labour, power supply and various other infrastructures at those places. Certain indicators that are used to recognize any industrial complex are the following:

i. Number of industrial units

ii. Number of industrial workers

iii. Amount of power being used for industrial purposes

iv. Total industrial output

v. Value added by manufacturing

Based on these indicators any concentration of industrial units is called an industrial complex. The regions having concentration of industries or complexes are known as industrial regions. India has several major and minor industrial regions and complexes as given in Table - 19.4. As it can be seen in the map, the major industrial regions are located mainly in the areas with rich availability of mineral resources, cheap labour supply, market and other infrastructures.

Table-19.5: Classification of industrial regions of India

S. No.	Classification of industrial regions	Regions
1	Major (8 regions)	1. Mumbai-Pune region 2. Hugli region 3. Bengaluru-Tamil Nadu region 4. Gujarat region 5. Chotanagpur region 6. Vishakhapatnam-Guntur region 7. Gurugram-Delhi-Meerut region 8. Kollam-Thiruvananthapuram region
2	Minor (13 regions)	1. Ambala-Amritsar region 2. Saharanpur-Muzaffarnagar-Bijnor region 3. Indore-Dewas-Ujjain region 4. Jaipur-Ajmer region 5. Kolhapur-South Kannada region 6. Northern Malabar region 7. Middle Malabar region 8. Adilabad-Nizamabad region 9. Allahabad-Varanasi-Mirzapur region 10. Bhojpur-Munger region 11. Durg-Raipur region 12. Bilaspur-Korba region 13. Brahmaputra Valley region

Notes

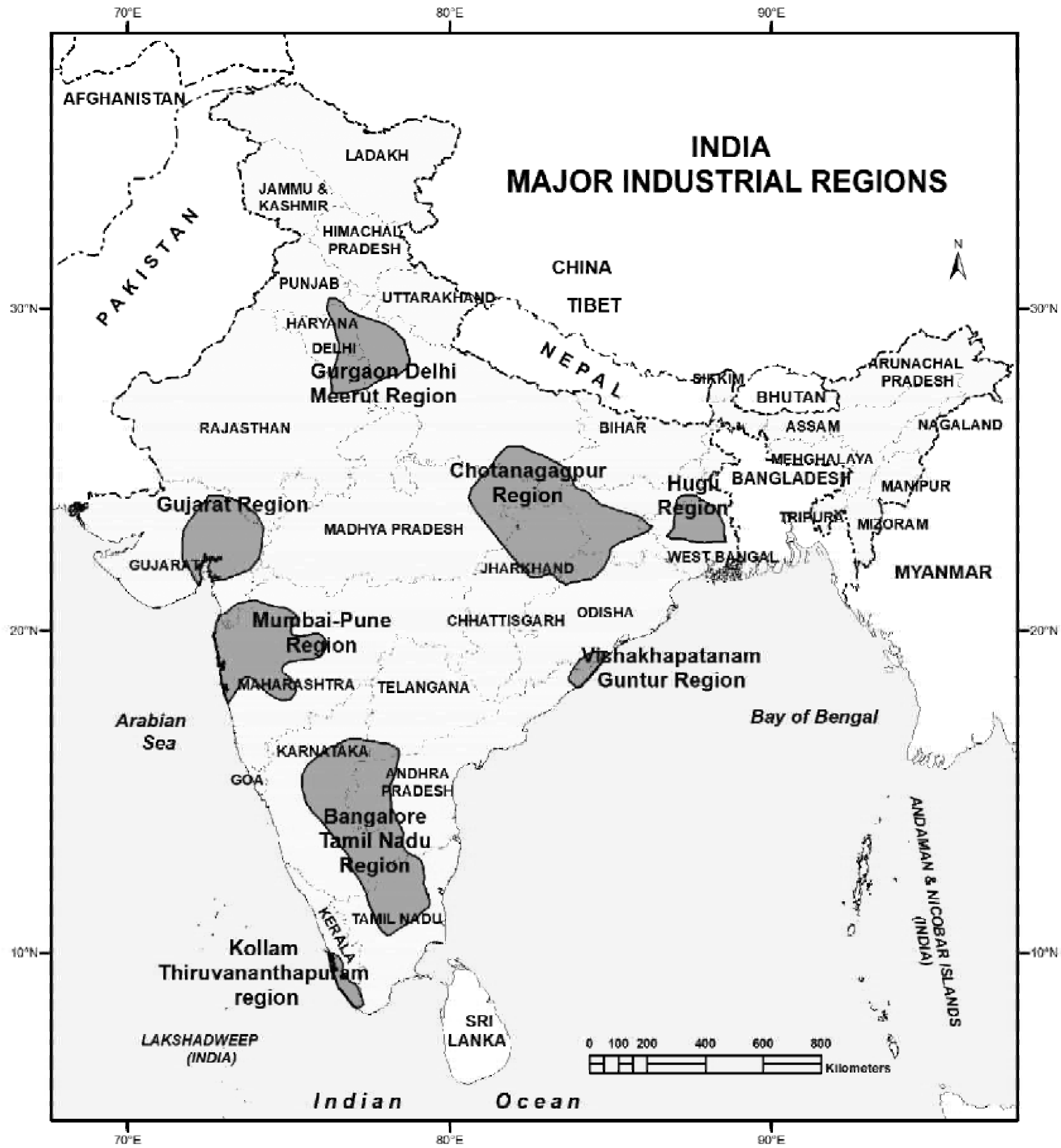


Fig. 19.5 Major industrial regions of India

In order to know how much you have understood, let us try to answer a few questions.

INTEXT QUESTIONS 19.6

1. Industries concentrated in particular regions are known as ____________________.
2. Why are several industrial units located at one place?
3. How many major and minor industrial regions are present in India? Name the major industrial regions.

Notes

4. Can you identify one the most important industrial regions of India?

19.7 GOVERNMENT INITIATIVES

By now, it is clear that industries play an important role in the national economy of any country. Therefore, it is important for any government to Since independence of India, there have been several initiatives taken up by the government of India for growth of industries and to enhance industrial production especially from the Second Five Year Plan (1956-61). In the recent past also the Government of India has taken several initiatives in order to promote a healthy environment for the growth of the manufacturing sector in the country.

Let's discucc Some of these initiatives.

Skill India campaign was launched by the Prime Minister of India, on 15 July, 2015 to train over 40 crore people in India in different skills by the year 2022. Various initiatives under this campaign are:

- National Skill Development Mission
- National Policy for Skill Development and Entrepreneurship, 2015
- Pradhan Mantri Kaushal Vikas Yojana (PMKVY)
- Skill Loan scheme
- Rural India Skill

For an example, a brief of Pradhan Mantri Kaushal Vikas Yojana (PMKVY) has been discussed here. PMKVYis the flagship scheme of the Ministry of Skill Development & Entrepreneurship (MSDE) implemented by National Skill Development Corporation. The objective of this Skill Certification Scheme is to enable a large number of Indian youth to take up industry-relevant skill training that will help them in securing a better livelihood. During PMKVY 1.0, 19.85 lakh candidates were trained, out of which 2.62 lakh (13.23 per cent) got placements. PMKVY 2.0 (2016-2020) was launched in October 2016 and by June 2019 about 52.12 lakh candidates have received training and about 57% of them reported placement

DO YOU KNOW?

National Manufacturing Policy was launched in 2011, which aims to create to 100 million jobs in the manufacturing sector and increase the share of manufacturing in GDP to 25 per cent by 2022.

Startup India is another flagship initiative of the Government of India which was launched in

2016, to build a strong ecosystem that is conducive for the growth of startup businesses, to drive sustainable economic growth and generate large-scale employment opportunities. This initiative aims to empower startups to grow through innovation and design.It aims to contribute to the vision of transforming India into a country of job creators instead of job seekers.

Several other measures at the policy level have been taken by the government in recent times in order to support and to have a robust growth of the manufacturing sector of India.

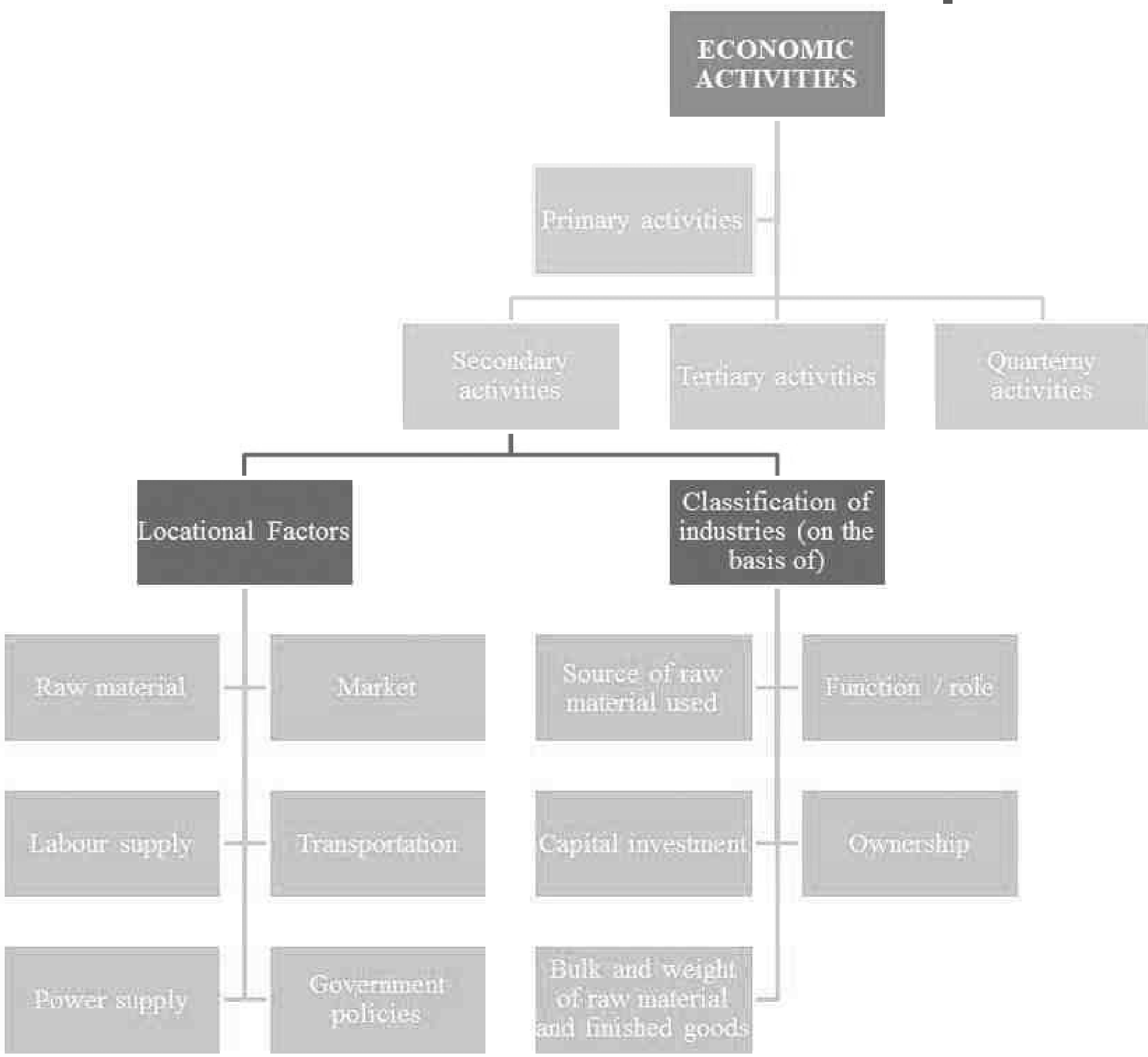
LET'S DO

Try to identify two startup industries of your state. Try to find out the factors behind these startups coming up in your state.

INTEXT QUESTIONS 19.7

1. Why has the government taken up steps to boost industries in India? Choose the correct answer.
   - i. For growth of industries
   - ii. To enhance industrial production
   - iii. Both i) and ii)
   - iv. To counter agricultural growth
2. The first major effort done by the government to support industries in India was during___________________.
3. Name the two major recent government initiatives in India in order to support industrial growth.
4. What is the idea behind the launch of the Skill India programme?

WHAT YOU HAVE LEARNT



Notes

TERMINAL QUESTIONS

1. If agriculture and related activities are classified under primary activities, what are secondary activities classified under?
2. In what manner industries contribute to the national economy of India?
3. Match the following:

Aluminium smelting	Agro-based industry
Amul dairy industry	Consumer industry
Sugar industry	Small-scale industry
Soap industry	Cooperative industry
Paapad making industry	Mineral-based industry Heavy industry

4. Mobile making industry can be classified under which type of industry? What are the characteristics of these industries?
5. Certain regions of India have a concentration of industrial units. Identify the reasons behind this spatial pattern.
6. Location of specific industries has specific factors responsible for their location. What are these? Give examples in support of your answer.

ANSWERS TO INTEXT QUESTIONS

19.1

1. Mining & quarrying, manufacturing (Registered & Unregistered), gas, electricity, construction, and water supply
2. 12 percent
3. (iii)

Notes

19.2

1. Location of industries
2. Near to the source of raw material
3. Agglomeration economies
4. Profit maximisation

19.3

1. Source of raw material, ownership, function, size of industry, weight of raw material and finished products. (Any five)
2. Consumer goods industry
3. Public sector and private sector

19.4

1. Raw material, Capital, Means of transport, Accessibility to the market, Nearness to ports, Cheap labour and Power supply
2. As sugarcane is produced in humid areas

19.5

1. (iii)
2. Chotanagpur region
3. One of the largest

19.6

1. Industrial complexes
2. They benefit from each other
3. 8 major and 13 minor
4. Mumbai-Pune region, Hugli region, Bengaluru-Tamil Nadu region, Gujarat region, Chotanagpur region, Vishakhapatnam-Guntur region, Gurugram-Delhi-Meerut region, Kollam-Thiruvananthapuram region (Any of these)

19.7

1. (iii)
2. Second Five Year Plan
3. Skill India campaign, Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Startup India (Any two)
4. To train over 40 crore people in India in different skills by the year 2022

20

FOREIGN DIRECT INVESTMENT (FDI), TRANSPORT, COMMUNICATION AND TRADE

In previous lessons, you have learnt about the richness of resources in our country and its agricultural and industrial development. The availability of such resources and their optimum use makes our standard of living high. The growth and development of a country is also impacted by the availability of financial resources, knowledge, technology and skills. Optimum availability of these things provide an appropriate atmosphere to grow industry resulting in the development of a country. Foreign Direct Investment (FDI) provides these essential elements of industry. Transport, communication and trade are an important aspect of the development of a country. They facilitate agriculture and industry to grow to their fullest potential. Transport carries the people and goods to different places. Communication is the process of receiving and sending messages between two persons or agencies located at different places. Trade involves exchange of goods among people living in different regions or countries of the world. It plays a vital role in accelerating the progress of agriculture and industry of a country.

In this lesson, you will study the significance of the FDI, importance of transport and communication and their distribution. In trade you will know its volume and direction.

OUTCOMES

After studying this lesson, learner:

- explains the role of FDI in the development over the years;
- identifies the different modes of transport and their development;
- traces out the role of ICT in development of India and
- describes the changing patterns of import and export.

20.1 MEANING AND SIGNIFICANCE OF FOREIGN DIRECT INVESTMENT (FDI)

According to the IMF, 'Foreign Direct Investment (FDI) is the category of international investment that reflects the objective of obtaining a lasting interest by a resident entity in one economy in an enterprise resident in another economy'. The 'Reserve Bank of India (RBI)' has also defined it as 'the investment through capital instruments by a person resident outside India (a) in an unlisted Indian company; or (b) in 10 percent or more of the post issue paid-up equity capital on a fully diluted basis of a listed Indian company'. It is an investment made by an individual or an organisation of a country into a business established in another country. This investment doesn't include money only but also includes new knowledge, technology, skills and employment. For the growth of a country it is important for the continuous growth of businesses and industries. An industry requires optimum finance for availing latest technologies, raw materials, equipment, human resources and infrastructure. In the lack of money, it becomes difficult for an industry or business to survive for a longer period. Sometimes, an industry may not be able to receive finances locally. In such cases, money received through FDI may help to provide optimum money, technology and infrastructure to innovate and grow. Often it is perceived that FDI is a channel of progress and development because it provides financial resources and technology.

The liberalisation in FDI by the Government of India was initiated during 1980-91. It began with the Industrial Policy Statements of 1980 and 1982. Later the Technology Policy Statement in 1983 also continued the process. During this period considerable degrees of trade liberalisation were also experienced. This was in the area of reductions in tariffs and the shifting of many import items under open general licence (OGL) category. However, in the beginning of 1990s, the FDI was accepted and promoted as a preferred way for financial resources over loans and other types of finance as the Foreign direct investment (FDI) in India was introduced in 1991 under the Foreign Exchange Management Act (FEMA). FDI was considered as an effective tool to bring new foreign technology which was still not available in India. Later multiple changes have been made in norms and procedures to regulate it and make it easier for doing business. Today, India is considered as an important destination for foreign direct investment.

Routes of FDI in India

There are two common routes for Foreign Direct Investments in India:

1. **The automatic route**

   Under this route an Indian company or Non-Resident does not need any prior permission from the RBI or the Government of India for investment from other countries in India. Many sectors are permitted to get 100 percent investment through the automatic route category. Such areas are agriculture and animal husbandry, airports, automobiles, construction companies, food processing etc.

2. The government route

Under this route the FDI is received after prior permission from the Government of India only. The companies interested to invest in India have to fill and submit an application form through the Foreign Investment Facilitation portal. This portal enables them to obtain single-window clearance.

Sector Specific Conditions on FDI

The FDI is governed with certain norms to monitor and regulate it. With these objectives some sectors have been identified where FDI is permitted or restricted. These sectors are:

Prohibited Sectors:

- Lottery Business including Government/private lottery, online lotteries, etc.,
- Gambling and Betting including casinos etc.,
- Chit funds,
- Nidhi company,
- Trading in Transferable Development Rights (TDRs),
- Real Estate Business or Construction of Farm Houses 'Real estate business' shall not include development of townships, construction of residential /commercial premises, roads or bridges and Real Estate Investment Trusts (REITs) registered and regulated under the SEBI (REITs) Regulations 2014,
- Manufacturing of cigars, cheroots, cigarillos and cigarettes, of tobacco or of tobacco substitutes,
- Activities/sectors not open to private sector investment e.g.(I) Atomic Energy and (II) Railway operations (other than permitted activities).

Permitted Sectors:

- Agriculture
- Agriculture and Animal Husbandry
- Plantation sector
- Mining and Petroleum and Natural Gas
- Manufacturing
- Manufacturing
- Defence
- Service sector

- Broadcasting
- Print media
- Civil aviation
- Construction development: townships, housing, built-up infrastructure
- Industrial parks
- Satellites- establishment and operation
- Telecom services
- Trading
- Railway infrastructure
- Financial Services
- Asset reconstruction companies
- Banking- private sec
- Banking- public sector
- Credit information companies (cic)
- Infrastructure company in the securities market
- Insurance
- Pension sector
- Power exchanges
- White label atm operations
- Other financial services
- Others
- Pharmaceuticals

Regional Pattern

India has witnessed a positive inflow of FDI in recent years. It attracted annual FDI inflows of approx $ 84,835 million in Financial Year 2021-22. It is estimated that the Total FDI inflows in the country in the last 22 years (April 2000 - March 2022) were $ 847 billion.

It is also observed that there are regional variations in receiving the FDI from different countries. Singapore with 27.01% of the total FDI topped the list of countries investing in India for financial year 2021-22. It was followed by the USA (17.94%), Mauritius (15.98%), the Netherlands (7.86%) and Switzerland (7.31%). There are also variations in receiving FDI in different sectors. If we talk about the major sector receiving the FDI for financial year 2021-22, the Computer Software & Hardware sector has received the highest FDI with 24.60%. Next was Services Sector (Fin., Banking, Insurance, Non Fin/Business, Outsourcing, R&D, Courier, Tech. Testing and Analysis, Other) which received 12.13%. Other important sectors were Automobile Industry (11.89%), Trading 7.72% and Construction (Infrastructure) Activities (5.52%).

INTEXT QUESTIONS 20.1

1. The term FDI refers to-
   a. Foreign Digital Investment
   b. Foreign Direct Investment
   c. Force Direct Investment
   d. Free Digital Investment
2. Which Country has maximum shares in FDI?
   a. USA
   b. UAE
   c. Singapore
   d. Switzerland

20.2 TRANSPORTS IN INDIA

India is a vast and diverse country with long distances. It has climatic as well as physiographic diversity. A dense and efficient network of transport is essential to promote social cohesion, accelerate economic prosperity and ensure security and territorial integrity. Transport consists of three different modes - land, water and air. Each one of them has some advantages and disadvantages. They all compete with one another. More importantly they complement each other and in the process constitute a single integrated network.

While air transport is of recent origin, the other two have been as old as the nomadic man himself. The land transport comprises road and rail transport. Of the two, rail transport is relatively new. The road transport on the other hand is very handy and convenient to carry goods and passengers over relatively short distances. Water transport for passengers is now no more attractive; but it is an ideal means of transport to carry heavy and bulky goods along navigable rivers and across the oceans of the world. Air transport has become tremendously popular for people who are called upon to urgently visit various parts of the world at a very short notice.

Transport system links areas of production with those of consumption. It facilitates the movement of goods, services and people at local, regional, national and international levels.

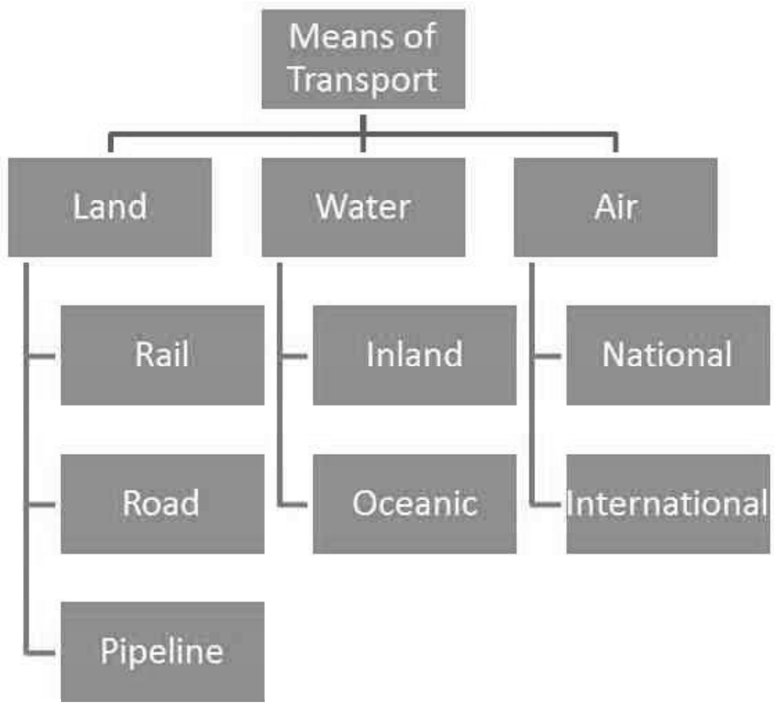


Fig. 20.1 Types of Transport

20.3 RAIL TRANSPORT

The Indian railway network is the fourth largest in the world after Russia, the U.S.A. and Canada. In a vast country like India, it has brought the people of the farthest corners of the country closer to one another. Railways are ideal for carrying goods and people over long distances. It employs the largest number of persons among the Central Government departments.

The first train steamed off in the country in 1853 from Mumbai to Thana, covering a distance of 34 km. During these years, Indian railways have grown into a vast network. The following table may give you an idea about the growth of the railway system during the post-independence era.

Table 20.1 Indian Railway- at a glance

Description	**1950-51**	**2019-20**
Total routes (in kilometre)	53,596	67,956

Notes

Electrified routes (in kilometre)	388	39,329
Number of Stations	5,976	7,325
Number of persons originating (in millions)	1,284	8,086
Passengers kilometre# (in millions)	66,517	10,50,738
Total Freight Traffic tonnes km.* originating (in millions)	93	1,212.22
Number of Steam locomotives	8,120	39
Number of Diesel locomotives	17	5,898
Number of Electric locomotives	72	6,792

Source-

- Summary sheet - Annual Report 2021-22, indianrailways.gov.in, Ministry of Railway, Govt. of India
- India, 2021, A reference annual

1 passenger-km = when one passenger travels one km.

*1 tonne km = when 1 tonne of goods is carried over one km.

You can observe from the above table that Indian railways has made tremendous progress over 75 years. In the first place the total route length has increased very slightly. However, the routes are not totally electrified but it is continuously increasing. Approximately 60% route lengths are electrified. It means over this track the traffic is far cleaner and faster. Similarly, the route length has increased only marginally but the passenger- km traffic has increased multiple times. Even the goods traffic in terms of tonne-km has increased by well over ten times. This also speaks of qualitative increase in the efficiency of the railways. This has become possible by electrification of part of the route and dieselisation of the track.

The railways have undertaken to convert metre gauge railway tracks into broad-gauge (1.68 metres) enhancing the capacity of railways to carry more goods and more passengers with an increased speed. Indian Railways also run several fast trains. Earlier there were passenger and express or mail trains, the only two categories. Now there are Super fast Expresses, Rajdhani Expresses, Shatabdi Expresses, Vande bharata, Hamsafar, Duronto, Jan shatabdi, Garib rath, Tejas, Gatiman, Double decker etc.

Let us have a glance at the regions of dense, moderate and sparse railway networks.

The Regions of Dense Network

- The northern plains and eastern coastal areas possess a dense network of railways. The level land, fertile soils, dense population and spread of industries are the reasons for this dense railway network.
- The plains of Gujarat and Saurashtra, Central Tamil Nadu and Chota Nagpur Plateau are the other regions. These regions have well developed industries.

Regions of Moderate Railway Network

- The whole of the peninsular region except Tamil Nadu and Chhotanagpur has a moderate network. The hilly and plateau terrain provides unfavourable conditions for laying railway lines.
- There are long trunk routes which connect the important industrial cities and ports. The railway lines either pass through the large gaps between hills or through the tunnels.

Regions of Sparse Railway Network

- The Himalayan mountain region, comprising Jammu and Kashmir, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh have hardly a line here and there. The hilly terrain, rugged topography are the main reasons responsible for the very sparse network. However, now efforts are being made to develop or extend the rail network in these hilly terrain.
- The North eastern region also has a sparse railway network. All hilly states in this region are almost without a railway line. The hilly terrain, thick forest cover, heavy rainfall, low level of economy and sparse population are the main factors for the absence of railway lines.
- Desert region of western Rajasthan also has a sparse network of railways.

20.4 ROAD TRANSPORT

Road transport is one of the most ancient means of transport. It plays a significant role in carrying goods and people in all parts of the country. Particularly, the rural economy depends upon road transport. The importance of roads has increased with the advent of auto vehicles. The relative importance of roads is much more than that of railways.

Importance of road transport

- Railway transport is limited to the railway heads while the roads provide door to door services.

- Roads can negotiate higher gradients of slopes and can traverse the mountainous regions. Construction of railway lines is difficult and expensive in hilly regions.
- Road transport is flexible, reliable and quick,
- It is more suitable for carrying perishable goods like milk, fruit and vegetables.
- Its cost of construction and maintenance is far less than that of the railway.
- For short distance journeys, roads are more suitable. They supplement the railways by linking the interior areas with railway heads.
- Roads are ideal for the promotion of tourism in the country.

Surfaced and Unsurfaced Roads

Surfaced roads are the metalled roads and are made up of cement, concrete or bitumen. These are all weather roads. The total route length of roads in India till March, 2019 was 63,71,847 km. It included a surface road of 41,16,390 km. Unsurfaced roads are 'Kutcha roads made up of earth. They provide tracks for the bullock carts and link the rural areas with the urban centres. They play an important role in the development of the rural economy. During the rainy season these roads are of little use. The total length of these roads was 22,55,457 km. till march 2019.

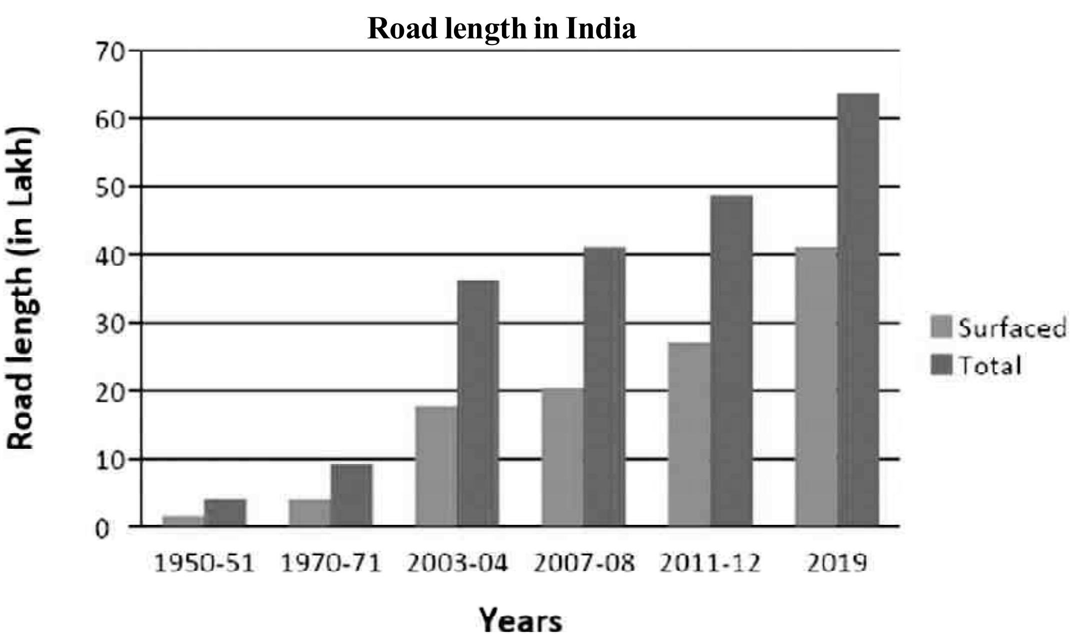


Fig. 20.2 Development of Road length in India

Development of Road Transport

There has been considerable development in the road length after independence. Route length of surfaced roads has increased from 1.571akh km. (1950-51) to 41.16 lakh km. in 2019. The length of unsurfaced roads during the same period has increased from 2.42 lakh km. to over 22.55 lakh km.

Not only has the route length of roads has increased but the number of commercial heavy vehicles, particularly the buses and trucks has also shown a tremendous increase since Independence. Vast increase in the road traffic has posed serious problems in handling it smoothly. The number of road accidents has also shown a steady increase. With increased road traffic, pollution of air has been on the rise.

Geographical Distribution of Roads

Road density refers to the average length of roads per 100 square km. area. The road density in India is increasing continuously but still comparatively low to the developed countries. High concentration of road network is found in the Northern Plains because of level land, fertile soil and high density of population. In these parts, unsurfaced roads are more common than surfaced roads. Peninsular plateau has a higher proportion of metalled roads because of the easy availability of road building materials. In the North eastern states; the road network is very sparse due to hilly terrain, thick forest cover and heavy rains causing frequent floods. Sparse population is also another important reason.

The pattern of road density is also uneven in the country. Tamil Nadu, Kerala, Punjab and Haryana have higher road density. It is because of the growth of agriculture, manufacturing industries, urbanisation and dense population. Karnataka and Maharashtra also fall in this category, the reason behind this is concentration of industries and urbanisation.

The states of Karnataka, Maharashtra, Andhra Pradesh and Telangana have moderate density of roads. In Rajasthan, Madhya Pradesh, Bihar, Jharkhand and Chhattisgarh, the density of roads is comparatively low.

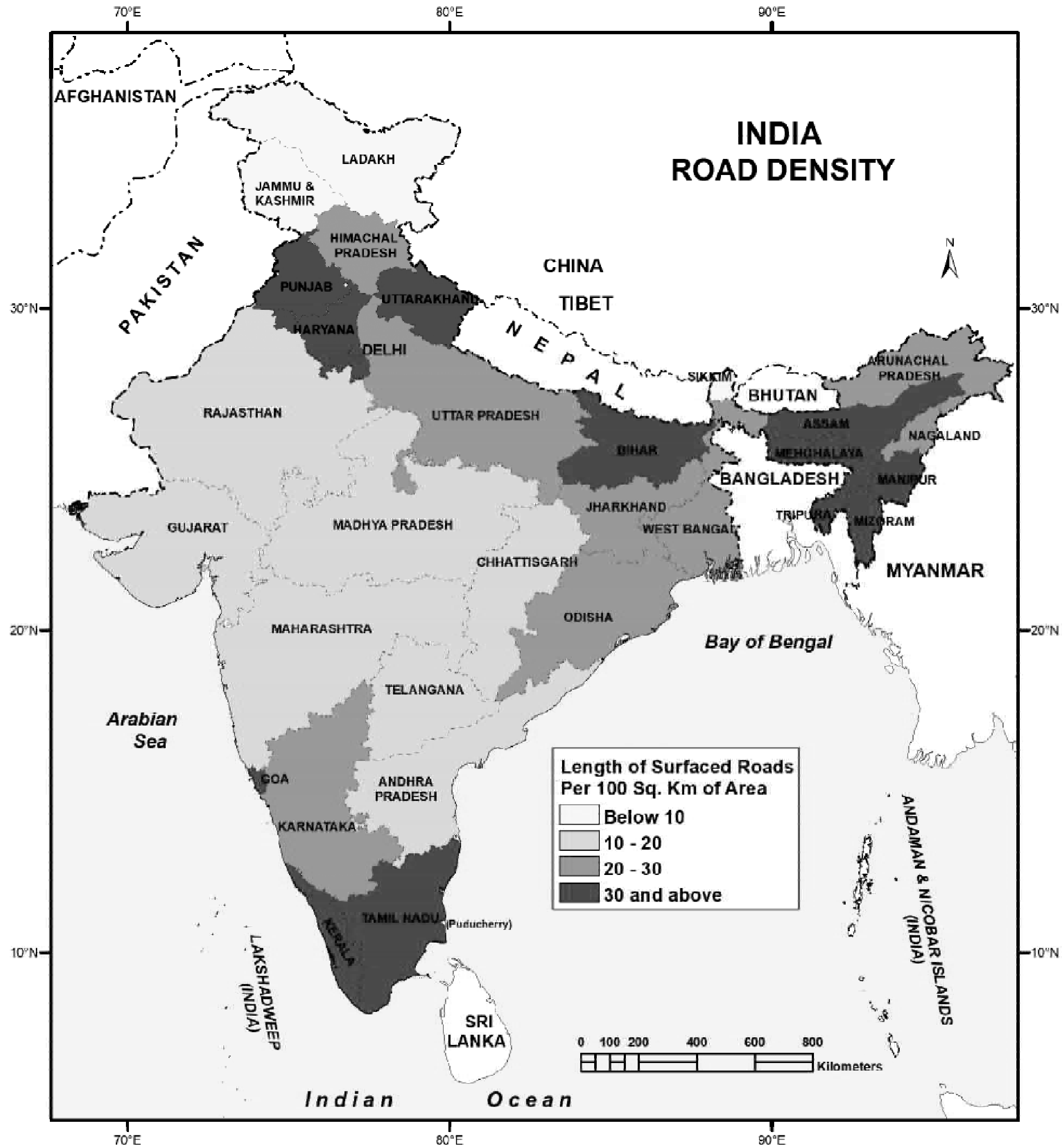


Fig. 20.2 India: Road Density

The Himalayan region and North Eastern states have a very low density of road network, which is below 20 km. per 100 square km area. As regards the pattern of surfaced roads, Punjab in the north and Kerala and Tamil Nadu in the south have the highest road density. The southern states have a good network of metalled roads. The pattern of surface road density is more or less the same as the total density of roads.

Road density in India is not uniform. It varies from region to region depending upon its relief and climatic conditions, economic development and density of population. Roads are divided into three categories: (i) National highways (ii) State highways, and (iii) District and village roads.

i. National Highways

National Highways are the trunk roads linking major cities of the country. They are built and maintained by the Central Government. Their total length of National Highways (2019) is 1,32,499 km. Although the national highways comprise only about 2 percent of the total length of surfaced roads in India, they carry about 40% of goods and passenger traffic. Maharashtra has the highest share of National Highways (17,757 km) followed by Uttar Pradesh (11,737 km) and Rajasthan (10,342 km). National Highway 44 is the longest national highway in India. It is 4,112 kilometres long running from Srinagar in the north to Kanyakumari in the south. It connects 11 states in its journey

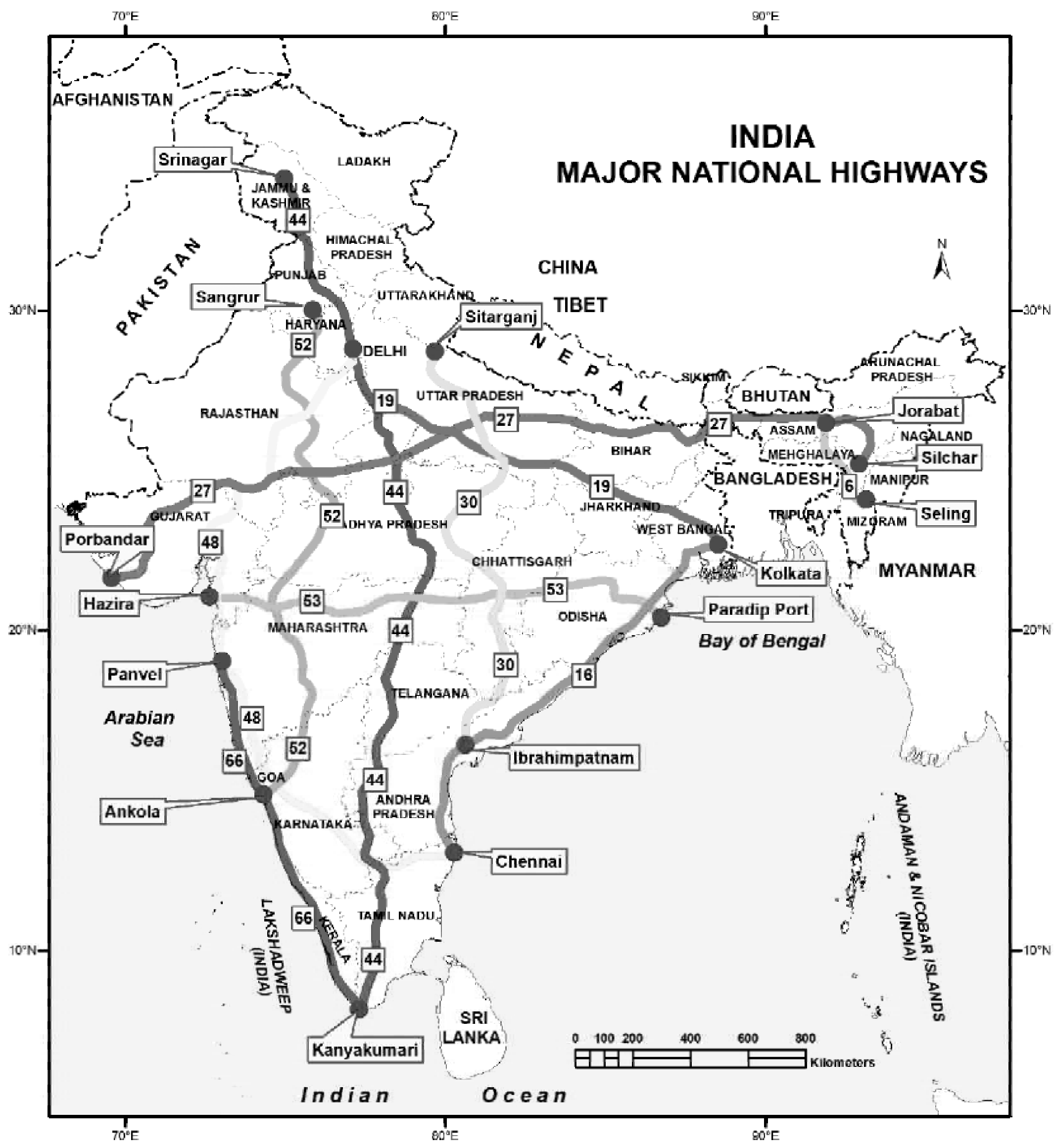


Fig 20.3: India: Major National Highways

ii. State Highways

The state highways are built and maintained by the State Governments. The total length of State Highways is 1,79,535 km (in 2019), out of these 1,78,384 km were surfaces and remaining 1,151 km were un-surfaced.

iii. District Roads

The District Roads comprise Major District Roads & Other District Roads constructed and maintained by State PWD. The District and village roads are looked after by the local bodies with some financial assistance coming from the states. The total length of District Roads (in 2019) were 6,12,778 km. It included 5,87,004 km of surfaces and 25,773 km of un-surfaced roads.

Border roads have been constructed on Indian international borders and its nearby areas. They connect these areas with the interior parts of the country. It's constructed and maintained by the Border Road Organisation. These roads have economic as well as strategic importance. 20,949 km of roads were under border roads in 2019.

Major Programmes/Projects

- **The Bharatmala Pariyojana :** The Bharatmala Pariyojana is a flagship programme of Government of India for the highways sector. This programme focuses on optimising efficiency of freight and passenger movement all over the country through bridging critical infrastructure gaps. To achieve this objective, the programme aims to initiate different ways i.e. development of Economic Corridors, Inter Corridors and Feeder Routes, National Corridor Efficiency Improvement, Border and International connectivity roads, Coastal and Port connectivity roads and Green-field expressways. In the first phase the programme envisages development of about 26,000 km length of Economic Corridors. It is expected to carry the majority of the Freight Traffic on roads along with Golden Quadrilateral (GQ) and North-South and East-West (NS-EW) Corridors.

- **Char Dham Pariyojna :** It is another important programme designed for improvement in connectivity for Char-Dham -Kedarnath, Badrinath, Yamunotri & Gangotri in Uttarakhand. The total length of the project is 889 km. This project after completion will make the journey safer, faster and more convenient. This project may also be strategically important due to its closeness with the international border.

20.5 PIPELINE TRANSPORT

Pipeline transport has been developed recently in India. It is the most convenient mode of transport for mineral oil, petroleum products and natural gas. Pipe lines connect oil and natural gas fields with refineries and the main market centres. Now solids are also being transported through pipelines after converting them into slurry.

There are certain advantages of pipelines over other modes of transport (i) Pipeline can be laid through difficult terrain as well as under water. (ii) Initial cost of laying pipeline is high but subsequent cost for maintenance and operation is low. It ensures steady supply and minimises transshipment losses and delays. (iv) Pipeline operation involves very low consumption of energy. There are some limitations of pipeline transport such as the capacity of the pipeline cannot be increased once it is laid. The security of pipelines in certain areas and the detection of leakage are difficult.

Some of the important pipelines are:

- Petroleum pipelines in Assam connect oil fields with the oil refineries of Assam and Bihar.
- The Mumbai-Ankleshwar-Koyali Pipeline: This pipeline connects the offshore of Mumbai and Gujarat with the Koyali refinery in Gujarat.
- The Salaya-Koyali-Mathura Pipeline: This pipeline runs from Salaya (Gulf of Kachchh) to Koyali and Mathura through Viramgam, It is 1075 kilometre long.
- Mathura-Delhi-Ambala-Jalandhar Pipeline: This 513 km long pipeline was built to transport refinery products from Mathura to the nearby major cities..
- The Hazira-Vijaipur-Jagdishpur (HBJ) Gas Pipeline: This pipeline transports natural gas from Hazira to Vijaipur and Jagdishpur. This pipeline is the longest oil pipeline in India with a total length of 1750 kilometres.

INTEXT QUESTIONS 20.2

1. State the number of railway stations in India in 2019-20.
2. Write any two regions with dense rail network.
3. Why road network is not uniform in India?
4. What is the total length of Char-Dham Pariyojna.

20.6 WATER TRANSPORT

India has a long coastline including island groups which is over 6100 km. This long coastline is dotted with 12 major ports managed by the central government. Then there are 200 minor ports operating under the jurisdiction of the state governments. These major ports alone handled 672.68 million tonnes of sea traffic. Out of the 200 non-major ports, around 65 ports are handling cargo. The remaining ports have "Port Limits" and no cargo is handled. These ports are used by fishing vessels and by small ferries to carry passengers across the creeks etc. The capacity of the ports has increased five times since 2001-02. In the year 2001-02, the port capacity was 343.95 million tones which increased to 1560.61 million tones in the year 2020-21.

The major ports along the western or Arabian Sea coast are Deendayal Port (at Kandla), Mumbai, JawaharLal Nehru Port (at Nhava Sheva on the opposite side of Mumbai harbour), Marmugao, New Mangalore and Cochin. Thus all the states on the western coast have at least one major port. The remaining five ports are Tuticorin, Ennore, Chennai, Visakhapatnam, Paradeep (Paradip) and the Joint port of Kolkata - Haldia. These ports connect India with the world and play a major role in the success of international trade and commerce.

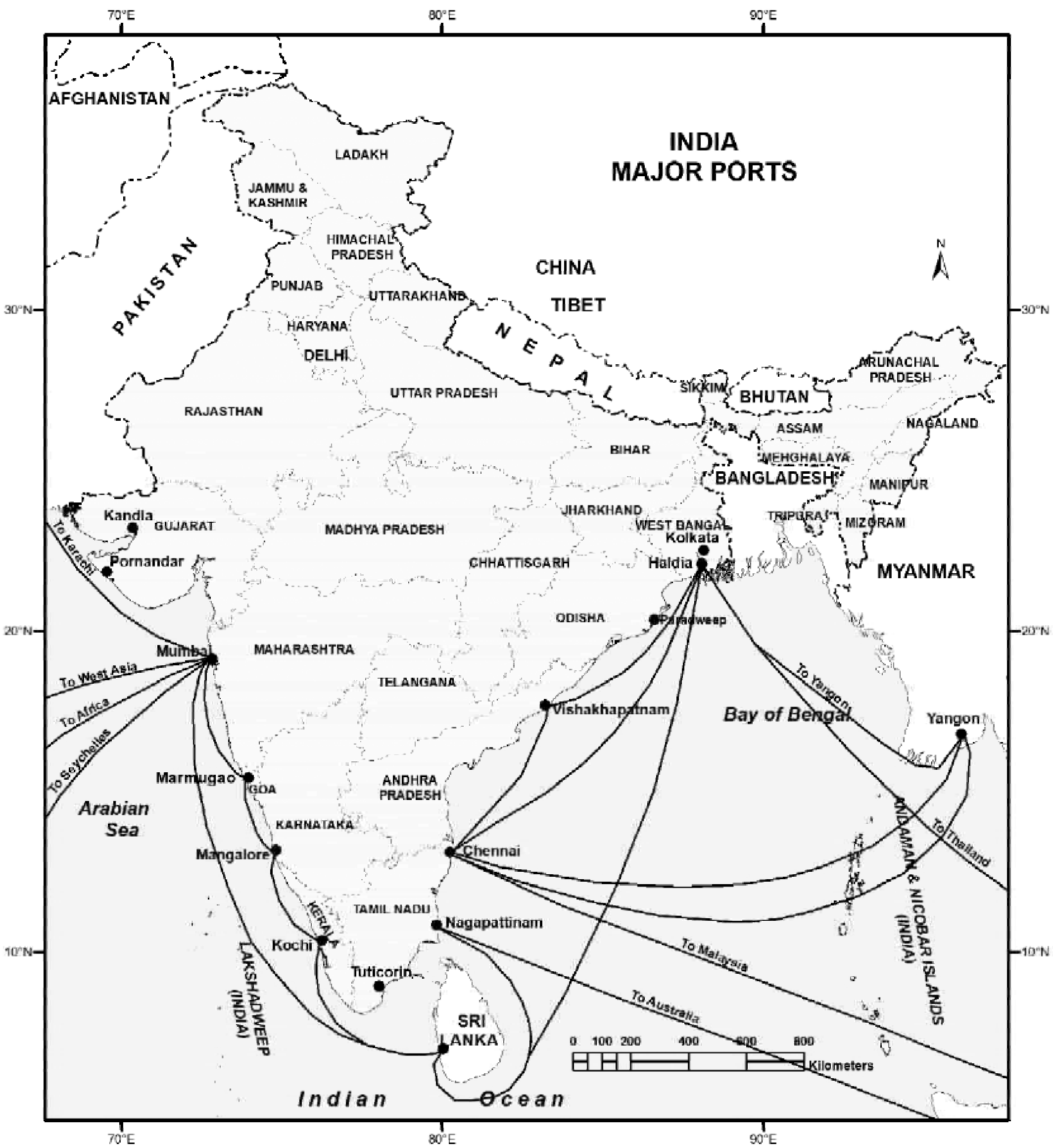


Fig. 20. 4: India: Major Ports

Inland WaterWays

India has the potential of extensive waterways in the form of rivers, canals, backwater etc. The waterways may be cost effective in comparison with other modes of transportation. However, this potential is not fully developed and underutilised. Under the National Waterways Act, 2016, 111 inland waterways have been declared as 'National Waterways' in the country to promote shipping and navigation on them. The total length of National Waterways is 20,275 km spread across 24 States in the country.

Major National Waterways (NW)

NATIONAL WATERWAY 1 (NW-1)- The Ganga river system between Haldia and Prayagraj was declared as National Waterway-1 (NW-1) in 1986. It covers a distance of approx 1620 km.

i. **NATIONAL WATERWAY 2 (NW-2)-** The river Brahmaputra having a length of 891 Km between Bangladesh Border and Sadiya has been declared as National Waterway no. 2 (NW-2) in 1988.

ii. **NATIONAL WATERWAY 3 (NW-3)-** The network of canals in Kerala with the total length of 205 km has been declared as National Waterway-3 in 1993.

iii. **NATIONAL WATERWAY 4 (NW-4)-** The stretch of Canals between Kakinada-Puducherry, integrated Bhadrachalam - Rajahmundry stretch of River Godavari and Wazira Vijayawada stretch of River Krishna with the total length of 1078 km was declared as National Waterway-4 in 2008.

iv. **NATIONAL WATERWAY 5 (NW-5)-** The Talcher- Dhamra stretch of river Brahmani, Geonkhali- Charbatia stretch of East Coast Canal, Charbatia- Dhamra stretch of Matai river and Mangalgadi-Paradip stretch of Mahanadi delta rivers with the total length of 623 km was declared as National Waterway-5 in 2008.

The following factors affect the inland waterways in India:

- Diversion of water of rivers for irrigation.
- Silting of river beds reduces the depth of river water.
- Seasonal fluctuations in the water level of the rivers.
- Presence of bridges, waterfalls and cataracts in the course of rivers.
- An unequal competition with railways and road ways.

India's inland waterways have not been developed as they can not compete with the railways and roads.

Major Programmes/Projects

Sagarmala

India has 7500 km long coastline and 14,500 km potential navigable waterways but still this potential is underutilised. Last mile connectivity to the ports is one of the major hurdles for movement of cargo to/from the hinterland. The location of industries and manufacturing centres may also be away from the port area and not well connected. Sagarmala project is an ambitious national initiative aimed at bringing about a step change in India's logistics sector performance, by unlocking the full potential of India's coastline and waterways. As per the Ministry of Ports, shipping and Waterways, Govt. of India, the vision of the Sagarmala is 'the vision of Sagarmala is to reduce logistics cost for both domestic and EXIM cargo with optimised infrastructure investment.' It includes-

- Reducing cost of transporting domestic cargo through optimising modal mix
- Lowering logistics cost of bulk commodities by locating future industrial capacities near the coast
- Improving export competitiveness by developing port proximate discrete manufacturing clusters
- Optimising time/cost of EXIM container movement

The components of Sagarmala are-

- Port Modernization and New Port Development
- Port Connectivity Enhancement
- Port-linked Industrialization
- Coastal Community Development
- Coastal Shipping & Inland Waterways Transport

20.7 AIR TRANSPORT

Air transport is the fastest and highly convenient mode of transport, although it is more costly than other modes. However, it is one of the growing modes of transportation. You can visit places which are far away in a shorter time in comparison with other modes. If you are residing in Uttarakhand and want to go to Chennai, you can reach within a few hours by an aeroplane while this distance is covered in more than one day by a railway express train.

Air transport becomes very important in the regions where surface means of transport are difficult to develop due to difficult terrains i.e. dense forests, marshy land, hilly terrain and high mountains.

India is favourably situated on a busy international air route, connecting North America, Europe and South-west Asia on the one hand and East and South-east Asia together with Australia on the other.

As on 31st December 2022, there were fifteen (15) scheduled commuter operators viz. Air India Ltd., Alliance Air, Air India Express Ltd., Jet Airways(India) Ltd., SpiceJet Ltd., Go Airlines (India) Pvt. Ltd., InterGlobe Aviation Ltd. (Indigo), Air Asia Pvt. Ltd., Tata SIA Airlines Ltd. (Vistara), SNV Aviation Pvt. Ltd. (Akasa Air), Ghodawat Enterprises Pvt. Ltd. (Star Air), GSEC Monarch and Deccan Aviation Pvt. Ltd. (IndiaOne Air); Aviation Connectivity and Infrastructure Developers Pvt. Ltd.(AIR TAXI), Big Charter Pvt. Ltd.(Fly Big) and Pawan Hans Ltd. These operators are operating in the domestic sector and provide wide choices of flights and connectivity to various parts of India. Some of these are also operated on international routes.

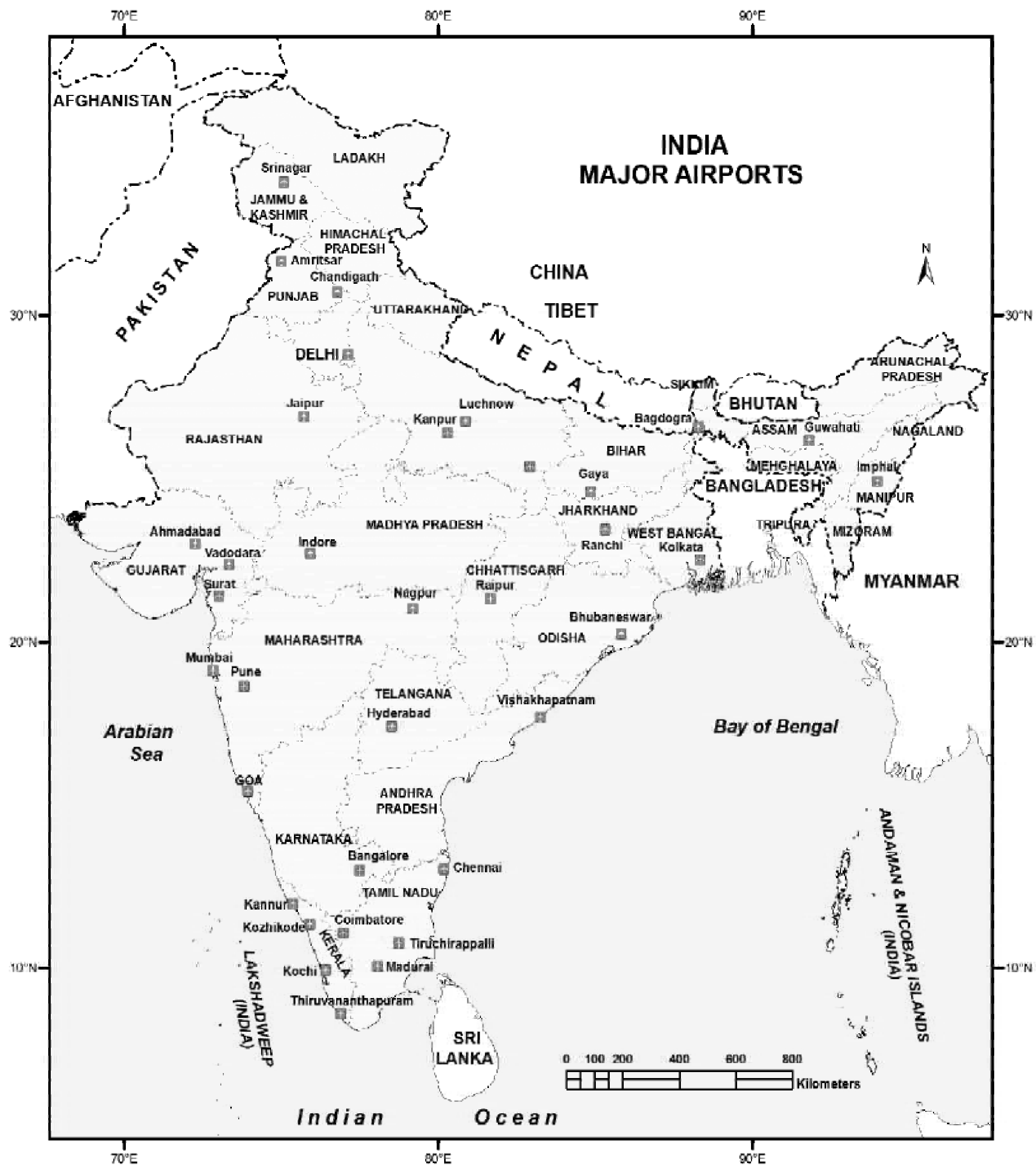


Fig. 20.5: India: Major Airports

There are two cargo airlines viz. Blue Dart Aviation Ltd. and Quick Jet Cargo Limited operate scheduled cargo services in the country. Further, SpiceJet Ltd. was also operating Cargo Operations with five (5) B737 Freighter aircraft.

The Airport Authority of India is responsible for providing safe and efficient air traffic services. It also provides aeronautical communication services for control of air traffic in the Indian air space. There are 131 operational airports in India. This include 29 international airport.

Major Programmes/Projects

Regional Connectivity Scheme (RCS-Udan)

The Ministry of Civil Aviation has started the Regional Air Connectivity under Regional Connectivity Scheme (RCS) -Ude Desh ka Aam Nagrik (UDAN) on 21.10.2016. It is a flagship programme of the Government of India. 459 RCS routes have been operationalised till date. It connects 72 RCS airports (including 9 heliports and 2 Water Aerodromes). 113 lakhs passengers have used the services of UDAN yet.

20.8 COMMUNICATION AND ROLE OF ICT

Communication is one of the important pillars of the development of a country. It is a system which contributes to the development of the economy, social relationships and also helps in promoting cultural unity. On the other hand, it brings diverse people and cultures of the world close to one another. It is also very important during any accident; calamity or emergency because instant means of communication flash the news across the globe so that relief can be rushed to the spot immediately. Let us discuss some of the major means of communication in India:

Postal Services

It is the most commonly used mode of communication in India. The postal services play a vital role in the rural areas of the country. About 99% of the villages are enjoying postal services today. At present (2021) the postal department is working with a network of 1,59,392 post offices including 808 Head post offices, 24281 Sub post offices and 1,34,303 Branch post offices to provide postal services covering every part of the country. 4,28,773 letter boxes have been installed across the country. It is providing a wide range of services i.e. delivery of mails, issuing of stamps, deposits under Small Savings Schemes, life insurance cover under Postal Life Insurance (PLI) and Rural Postal Life Insurance (RPLI) and retail services like bill collection, sale of forms, Post Office Passport Sewa Kendras etc.

It also acts as an agent for the Government of India in discharging other services for citizens such as old age pension payments etc. In tune with the rest of the world the Indian postal services are also being modernised.

Telecommunication

Innovation has changed the faces of modern day's communication. It provides individual as well as group communication at a very affordable cost and is easy to access. Telephone and Fax are the main means of telecommunication. With the launching of 4G and 5G services, telecommunication has become fast and effective. India currently has the world's second-largest subscriber base of 1.17 billion.

Telephone: There has been a very fast progress in telephone facilities. As of October, 2022 India has a total 117.02 crore telephone connection. India also has 114.4 crore mobile connections in October 2022. For the same period, India has 84.67% tele-density.

Telecommunication has observed a big change in technology. 5G services were launched in India on 1st October 2022. 5G use cases developed by Telecom Service Providers and start-ups in Education, Health, Worker safety, Smart agriculture etc. are now being deployed across the country. The telecom services are provided by both the public and private sector. Presently, India has 6 telecom service providers.

Mass - Communication

The mass communication includes radio, television, newspaper, magazines and internet based websites and portals. Radio and television are the electronic media of mass communication. They play an important role in individual and social life. Later on June 8, 1936, the Indian State Broadcasting Service became All India Radio. There are 470 Broadcasting centres located across the country. These stations cover about 92% of the country's area and 99.19 % of the total population. All India Radio offers programmes in 23 languages and 179 dialects. Now, FM Radio services have given a new face to radio transmission.

Television service was started in 1959 in India. However, the real expansion of T.V. Service began after 1980. Several channels on television have been made available to private parties. This has promoted keen competition to improve the quality of programmes even of Doordarshan. Doordarshan's network consists of (i) 66 Doordarshan Kendra (studio centres) including 17 major studio centres at state capitals. Doordarshan has a network of 34 satellite channels. DD1 provides services in more than 79% of area and about 91% of the total population.

The television industry is also functioning in private sectors and many channels in the area of entertainment, news, infotainment etc in various languages are operational. Cinema is yet another means of mass communication. It entertains millions of people everyday.

Print media

Newspapers, periodicals and journals fall in the category of print media. Print media expanded very rapidly after independence. The total numbers of registered publications as on 31st March, 2018 were 1,18,239. Out of these 17,573 were under newspaper category and remaining 1,00,666 were periodicals. The largest number of newspapers and periodicals registered in any Indian language is in Hindi (47,989) followed by English (14,626).

Role of ICT

The world is changing so fast and so are the technologies. Information and Communication Technology (ICT) has made a significant impact on human lives. It gives an opportunity to its users to be a part of a very fast changing world. It also allows connecting with other advanced technologies around the world.

India has witnessed the effective use of ICT in different aspects of life and economy. India's core digital economy has added 8.5 % of Gross Value Added (GVA) in 2019. Its growth is 2.4 times faster than the Indian economy. Around 62.4 million workers are employed in a digitally dependent economy. The contribution of the digital economy in India's GDP was approx 8.49% in 2019. It included the three main sub-sector - (i) computer, electronics, and optical products; (ii) telecommunications; (iii) computer and ICT services.

Use of ICT is not limited to certain sectors but it has been widely accepted and expanded its role in industry and economy. Construction, food and beverage, textile, electrical and other electronic equipment, education, retails trade, finance etc are some examples where ICT is playing a crucial role. As per RBI Bulletin, December 2022, 4.9 million people were employed in the core digital sector. The report also says that in the total digitally dependent economy, around 62.4 million workers are employed in sectors that are digitally disrupted.

ICT has touched various aspects of life. The Digital India programme is one of such programmes which has made significant changes. It is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy. This has changed the face of digital payment in India and is continuously increasing. The number of transactions has been increased from 2071 crore in 2017-18 to 8840 crore in 2021-22.

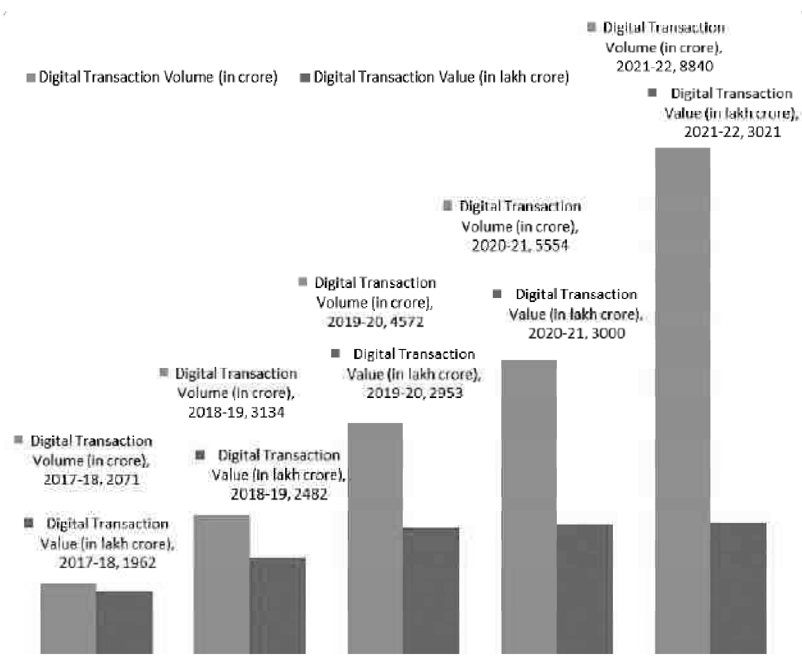


Fig. 20.6 Digital Payments in India

20.9 TRADE

The services which involve the activities of buying and selling of goods are termed as trade. Like transport, communication, banking etc. it is also a tertiary service and an important infrastructure for the development of the economy including agriculture and industry in the country. Trade may take place at various levels -local, regional, national or international.

The growth of trade depends on accessibility of a well developed market and well advanced communication system.

International Trade

International trade involves the selling and buying of various commodities at the international level. International trade may be multilateral or bi-lateral; depending upon the number of parties involved. India's international trade has grown very rapidly after Independence. India's total international trade in the year 1950-51 stood at Rs. 1,214 crore. Since then this has witnessed continuous increase with occasional downwards twins. The opening of the economy, liberalisation and globalisation have boosted international trade. During the year 2021-22 the value reached Rs. 77,19,796 crores. Though India has trade relations with all the major trading blocs and all the geographical regions of the world, the major trade partners are the USA, Russia, countries of West Europe, Japan and Oceania. Europe (6,42,717 crore) and North America (6,29,080 crore) are important trading blocs which comprise large parts of India's exports. North East Asia, Commonwealth of Independent States (CIS), Africa and Oceania are other important trade blocs.

Export

Major commodities of our exports before independence were either raw materials like cotton, jute, leather, spices, minerals or food items like wheat, tea, coffee and spices etc. All the trade was channelised through Britain. After Independence there have been significant changes in the items of export because of the rapid industrial development in the country. Now India exports more than 7500 commodities. There has been an appreciable growth in exports since 1950-51 when it was worth only Rs. 607 crores. It has increased to Rs. 31,47,021 crores by 2021-22.

There are year to year variations in the commodities exported. However, petroleum products remain on top of exported principal commodities from the last few years. Top five principal commodities exported from India are petroleum products; pearls, precious and semi-precious stones; iron and steel; drug formulation and biological; and gold and other precious metal jewellery. There has been a significant change in the export products since Independence. The top five countries where commodities were exported are the USA, UAE, China, Bangladesh and Netherland.

Notes

Imports

After Independence, there has been a sharp increase in the value of imports in India. We now import more than 6000 commodities. During the pre-Independence period, the main items of imports were machinery, manufactured goods, textiles, chemicals, medicines etc. After independence in the early decades, India's import consisted mainly of food grains because of the partition of the country. India's total value of import in 1950-51 was of Rs. 581 crores which had increased to Rs. 45,72,775 crores in 2021-22.

Due to growing demand and insufficient reserves India has to import huge quantities of crude petroleum to fulfil its domestic requirements. The crude petroleum comes on top of important principal commodities. It is followed by gold; petroleum products; coal, coke and briquettes and pearls, precious and semi-precious stones. The other principal imports consist of machinery, project goods, medicinal and pharmaceutical products, organic and inorganic chemicals, artificial resins etc.

Balance of Trade

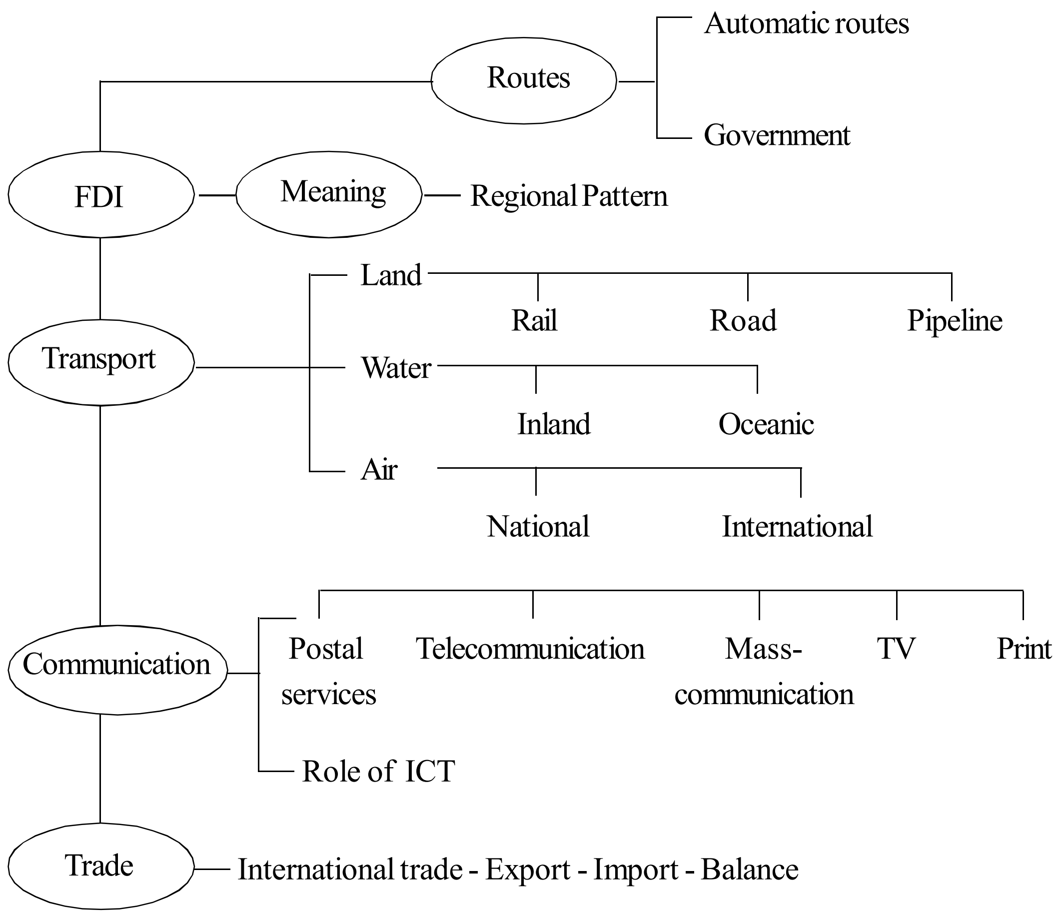
Difference between the value of exports and imports is termed as balance of trade. When the value of exports and imports of a country is equal it is a situation of balanced foreign trade. If exports exceed imports, It is favourable; and on the other hand when imports are more than exports, it is unfavourable trade.

At the time of Independence, our foreign trade was favourable but after Independence, in the first two decades, the imports of India increased rapidly due to the imports of food grains. At present the imports of the country exceed the exports. Thus, our foreign trade has become unfavourable. In rupee terms, the trade deficit in 2021-22 was Rs. (-) 14,25,753 crore. It is worth noting that our exports and imports have increased in volume and value remarkably.

INTEXT QUESTIONS 20.2

1. What is the name of waterways between Haldia and Prayagraj?
2. How may scheduled Computer Operators are in India?
3. In which year RCS-Udan scheme was launched?
4. State the number of Post Office in India.
5. What was the trade defict of India in 2021-22.

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Define Foreign Direct Investment.
2. Explain two routs of FDI in India
3. Highlights the regional pattern of FDI in India
4. Explain the distributions of rail network in India.
5. Why road transport is important?
6. Write short not on
   i) National Highways
   ii) Bharatmala Pariyojna

iii) RCS-Udan

7. How ICT is making Positive changes in India? Explain

8. Write a brief note on trade in India.

ANSWERS TO INTEXT QUESTIONS

20.1

1. b
2. c

20.2

1. 7325
2. Northern Plain, Eastern coastal area, Plains of Gujrat etc
3. Uneven due to relief, climatic condition, density of population
4. 889 KM

20.3

1. National Water way 1
2. 15
3. 2016
4. 159392
5. (-) 14,25,753 crore.

MODULE -9

Human Resource Development in India

21

POPULATION GROWTH AND DISTRIBUTION

In the previous two modules we have discussed in detail about various natural resources and major economic activities of India. They include land,soil, water, mineral, forest, and wildlife resources. We have also analysed the distribution of these above mentioned resources as well as their utilization. All these aspects were studied in relation to people living in the country. By people we mean not only their numbers as consumers but also as developers or managers of natural resources. For this purpose, we look at their educational and health status, their vocational, technical and social skills and above all their aspirations, value system. In this context you would realise that people are not mere consumers but also constitute the most important resources of a country. In this lesson, we will describe the size of India's population in the world context. We will also analyse trends in population growth, their determinants and consequences. We will explain distribution and density of population and analyse various factors influencing them. In the concluding section, we will discuss challenges of growing population.

OUTCOMES

After studying this lesson, Learner

- describes the size of Indian population in the world perspective;
- explains the trends in population growth since 1901;
- analyses factors responsible for uneven distribution of population; and
- explain these issues and challenges of growing population.

21.1 POPULATION SIZE AND GROWTH

Before discussing in details about growth and distribution of population in India in detail, let us know about the size of population in India in relation to its total area. Let us analyse India's total population and area in comparison to world population and area. This would provide you an idea about India's population concentration. In the below given section, a detailed discussion has been presented about this. This would help you to critically analyse population related issues and challenges in India.

A Population Size

You might be knowing that India is the second most populous country in the world next only to China. According to 2011 Census, the total population of India was at 1,210,854,977(about 1210 million or 1.21 billion). This accounted for 16.7% of the world's total population. In other words, about every sixth person in the world there is an Indian. India possesses only 2.42% of the world's total land area.In terms of area, India stands seventh preceded by Russia, Canada, China, the United States of America, Brazil and Australia. Barring China, the total population of these large five countries is far less than that of India. The total area of these five countries is over sixteen times whereas their total population is much less than that of India. It can also be revealed from the fact that the total population of North America, South America and Australia added together is less than the population of India. On the top of it, we are adding over 17 million people each year. It is more than the total population of Australia. In fact the net addition to Chinese population each year is less than India.

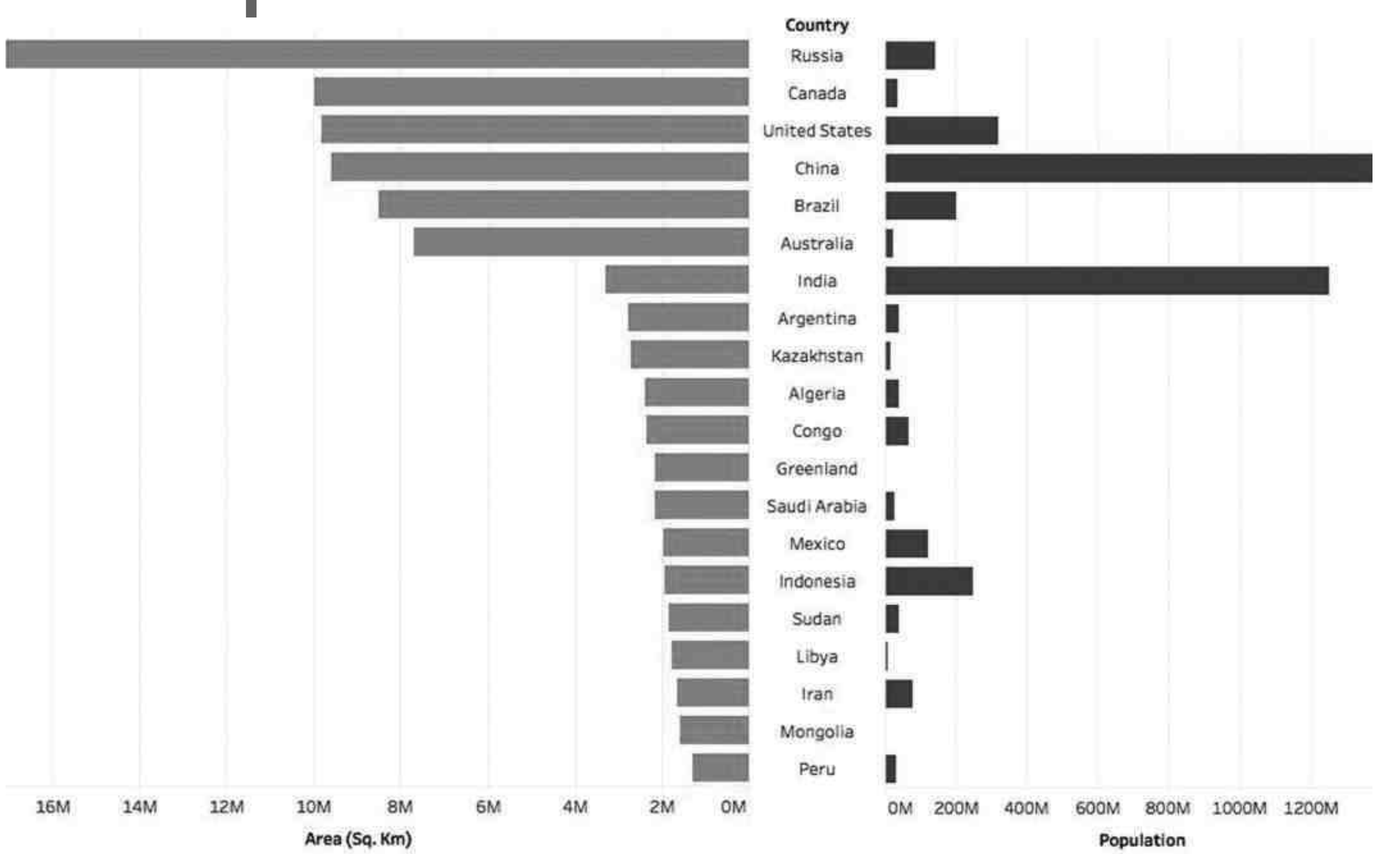


Fig. 21.1: Countries by Land Area and Population Size

B Growth of Population

Do you have any idea about the trend of growth of population? When we say trend it means the changes in number of population over the years. Do you know what the determinants responsible for the population growth are? The growth of population in a region depends upon three factors namely birth rate, death rate and migration. Birth rate is measured in terms of total number of live births per thousand populations per year. Generally, birth rate is affected by various social, economic and demographic factors. Similarly, death rate is measured in terms of total number of deaths per thousand population per year. The difference between birth rate and death rate is known as natural growth rate. The term migration refers to the movement of people from one area to the other or from one country to another. The rate of migration affects the growth of population of a region by increasing or decreasing the number of people living there.

Natural Growth = Birth Rate - Death Rate

Actual Growth Rate = Birth Rate - Death Rate + In Migration - Out Migration

The growth rate of population may be positive or negative. A positive growth rate of population mean an increase in the number of people living in a region, where as negative growth rate means declining population. A positive growth rate occurs when the number of births and in migration exceeds the number of deaths and outmigration. On the other, the negative growth rate means just opposite to positive growth rate i.e. the number of deaths and out migration exceeds the number of birth and out migration.

Look at the table 21.1, you will find that the total population of our country, was 238 million. By 2011, it had risen to a phenomenal figure of 1027 million. About 972 million persons were added in the last century. The rise is of about 4.3 times since 1901.

Table 21.1: India: Decadal Growth of Population 1901-2011

Census Year	Total Population (in million)	Absolute Growth	Growth in Percentages	Decadal Growth
1901	238.40	-------	------	-----
1911	252.09	+ 13.70	5.75	0.56
1921	251.32	-0.77	-0.31	-0.03
1931	278.98	+11.00	11.00	1.04
1941	318.66	+39.68	14.22	1.33

1951	361.09	+42.43	13.31	1.25
1961	439.23	+78.15	21.64	1.96
1971	548.16	+108.92	24.80	2.22
1981	683.33	+135.17	24.66	2.22
1991	843.39	+163.06	23.86	2.14
2001	1027.02	+180.63	21.34	1.93
2011	1210.19	+181.58	17.64	------

Source: Census of India

If we look at the 100 years population growth then, it can be broadly grouped under the following four categories.

1. Period of stagnant growth rate (before 1921)
2. Period of steady growth rate (1921-1951)
3. Period of rapid growth rate (1951-1981)
4. Period of declining growth rate (after 1981)

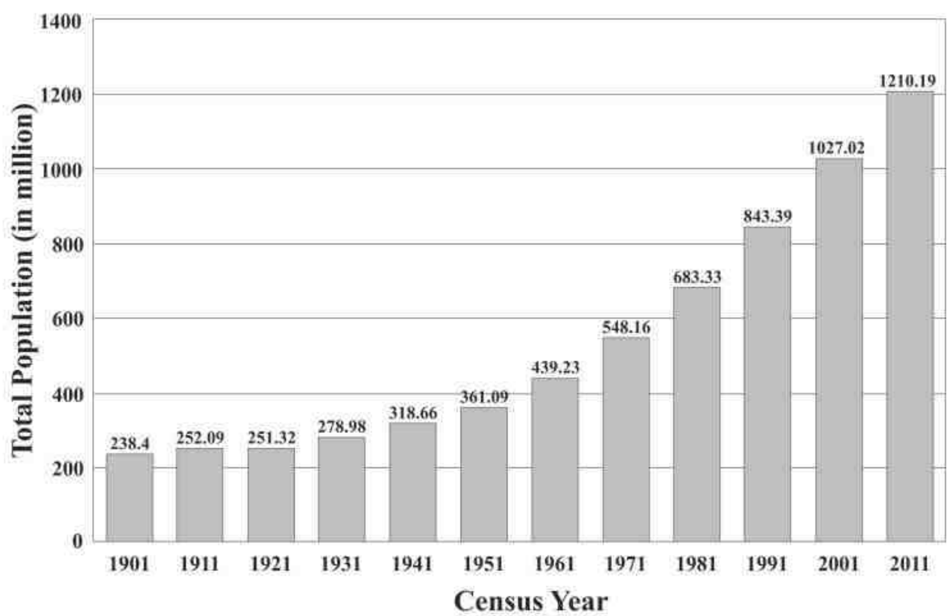


Fig. 21.2: India: Trend of Population Growth 1901-2011

Notes

Let us discuss each phase briefly.

1. **Period of stagnant growth rate (before 1921):** Before 1921 the increase in population was sporadic, irregular and slow.This was mainly due to high birth and death rate. Therefore, the natural growth was insignificant. In 1911-21 the absolute increase declines marginally dueto famines, epidemics etc. After 1921 the population has been increasing.Therefore, 1921 is known as demographic divide in the population study of India.

2. **Period of steady growth rate (1921-1951):** Since 1921 to 1951 there was a steady increase in population. This is because of steady decline in death rates. The decline was mainly due to improvement in sanitation and medical facilities. Other factors which helped were development in road facilities which helped in meeting the exigencies of food shortage and substantial improvement in agricultural economy. Therefore,the population growth during this period was known as mortality induced growth.

3. **Period of rapid growth rate (1951-1981):**This is a very crucial phase as far as population growth of India is concerned.The population was almost doubled during these three decades. During this period there was a rapid decline in death rate whereas the decline in birth rate was marginal. Look at the table, you will find birth rate was reduced from 41.7 to 37.2 whereas death rate was reduced from 22.8 to 15.0 during this period. Therefore the difference between birth rate and death rate was very high and as a result natural growth rate remains very high. This was dueto acceleration in developmental activities further improvement in medical facilities, improvement in living conditions of the people etc. This period of growth is termed as fertility induced growth.

4. **Period of declining growth rate (after 1981):** In the last three decades i.e. 1981-91, 1991-2001, and 2001-2011 the rate of growth started declining gradually. It indicates the beginning of a new era in the demographic history of India. During this period birth rate declined significantly,from 37.2 in 1971-81 to 24.8 in 1991-2001 whereas the decline in death rate continued in a slower rate. The death rate has declined from 15.0 to 8.9 during this period. This declining trend is a positive one and may be attributed to effective government role in promoting family welfare programmes and people's awareness.

Regional Variation in Population Growth

Till now we have discussed the growth rate over a 110 years' time period. But do you know how this growth rate varied over the space.The growth rate of population during 1991- 2001 in Indian States and Union Territories shows very obvious pattern. The States like Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha, Puducherry, and Goa show a low rate of growth not exceeding 20 per cent over the decade. Kerala registered the lowest growth rate

(9.4) not only in this group of states but also in the country as a whole. A continuous belt of states from west to east in the north-west, north, and north central parts of the country has relatively high growth rate than the southern states. It is in this belt comprising Gujarat, Maharashtra, Rajasthan, Punjab, Haryana, Uttar Pradesh, Uttarakhand, Madhya Pradesh, Sikkim, Assam, West Bengal, Bihar, Chhattisgarh, and Jharkhand, the growth rate on the average remained 20-25 per cent. During 2001-2011, the growth rates of almost all States and Union Territories have registered a lower figure compared to the previous decade, namely, 1991-2001. The percentage decadal growth rates of the six most populous States, namely, Uttar Pradesh, Maharashtra, Bihar, West Bengal, Andhra Pradesh and Madhya Pradesh have all fallen during 2001-2011 compared to 1991-2001, the fall being the lowest for Andhra Pradesh (3.5% percentage points) and highest for Maharashtra (6.7 percentage points). Tamil Nadu (3.9 percentage points) and Puducherry (7.1 percentage points) have registered some increase during 2001-2011 over the previous decade.

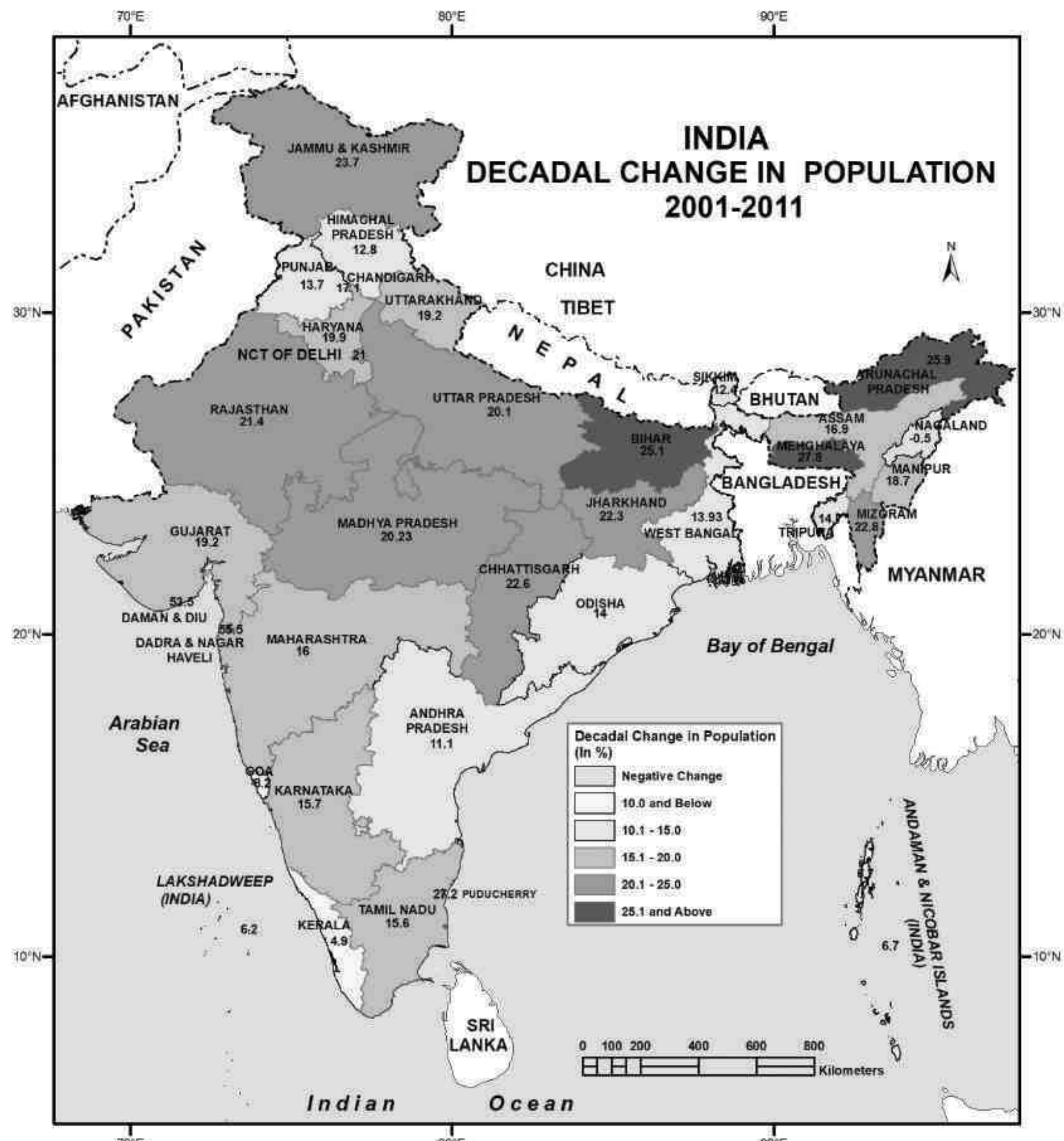


Fig. 21.3: India: Population Growth 2011

INTEXT QUESTIONS 21.1

1. Tick (√) Mark the most appropriate answers

   (a) The major reason for the high growth rate of population in India is:

   (i) rapidly rising birth rate

   (ii) rapidly falling death rate

   (iii) high in-migration from outside

   (iv) very high birth rate and death rate

   (b) The growth rate of population in India has been constantly rising right since

   (i) 1901

   (ii) 1921

   (iii) 1951

   (iv) 1981

2. Name the State where the growth rate of population is the highest and lowest according to 2011 Census.

   ____

3. Name the states where the growth rate of population is the lowest.

   ____

21.2 POPULATION DISTRIBUTION

Population of the world or of any country is not uniformly distributed. The same is true about India also. Some parts of the country are densely populated, some parts moderately populated and some parts are sparsely populated. (Fig. 21.3). For example hilly and forested region of the Himalaya are sparsely populated whereas plain and fertile areas in and around Ganga river are densely populated. Do you know why it is so? There are various factors responsible for such variations. These factors can be broadly grouped under two categories namely physical and socio-economic.

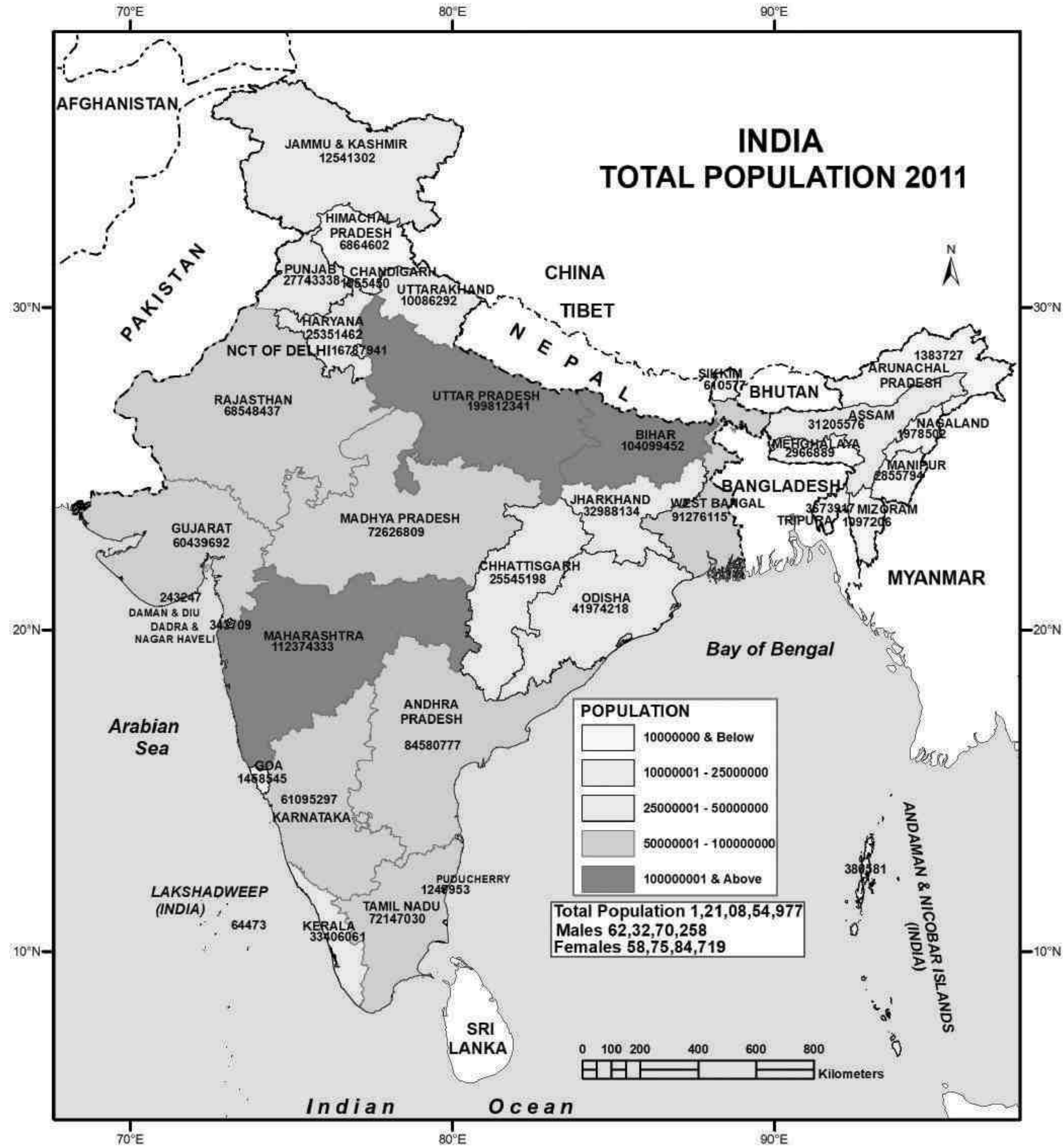


Fig. 21.4: India: Distribution of Population (2011)

Factors Influencing Distribution of Population

As we discussed earlier, the spatial spread of population in India is not uniform. There are very wide regional variations. Let us analyse various factors that are responsible for such variations. All such factors affecting the population distribution may broadly be grouped into two major categories. They are (A) physical factors and (B) socio-economic factors.

A. Physical Factors: Physical factors play a vital role in the density and distribution of population. Physical factors include landform, climate, soil, etc. Though there is a lot of improvement in technology but the patterns of population distribution all over the world continues to reflect the influence of varied physical factors.

(i) Landforms: The most important attributes of landforms which determine population distribution are the altitude and slope. The most striking evidence of the influence of altitude and slope on population distribution have been observed between mountains and plains. For example, take the case of most densely populated Indo-Ganga plains on the one hand and mountainous state of Arunachal Pradesh on the other. Other than this, factors like drainage, and water table have also been affecting population distribution.

(ii) Climate: It is one of the essential elements of the physical factors which influence the spatial distribution of population. Major elements of climatethat affect the distribution of human population are temperature conditions and the amount of precipitation. Take the case of hot and dry deserts of Rajasthan and the cold and wet Eastern Himalayan region of the country where very low temperature and heavy precipitations prevail. Apart from other reasons namely steep slope, poor soil, this is also one of the major reason for sparse population in these regions. Almost even distribution and high density of population are found in coastal plains of Kerala and Ganga plains of Uttar Pradesh, Bihar and West Bengal where rainfall is moderate to high.

(iii) Soil: As mentioned above, it is another factor which affects the density and distribution of population. One may be tempted to question the validity of the role of soil in the present day highly industrialised society. But, even today, about 70 percent of population in India lives in villages. People in villages earn their livelihood from agriculture which depends upon the quality of soil. That is why alluvial region of northern plains and coastal and deltaic regions of India continue to support high concentration of population. On the other hand, it may be worth mentioning that vast tracts of land in desert areas like Rajasthan, Rann of Kuchchh in Gujarat,Terai region in Uttarakhand have been suffering from problems like soil erosion and soil effloresce which support only low concentration of population.

In any region, the distribution is influenced by more than one factor. Take for example North-Eastern region of India. Here several factors are responsible for low density of population. These factors are high rainfall, rough terrain, dense forests and poor quality of soil.

B. Socio-Economic Factors: Like physical factors, socio-economic factors also play an equally important role in the distribution of population. However, there may not be a perfect agreement upon the relative importance of these two determinants. In certain places physical factors play a vital role whereas in some places socio-economic factors have a greater impact. Various socio-economic factors which have impact upon the population distribution are (i) socio-cultural and political factors; (ii) availability of natural resources.

(i) **Socio-Cultural and Political Factors:**Let us explain this factor with an example. Mumbai-Pune industrial complex is a good example to show how social, cultural, historical and political factors collectively have contributed to rapid growth of population. About 500 years ago, there were small insignificant islands of the Thana Creek on the western coast. The adventurous Portuguese seamen claimed these islands for their monarch. They in turn gifted these islands to the Royal Family of England by way of dowry. These couple of sleepy fishing village located on these islands could never guess that they would shortly turn into India's largest population conglomeration. East India Company of England set up a trading centre on these islands and later made it the capital city of Bombay Presidency. Enterprising trading and business communities of Parsis, Kuchchhis and Gujaratis played a leading role in setting textile mills, development of water power and laying roads and railways across the Western Ghats connecting it with its hinterland. Unexpectedly, the Suez international navigation canal made Mumbai the nearest Indian port to Europe. Availability of educated youth from Mumbai and Pune and inexpensive and disciplined labour from Konkan also contributed to the rapid population growth. The discovery of Bombay High oil and natural gas fields gave boost to its petro-chemical industry. Today, Mumbai is known as commercial capital of India backed by international and domestic airports, major sea ports and national road and rail terminals. Simillar is the case with other cities like Kolkata and Chennai which were established by the colonial rulers.

(ii) **Availability of Natural Resources:** The Chota Nagpur Plateau region has all along been a rocky and rugged terrains. This rainy and forested region has been a home of several tribes and was one of the sparsely populated parts of the country. However, a string of industrial towns and centres have sprung up over the past century soon after rich minerals such as iron-ore, manganese, limestone, coal etc. were found in unusual abundance and close to one another. The rich coal and iron fields have attracted heavy industries particularly iron and steel, heavy engineering, metallurgy and transport equipment industries. The region has also important super-power thermal stations from where power is supplied to far off areas. After liberalisation, many multi-nationals as well as national companies have been establishing their industries in large numbers.

Notes

Till now, it must be clear to you that why a particular area is sparsely populated whereas another area is densely populated. But, do you know the measurement of such concentration of population? Density is one such measurement. Let us discuss about density of population in the below given section.

21.3 DENSITY OF POPULATION

The size of population of different areas can be compared in many ways. One of the ways can be to compare the absolute size of the population. But it does not provide any idea about the relationship of population with the area or resource base of the country. This type of comparison is therefore not adequate. For example, population of Singapore is 4.2 million and that of Peoples Republic of China is 1,300 million. Indeed one is too small and the other is too big. Now take into consideration that the area of Singapore is just 630 sq. km; whereas China has an area of 9.5 million sq. km. This helps us to know how crowded Singapore is as compared to China. Therefore, the population of various countries are generally compared in terms of density of population. This is a method of comparing the human-land ratio of different regions. For this purpose, the population of a region is assumed to be distributed evenly in all its parts and the number of people per square kilometre is thus calculated. This is called arithmetic density of population or simply density of population. Hence, density of population is calculated by dividing the total population of a country or a region by the total area. Therefore the density of population is expressed as the number of persons per square kilometre.

Table 21.2: India: Density of Population

Census Year	Density of Population
1901	77
1911	82
1921	81
1931	90
1941	103
1951	117
1961	142
1971	177
1981	216
1991	274
2001	324
2011	382

Source: Census of India, 2011

[redacted]

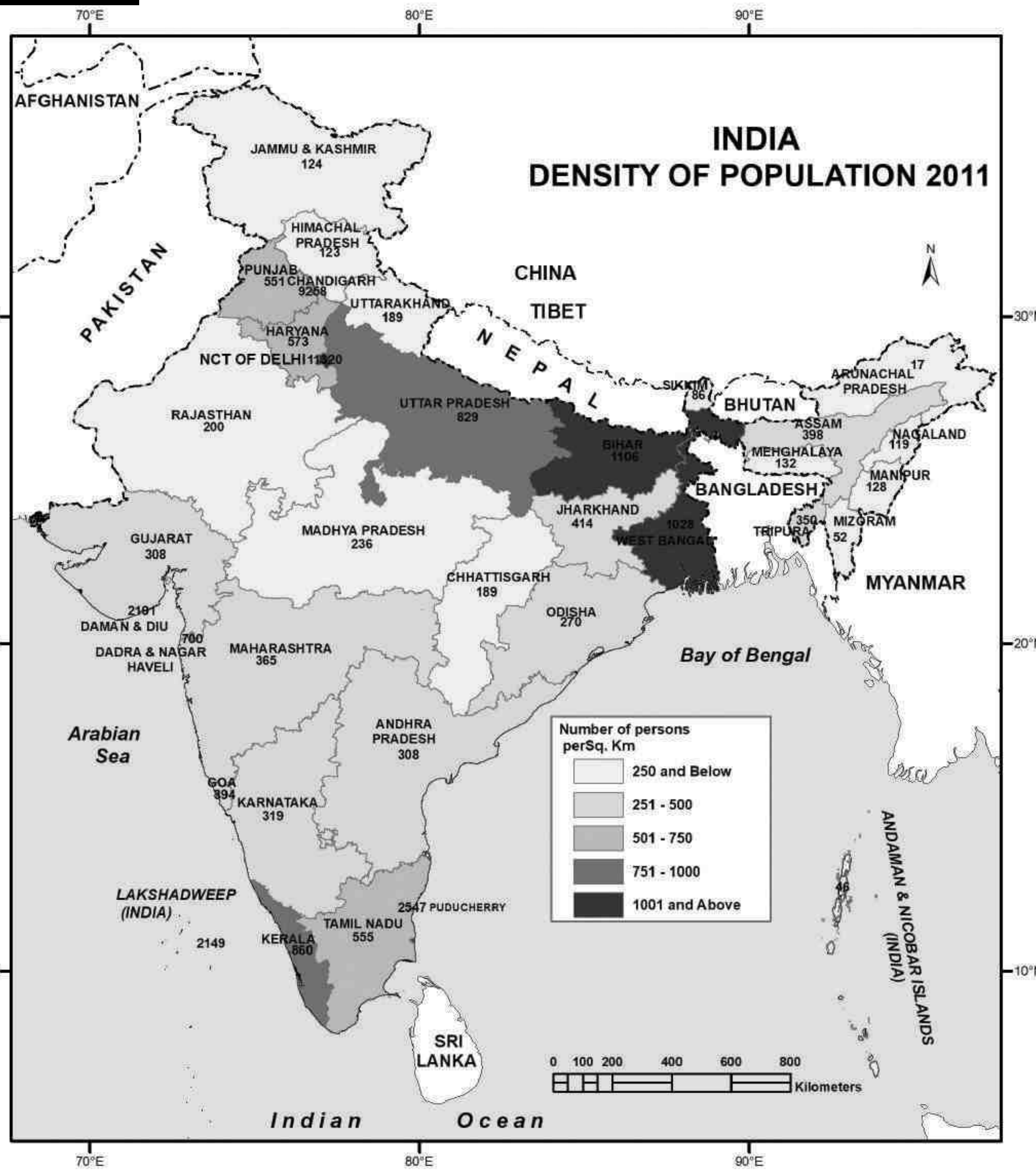


Fig. 21.5 India: Density of Population (2011)

According to 2011 census, the density of population in India is 382 persons per square kilometre. Over the last 110 years (1901 to 2011) density has increased about five times. It has increased from 77 in 1901 to 382 .in 2011. The increase has been very rapid after independence. The density of population was 117 persons per square kilometre in Census 1951 (the first census conducted after independence).Since independence, density has increased about three times. When we say that the density of population of India is 382 persons per square kilometre, this does not mean that population is exactly 382 persons in each and every square kilometre.

In reality, the distribution of population in India is highly uneven. In the below given section, we will discuss spatial variation of density in India by taking state as an unit area of analysis.

Population Density: An Inter-State Level Analysis

Population density can be described or interpreted in a couple of ways depending upon its purpose. For finding out a broad distribution pattern, density is calculated on the basis of large units like states. If information is needed for more accurately, the smaller units like districts or even tehsils are used. Let us find out a broad pattern of population density in India by taking state as an unit area of analysis.

You will get a clear picture about the variations of density of Population in India from the fact that in Arunachal Pradesh the average number of population is only 17 persons per square kilometre, whereas it is 11,320 persons per square kilometre in National Capital Territory of Delhi as per 2011 census.Among the states, northern Indian States, Bihar (1106), West Bengal (1028) and Uttar Pradesh (829) have higher densities, while Kerala (860) and Tamil Nadu (555) have higher densities among the southern Indian states. States like Assam, Gujarat, Andhra Pradesh, Haryana, Jharkhand, and Odisha have moderate densities. The hill states of the Himalayan region and North eastern states of India (excluding Assam and Tripura) have relatively low densities while the Union Territories (excluding Andaman and Nicobar islands) have very high densities of population.

On the basis of availability of state level data, the density of population in India can be broadly divided into three zones: the areas of high density, moderate density and low density.

(i) **Areas of High Density:** In the map given above (Fig. 21.1) the areas having a density of population of more than 400 persons per square kilometre are included in this category. These areas have a high density due to fertile land and high amount of precipitation namely West Bengal, Bihar, andKerala. Can you identify the other states from the above given map that falls in this category? In these regions, a larger number of people can be provided sustenance per unit of area due to availability of fertile land which can produce more food for a large number of people. But the situation is entirely different in the case of Union Territories like Delhi, Chandigarh and Pondicherry. These regions are highly urbanised and offer job opportunities in industrial and service sectors. Thus we can say that the areas having fertile soil and those having good employment opportunities are densely populated. Find out which are the other states which have high density of population.

(ii) **Areas of Moderate Density:** States and Union Territories in which the density of population ranges between 100 and 400 persons per square kilometre are categorised as areas of moderate density of population. They are Andhra Pradesh, Assam, Dadra & Nagar Haveli, Goa, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tripura, Chhattisgarh, Uttarakhand, Himachal Pradesh, Nagaland, Manipur and Meghalaya. This region includes largest part of the country in terms of area. Broadly speaking moderate density of population is characterised by the areas in which the agriculture is handicapped by rugged topography, lower amount of precipitation and paucity of water for irrigation. The scope for developing primary and secondary activities is quite large if the facilities are provided in this area. For example, at the time of independence Chhotanagpur region was a sparsely populated area but development in the field of mining and industries in this part of the country has been mainly responsible for moderate density of population in this region.

(iii) **Areas of Low Density:** All the remaining parts of India having a density of population less than 100 persons per square kilometre may be classified under this category. The States and Union Territories falling under this category include Arunachal Pradesh, Mizoram, Sikkim and Andaman and Nicobar Islands. Low density of population areas are characterised by rough terrain, low rainfall or unhealthy climate. Due to the above reasons the prospects of earning livelihood is low in these areas. Agriculture cannot be developed in too dry or cold areas. Uneven topography and poor agricultural resources put a limit on urbanisation and industrialisation. Therefore, the number of persons that can be supported per unit area is low in such regions. Difficulties exist not only in transport and communication in the hilly and mountainous areas but also in the overall levels of economic development. That is why the density of population in all these areas is low.

INTEXT QUESTIONS 21.2

1. Name three states having a high density of population

   (i) .... (ii) ....and (iii) ....

2. Name any three Union Territories in India which fall under the areas of high density of population

   (i) .... (ii) ....and (iii) ....

3. Name any three sates falling under the category of areas of low density of population.

Notes

(i) .... (ii) ....and (iii) ....

4. Name any one Union Territory having a low density of population

---

5. Fill in the blanks with most appropriate words given in the brackets.

   (a) Areas receiving ample precipitation and having fertile soils are likely to have a .... density of population. (high, moderate, low)

   (b) Areas suffering from droughts and having a rough terrain are likely to have a .... density of population. (high, moderate, low)

21.4 CHALLENGES OF GROWING POPULATION

Till now we have discussed size and growth of population. We have also discussed distribution of population, and factors affecting distribution of population. Looking at the huge population, there has been different views relating to the size and growth of population in the country. These views can be broadly grouped under two categories. These broad views are as follows:

1. Huge number of population act as a deterrent for the overall development of the country.

2. Number and growth of population is not the real problem

The first one is a pessimistic view whereas the latter one is an optimistic view. In the following paragraphs, we will discuss some of the main arguments for and against both views.

1. **Huge number of population act as a deterrent for the overall development of the country:** The extreme version of the population-as-a-serious-problem position attempts to attribute almost all the India's economic and social evils to excessive population growth. It has a negative impact on economic development by way of hampering various sectors like education, health, environment, food, economic growth. Similar view influenced the thinking of policy makers and planners in India till late 1970's.Various population control measures were implemented during various Five-Year Plans. After 1975-77, there was a shift in policy by changing the nomenclature from 'family planning' to 'family welfare'. But the real change in population policies were observed after International Conference on Population and Development (ICPD) was organised at Cairo, Egypt in 1994. This was fully reflected in National Population Policy, 2000.

2. **Number and growth of population is not the real problem:** The Problem is not population growth but 'Some Other Issue'.These are under development, inequitable distribution and access to resources, subordination of women etc. As long as the vast

majority of people in developing countries like India remain impoverished, uneducated, the large family will constitute to be the only real source of social security. The fact is that the developed countries, with less than 25 per cent of the world's population, consume almost 80 per cent of the world's resources. According to this argument, the developed nations should curtail, or cut back on their excessively high consumption standards, rather than having the less developed nations restrict their population growth. The latter's high fertility is really due to their low levels of living. It is this combination of rising affluence and extravagant, selfish consumption habits in rich countries and among rich people in poor countries which should be the world's major concern, not population growth.

There has been debates and discussion on the above mentioned issue both at national and international level. International Conference on Population and Development (ICPD) held at Cairo, Egypt in 1994 is a milestone in providing a new direction in population issues. In the below given section let us briefly discuss highlights of ICPD.

International Conference on Population and Development

International Conference on Population and Development (ICPD) was organised at Cairo, Egypt in 1994. ICPD is considered as a watershed in the history of population issues. It brought a paradigm shift in the field of population issues. Do you know what a paradigm shift is? In simple term it refers to shift in frameworks, strategies and approaches relating to population related issues. In this case the paradigm shift was from population control to creating an enabling environment focussing on improving quality of life that would help individuals to make a judicious decision. In other words, population was no longer refers to mere numbers, figures and statistics but about people and improving their quality of life. It was also agreed that no force, no coercion, no incentives and disincentives are required.Because, incentives and disincentives are either coercive or ultimately tend to be coercive and are in fact counterproductive. Coercion infringes upon human rights and inhibits human development. There was a consensus amongst all the 179 participating government representatives that the equality and empowerment of women is a global priority. It approached this not only from the perspective of universal human rights, but also as an essential step towards eradicating poverty and stabilizing population growth. A woman's ability to access reproductive health and rights is cornerstone of her empowerment.

A total of 179 governments including India signed the ICPD Programme of Action which include the following:

- Provide universal access to family planning and sexual and reproductive health services and reproductive rights;

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- Deliver gender equality, empowerment of women and equal access to education for girls;
- Address the individual, social and economic impact of urbanization and migration;
- Support sustainable development and address environmental issues associated with population changes.

The ICPD Programme of Action (PoA) placed "individuals" in the centre of development with a focus on building pillars of Human Development, Human Rights, Gender Equity and Equality. The central theme of the ICPD was to forge a balance between population, sustained economic growth and sustainable development. The objective of the agreement reached at the Cairo Conference was to raise the quality of life and enhance well-being and to promote human development. The Programme of Action (PoA) rightly emphasized the need to integrate population concern fully into development strategies and planning, taking into account the interrelationship of population issues with goals of poverty eradication, food securityadequate shelter, employment and basic services (like health and education) for all.

Two fundamental changes have occurred in recent times in conceptualizing and implementing Population Policies. First is to ensure that Population Policies and Programmes address the root cause of high fertility such as persistent gender disparities in access to education, health, employment and other productive resources. The second is to expand existing Family Welfare Programme beyond contraceptive delivery to include a range of Reproductive Health Services with a greater emphasis on quality of care and individual's right. Now the focus has become broader and holistic and different in nature. Earlier, Total Fertility Rate (TFR) and Contraceptive Prevalence Rate (CPR) used to be the fixation of most population programmes as they also served as indicators of success. ICPD replaced them with quality of care, informed choice, gender factor, women's empowerment and accessibility to a whole gamut of reproductive health services.

ICPD placed population, reproductive health and gender equality in a human rights-based framework. What does this mean? A human rights-based approach to programming differs from the basic needs approach. In this approach, it recognizes the existence of rights. It also reinforces capacities of duty bearers (usually governments) to respect, protect and guarantee these rights. In a rights-based approach, every human being is recognized both as a person and as a right-holder. A rights-based approach strives to secure the freedom, well-being and dignity of all people everywhere, within the framework of essential standards and principles, duties and obligations. The rights-based approach supports mechanisms to ensure that entitlements are attained and safeguarded. Governments have three levels of obligation: to respect, protect and fulfil every right.

INTEXT QUESTIONS 21.3

1. In which country the International Conference on Population and Development (ICPD) was organised in 1994?

2. How many countries have signed the ICPD Programme of Action?

3. State any two points given in ICPD Programme of Action.

WHAT YOU HAVE LEARNT

Human resource is the most important resource in an area. It is the quality rather than quantity of this resource which is important for the economic development of a country India is the second most populous country of the world after China. The distribution of population is generally studied in terms of density. The density of population in India is not uniform. On the basis of density of population, India can be divided into three broad regions of high density, the areas of moderate density, and the areas of low density.

The factors which affect density and distribution can be grouped into two categories. They are physical factors and socio-economic factors. The population of India has been increasing very rapidly since 1921 and the rate of growth has been increasing. The growth rate of population is determined by the birth rate, death rate and migration of an area. Like density and distribution, the growth rate is also not uniform throughout the country. Looking at the huge population, there has been different views relating to the size and growth of population in the country. These views can be broadly grouped under two categories. These broad views are as follows: (i) huge number of population act as a deterrent for the overall development of the country; and (ii) number and growth of population is not the real problem.

TERMINAL QUESTIONS

1. What are the major trends in population growth in India? Discuss the factors responsible for it with suitable examples.

2. Discuss in brief the distribution of population in India. Outline some of the areas of high, moderate and low density of population.

3. Explain the Plan of Action suggested by International Conference on Population and Development.

ANSWERS TO INTEXT QUESTIONS

21.1

1. (a) (ii)

   (b) (ii)

2. Nagaland

3. Kerala

21.2

1. West Bengal, Kerala, Bihar, U.P. Punjab, Tamil Nadu and Haryana (Any three)

2. Delhi, Chandigarh, Pondicherry, Lakshadweep and Daman & Diu (Any three)

3. Sikkim, Mizoram, Arunachal Pradesh

4. Andaman and Nicobar Islands

5. (a) High

   (b) Low

21.3

1. Egypt

2. 179

3. ● Provide universal access to family planning and sexual and reproductive health services and reproductive rights;

   ● Deliver gender equality, empowerment of women and equal access to education for girls;

- Address the individual, social and economic impact of urbanization and migration;
- Support sustainable development and address environmental issues associated with population changes. (Any 2)

Notes

22

POPULATION COMPOSITION

In the previous lesson, we studied about distribution, density and growth of population of India. We also looked into the causes and consequences of distribution and density of population. We pondered over the causes and consequences of rapid growth of population for the past hundred years. In this lesson we will study composition of Indian population along certain dimensions. Firstly, we would like to note the location and size of settlements in which people prefer to live and why they do so. This constitutes the rural and urban composition of population. Next we will find out if males and females are equal in number and more importantly in status. Age composition of Indian population and its implication would be yet another focal point of our inquiry. Then we would move away from purely demographic to socio-cultural dimensions of our population composition. This will help us to know the linguistic and religious composition of our society. Finally, we have a glance at scheduled caste and scheduled tribespopulation with regard to their numbers, location and distribution. Last but not the least important focal point of our study would be the levels of literacy in our country. All these analytical aspects would help us to look at our population not only as mere numbers but as a human resources as well.

OUTCOMES

After studying this lesson, learner:

- explains the rural-urban, Sex ratio and age composition of Indian population;
- describes the spatial and temporal change in levels of literacy;
- analyses the concentration of scheduled castes, scheduled tribes, religious and linguistic composition of population and
- describes recent population issues related to gender equality and reproductive health.

22.1RURAL-URBANCOMPOSITION

Population is divided into two parts-rural and urban on the basis of the size and occupation of settlements. The rural population consists of small sized settlements scattered over the countryside. Urban population is one that lives in large size settlements i.e. towns and cities. However, more importantly this division is based on occupational structure. In India, rural area is defined as one where three-fourths or more of its population is engaged in primary occupations such as farming, animal rearing, forestry, fishing, quarrying etc. On the other hand, urban area is one where three-fourths or above of its population is engaged in non-agricultural activities such as manufacturing, trade, transport, communication, banking and social services like health, education, administration etc.

Table 22.1 Rural and Urban Population in India (1911-2011)

Census year	**Percentage of total Population**	
	Rural	Urban
1901	89.2	10.8
1911	89.7	10.3
1921	88.8	11.2
1931	88.0	12.0
1941	86.1	13.9
1951	82.7	17.3
1961	82.0	18.0
1971	80.1	19.9
1981	76.7	23.3
1991	74.3	25.7
2001	72.2	27.8
2011	68.8	31.2

Source: Census of India

The total population of India spreads over more than 6, 40, 867 villages and 7,935 towns. India, proverbially, is considered to be a country of villages. Even today, about 69% of the

Notes

total population of India lives in villages. But the proportion of rural population has been decreasing in each successive census (See Table 22.1). Consequently the proportion of urban population to total population has been increasing slowly but steadily. It was as low as 10.8% in 1901 and rose to 31.2% by 2011. The question arises why is it so? It is because the rate of growth of urban population is higher than that of rural population. The Growth in Urban population is significantly higher at 31.8% that in Rural population (12.18%) during 2001-11. Growth in Rural Population in India is steadily declining since 1991. However all this growth is not a result of only the natural increase of population.In fact, much of the growth of urban population is due to high rate of migration of people from rural to urban areas. Very often limits of municipal or city Corporation areas are extended to cover neighbouring villages or suburbs.

Half of the total urban population of India lives only in five states. These five states are Maharashtra, Uttar Pradesh, Tamil Nadu, West Bengal and Andhra Pradesh. Gujarat, Karnataka, Madhya Pradesh, Bihar, Rajasthan and Union Territory of Delhi, have about 32 per cent of urban population of the country. Rest of the urban population (about 18%) is spread over the remaining states and Union Territories

According to 2011 census, 53 cities have more than 1000000 population each. They are called the metropolitan or million plus cities. These 53 metropolitan cities alone account for 37.8% of the total population. This highly rapid growth of metropolitan cities will brings several problems like supply of housing, electricity, water, school, dispensaries, ration shops etc. Let us now find out the distribution of these metropolitan cities in India.

All the 53 metropolitan cities are arranged in terms of descending orders of population. These are Mumbai, Delhi, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Jaipur, Kanpur, Lucknow, Nagpur, Ghaziabad, Indore, Coimbatore, Kochi, Patna, Kozhikode, Bhopal, Thrisur, Vadodara, Agra, Vishakhapatnam, Mallapuram, Thiruvananthapuram, Ludhiana, Kanur, Nasik, Vijaywada, Madurai, Varanasi, Meerut, Faridabad, Rajkot, Jamshedpur, Srinagar, Jabalpur, Asansol, Vasai-Virar, Dhanbad, Allahabad, Aurangabad, Amritsar, Jodhpur, Ranchi, Raipur, Kolam, Gwalior, Durg-Bhilainagar, Chandigarh, Tiruchirapalli, and Kota.

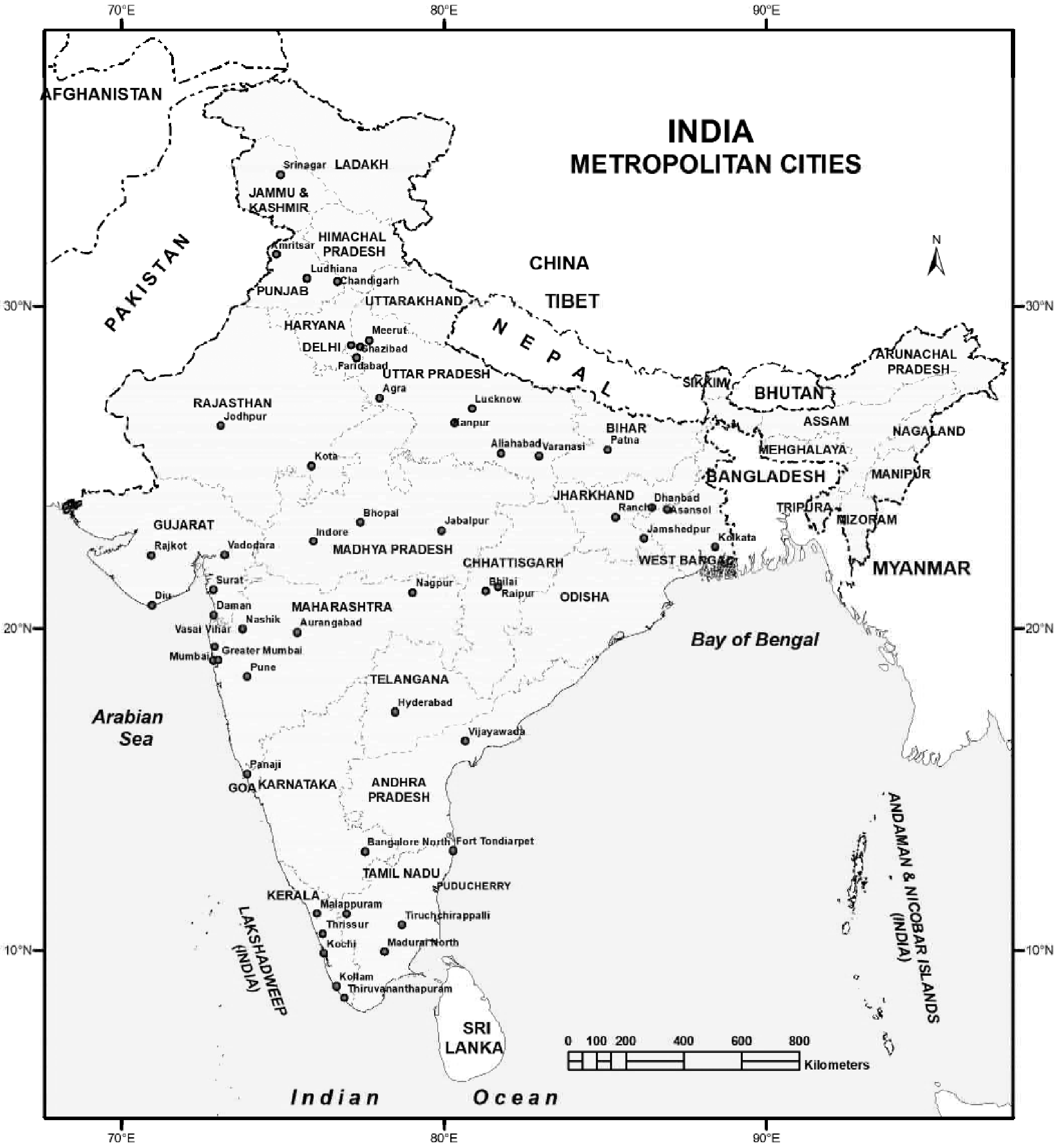


Fig. 22.1 India: Major Metro Cities

INTEXT QUESTIONS 22.1

1. Fill in the blanks with suitable words from those given in the bracket

(Secondary and tertiary, increasing, 53, lower, primary)

(a) The growth rate of rural population is ------than the growth rate of urban population in India.

(b) The rural population is mainly engaged in ----- activities whereas the urban population is primarily engaged in ----- activities.

(c) Proportion of urban population has been --- since 1921.

(d) Altogether there are --- "million cities".

22.2 SEX-RATIO

Sex Ratio refers to the number of females per thousand males of an area. According to the Census of India 2011, there are only 943 females per thousand males. So sex composition in India is unfavourable. It means there are less number of females than the number of males. When the number of females is more than the males it is said to be favourable. If we analyse the data over a period of 100 years (1911-2011), it has been observed that there has been steady decline of sex ratio in the country except some marginal increases in the 1951, 1981, 2001 and now in 2011.

Table 22.2: Sex Ratio in India 1911-2011

Census Year	Sex Ratio
1911	964
1921	955
1931	950
1941	945
1951	946
1961	941
1971	930
1981	934
1991	927
2001	933
2011	943

Source: Census of India

As far as states are concerned only Kerala has favourable sex ratio (1058). It has the highest sex ratio in the country. The lowest sex ratio among states is found in Haryana (877). Among the Union Territories, Pondicherry has the highest sex ratio in the country with (1001) females per thousand males, whereas the lowest sex ratio is found in Daman and Diu where there was 618 females per thousand males. The significant trend with regard to the sex ratio in the country is that it has been a steadily declining except some marginal increases in the 1951, 1981, 2001 and now in 2011 censuses.

Why is there a decline in the sex ratio in India? The major reasons for the declining sex ratio in India are the higher rate of maternal mortality and a high child mortality among the female children. These two causes are related to the comparatively lower status of the women in our society. Apart from this our socio-cultural values and beliefs like male preference in our society are responsible for the declining sex ratio. The female mortality rate is likely to be reversed with the improving status of the women and also due to better health facilities and education particularly of the females. The improved medical facilities have helped in checking the rate of child mortality and the deaths of mothers during child birth.

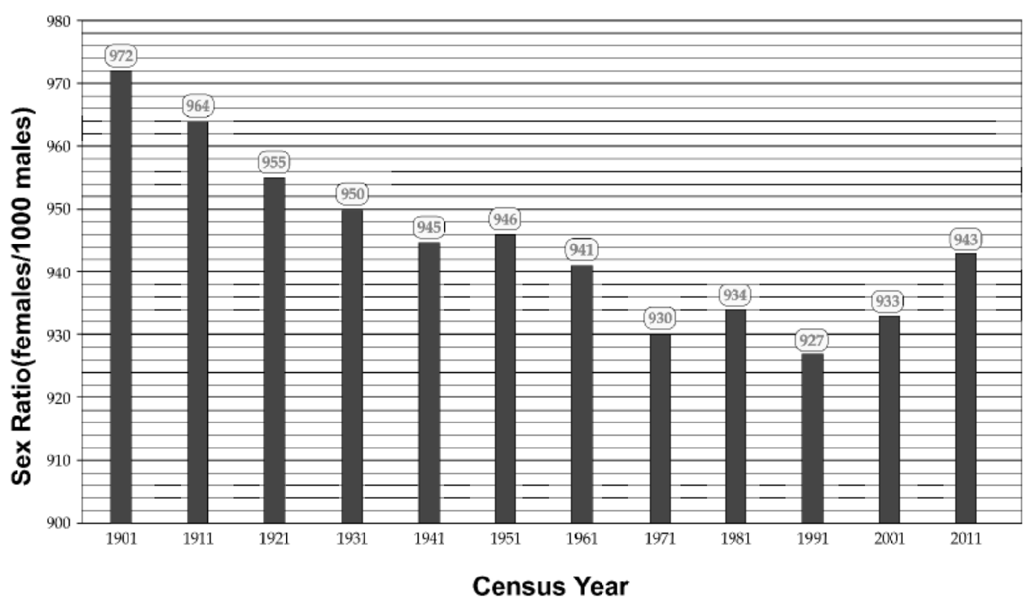


Fig. 22.2 India: Trends of Sex Ratio 1901-2011

Gender Equity, Equality and Empowerment of Women

Gender equity and equality is a human right. Women are entitled to live with dignity and with freedom from want and from fear. Gender equality is also a precondition for advancing development and reducing poverty: Empowered women contribute to the health and productivity of whole families and communities, and they improve prospects for the next generation. Still, despite solid evidence demonstrating the centrality of women's empowerment to realizing

Notes

human rights, reducing poverty, promoting development and addressing the world's most urgent challenges, gender equality remains an unfulfilled promise.

Reproductive Health and Reproductive Rights

Reproductive health is a state of complete physical, mental and social well-being in all matters relating to the reproductive system and to its functions and processes. It implies that people have the capability to reproduce and the freedom to decide if, when and how often to do so. Implicit in this is the right of men and women to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice, as well as other methods of their choice for regulation of fertility, which are not against the law, and the right of access to health-care services that will enable women to go safely through pregnancy and childbirth. Reproductive health care also includes sexual health, the purpose of which is the enhancement of life and personal relations.

Reproductive rights embrace certain human rights that are already recognized in national laws, international human rights documents and other relevant UN consensus documents. These rights rest on the recognition of the basic right of all couples and individuals to decide freely and responsibly the number, spacing and timing of their children and to have the information and means to do so, and the right to attain the highest standard of sexual and reproductive health. They also include the right of all to make decisions concerning reproduction free of discrimination, coercion and violence. Full attention should be given to promoting mutually respectful and equitable gender relations and particularly to meeting the educational and service needs of adolescents to enable them to deal in a positive and responsible way with their sexuality.

Reproductive health-care programmes should be designed to serve the needs of women, including adolescents, and must involve women in the leadership, planning, decision-making, management, implementation, organization and evaluation of services. Innovative programmes must be developed to make information, counselling and services for reproductive health accessible to adolescents and adult men. Such programmes must both educate and enable men to share more equally in family planning, domestic and child-rearing responsibilities and to accept major responsibility for the prevention of STDs

INTEXT QUESTIONS 22.2

Answers the following questions in brief:

(a) Name the state having the highest sex ratio in India

(b) Name the state having lowest sex ratio in India

(c) What is the sex ratio of India according to Census of India, 2011?

(d) Define sex ratio.

22.3 AGE COMPOSITION

Age-sex pyramid refers to the composition of population in terms of the age and sex of people. It gives an indication regarding the growth rate of population and the nature of population in terms of working and non-working sections. As per the census of India 2011, children up to 14 years of age account for 30.80% of the total population. The age group of 15-59 years accounts for 60.7% of total population and the age group of 60 years and above for 8.4% of population. The age structure has been undergoing some gradual changes during the recent decades. One of the trends is that proportion of the younger population i.e. in the age group of 0-14 years is declining and the percentage of persons on the working age group, i.e. 15 to 59 age group as well as old age population i.e. 60 years and above is increasing. But in 2001 Census, the percentage of persons in the age group of 15-59 has increased from 56.9% in 2001 Census to 60.7 % in 2011 Census. However, the proportion of people in old age group has increased from 7.4% in 2001 to 8.7% in 2011 census. The proportion of young population i.e. 0-14 years declined from 35.3% in 2001 census to 30.80% in 2011 census (Fig.22.3).

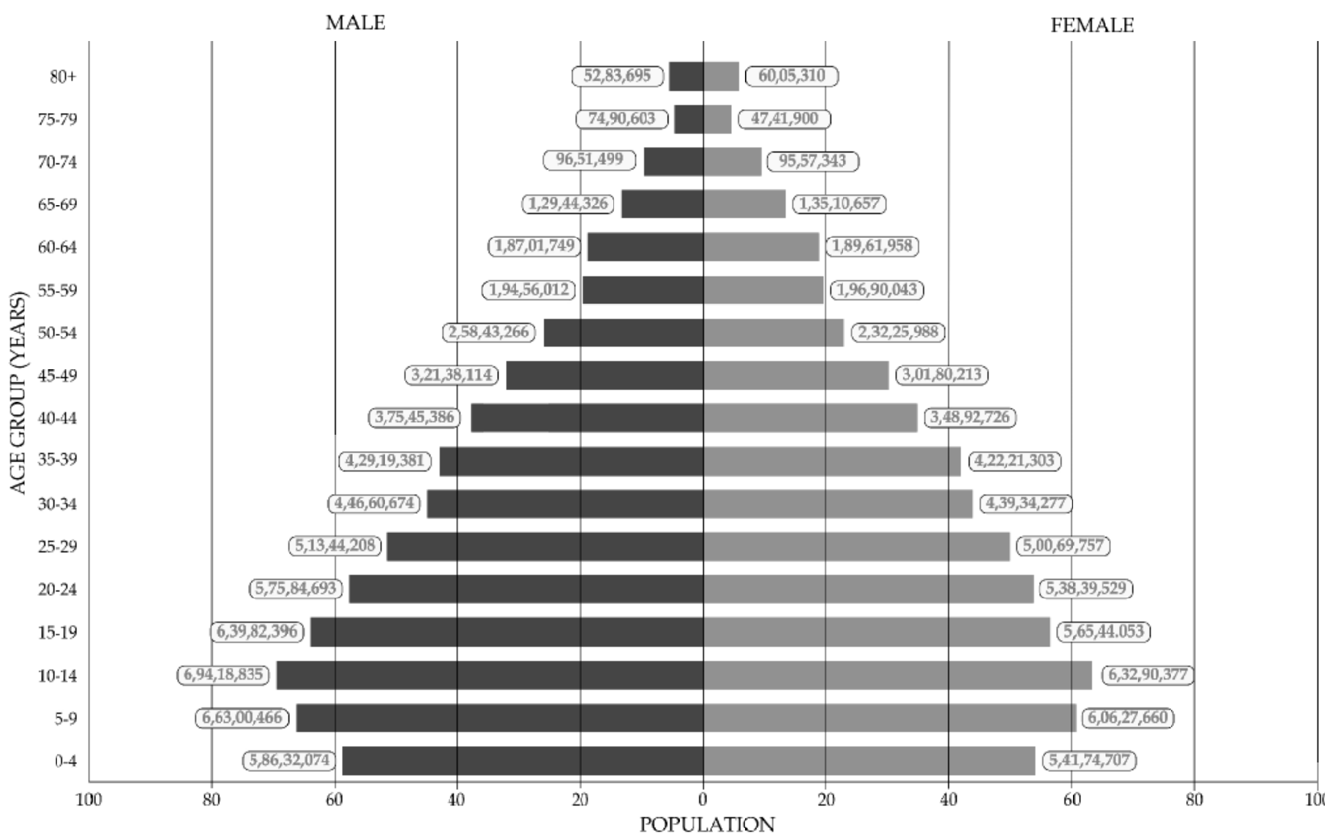


Fig. 22.3 India: Age-Sex Composition 2011

DEMOGRAPHIC DIVIDEND

Have you heard this term? Now a day's planners, policy makers, political leaders and academics have been talking about this for quite some time. It has been clear from the discussion in the previous section that India has been adding large number of population each year in terms of absolute number. If you look at their age composition, you will find that a significant proportion of them are youth population (15-35 years). According to 2011 India there were 62.5 per cent population in the age group 15-59. As you know this is the active working population. This increase in share of active working population helps in reaping the benefits of 'Demographic Dividend'. In simple terms demographic dividend can be expressed as a limited time 'window of opportunity' for rapid economic growth. However, the challenge before the nation is to make them skilled human resource so that they can contribute significantly for nation building in general and improve their standard of living in specific.

22.4 LINGUISTIC COMPOSITION

India has also linguistic diversity like physical environment. The languages spoken and their dialects number is in hundreds. In 1961 census, 1652 languages were listed as mother tongues in India. Out of these only 23 languages together accounted for 97% of total population of the country. Out of these 23 numerically major languages, Constitution of India recognizes only 22 languages besides English in the Eighth Schedule of the Constitution. These languages are Assamese, Bengali, Hindi, Telugu, Tamil, Malayalam, Kannada, Marathi, Gujarati, Oriya, Punjabi, Kashmiri, Sanskrit, Konkani, Sindhi, Nepali, Manipuri, Urdu, Bodo, Dogri, Maithili and Santhali. Out of these above mentioned 22 languages, Hindi is spoken by most of the people whereas Sanskrit is spoken by the least. Of these languages, 14 were initially included in the Constitution. Sindhi language was added in 1967. Thereafter three more languages viz., Konkani, Manipuri and Nepali were included in 1992. Subsequently Bodo, Dogri, Maithili and Santali were added in 2004.

The languages also vary slightly in terms of the meaning of different words and their pronunciation. Thus the people speaking one particular languages speak it with some difference in vocabulary and pronunciation from one place to the other. Such variations in the way of speaking of a language lead to emergence of dialects of language. Thus, a dialect is something akin to a part of some language and they can be thought as regional language also. Some of the examples of the dialects of Hindi are Rajasthani, Harayanavi, Bhojpuri or Poorvi dialects etc. Language is an important constituent of culture and various languages and their dialects are spoken in different parts of India. It makes Indian culture rich and diversified. Also, the languages have an almost complete regional identity in the country and the distribution of major languages has been considered as a basis for re-organization of states after independence.

On the basis of numerical strength, India can be divided into twelve principal linguistic regions. So linguistic region is an area in which most of the people speak a common language. The languages forming linguistic regions in India are Kashmiri, Punjabi, Hindi/Urdu, Bengali, Assamese, Oriya, Gujarati, Marathi, Tamil, Telugu, Kannada and Malayalam.

CLASSIFICATION AND DISTRIBUTION OF INDIAN LANGUAGES

Though all the languages spoken in India seem to be different from each other, they can be grouped into four linguistic families on the basis of their roots and genesis. The four linguistic families are: Austric, Dravidian, Sino-Tibetan and Indo-European Family.

(i) The speeches of the Austric family are spoken by tribal people in Meghalaya, Andaman & Nicobar Islands and in parts of Central Indian tribal belt, especially in the districts of Santhal Praganas, Ranchi and Mayurbhanj.

(ii) The languages and dialects of Sino-Tibetan family are spoken by tribal people in North-Eastern region of the country and in the Sub-Himalayan region in the north and North West. These languages are spoken by people living in the Union Territory of Ladakh, parts of Himachal Pradesh and Sikkim also.

(iii) The speakers of the languages of Dravidian family are more numerous in southern part of India. Tamil Nadu, Andhra Pradesh, Karnataka and Kerala are the states Union Territory of Pondicherry where these languages are spoken by the majority of population. A large number of tribal living in peninsular plateau region also speak speeches of this family.

(iv) The speaker of the languages of Indo-Aryan family are concentrated more in the northern and central parts of the country. The entire North Indian plain is inhabited by the speakers of this family. Maharashtra and Madhya Pradesh also have large population of speakers of these languages.

The proportion of the speakers of languages of different families in the total population varies significantly. While the Indo-Aryan family languages are spoken by more than 70% of the people, the Sino-Tibetan languages are spoken by only about 0.85 percent of the population and Dravidian languages are spoken by about 20 percent of the people.

INTEXT QUESTIONS 22.3

Fill in the blanks with the most appropriate words out of those given in the brackets:

1. (a) One of the languages belonging to the Austric Family of languages is ------- (Santhali, Hindi, Bengali)

Notes

(b) Hindi is a languages belonging to the --- family of languages (Dravidian, Aryan, Austric)

(c) Speakers of Austric languages are concentrated primarily in --- - (tribal areas of central India, western Himalayas, Konkan region

22.5 RELIGIOUS COMPOSITION

Indian society has a large number of religious communities. But, broadly there are seven major religions. The majority of people follow one of these seven major religions. These are Hinduism, Islam, Christianity, Jainism, Budhism, Sikhism and Zoroastrians. Hindus are the largest religious community in India .

Table 22.4 Population by Religion in 2011 Census

S. No.	Religion	In Crore (%)
1	Hindu	96.63 (79.8%)
2	Islam	17.22 (14.2%)
3	Christian	2.78(2.3%)
4	Sikh	2.08 (1.7%)
5	Buddhism	0.84 (0.7%)
6	Jain	0.45 (0.4%)
7	Other Religions and Pursuations	0.79 (0.7%)
8.	Religion Not Stated	0.25 (0.2%)

According to 2011 census, 79.8% percentage of population follow Hindu religion. Followers of this religion are more concentrated in the northern plains and the northern parts of the plateau region. However they are numerous in all parts of the country except a few north-eastern states and union territory of Lakshadweep. But the distribution of the other religious communities is less continuous and there are only some pockets in which they have larger concentration.

The largest number of Muslim population is in Uttar Pradesh followed by West Bengal and Bihar. But the Muslim population make a large proportion of the total population in Jammu and Kashmir and Union Territory of Lakshadweep. Apart from these above mentioned states and Union Territory, other states where Muslims have significant presence (more than national average) are Assam and Kerala. If we look at spatial distribution, then it is observed that most of these states stretch over Northern Plains except Kerala and Jammu and Kashmir.

The largest concentration of Christians is found in the state of Kerala followed by Tamil Nadu and Andhra Pradesh. But if we look at the proportion to total population, then it is found in some of the north eastern states namely Mizoram, Meghalaya and Nagaland. As far as Sikhs are concerned more than ¾th Sikh population are found in Punjab alone. Besides Punjab, neighbouring districts of Haryana and Rajasthan also have concentration of Sikh population. Apart from these states, Terrai region of Uttarakhand and National Capital Territory of Delhi have significant number of Sikh population. As far as Buddhists and Jains are concerned, Maharashtra has the largest number of population belong to both the religion. Apart from Maharashtra, traditional pockets of Buddhists are Union Territory of Ladakh, Dharamsala (Mcleodganj) and surrounding districts of Himachal Pradesh, Sikkim, Arunachal Pradesh and Tripura. Similarly, besides Maharashtra, Jains have significant presence in the states of Rajasthan, Gujarat, Madhya Pradesh and Chhattisgarh.

INTEXT QUESTIONS 22.4

1. In which part of India do most of the Zoroastrians live?
2. In which states do most of the Indian Christians live?
3. Name one state having a large concentration of Muslim population of India.
4. In which states of India do most of the Indian Budhists live?

22.6 SCHEDULED CASTES AND SCHEDULED TRIBES COMPOSITION AND DISTRIBUTION

The Constitution of India recognises a number of castes and tribal groups. These castes and tribes are called Scheduled Castes (SC) and Scheduled Tribes (ST) respectively. They are the major constituents of the population of India. According to the census of India 2011 Scheduled Castes and Scheduled Tribes constitute 16% and 8.2% respectively. Their distribution is very uneven throughout the counry.

(A) Scheduled Castes

Numerically they have the largest concentration in Uttar Pradesh followed by West Bengal and Bihar. Mizoram has the least SC population. The state of Nagaland and Union Territories of Lakshadweep and Andaman & Nicobar Islands do not have any notified SC Population. In terms of the proportion of the total population of a state they are most numerous in Punjab where they account for more than 28.85% percent of its total population followed by Himachal Pradesh (24.7%) and West Bengal (23.3%). The Scheduled Castes are by and large landless agricultural labourers, cultivators with small land holdings and small commodity producers or artisans. Due to the association with agricultural activities, their main concentrations are found in the alluvial and coastal plains of the country. That is why, the major concentrations are found in the states like Punjab, Uttar Pradesh, West Bengal, and Bihar. On the other hand the hilly and forested tracts and the tribal belt of the central and north east India have only a small population of the Scheduled Castes. The analysis at districts level pattern leads to the identification of the following three zones.

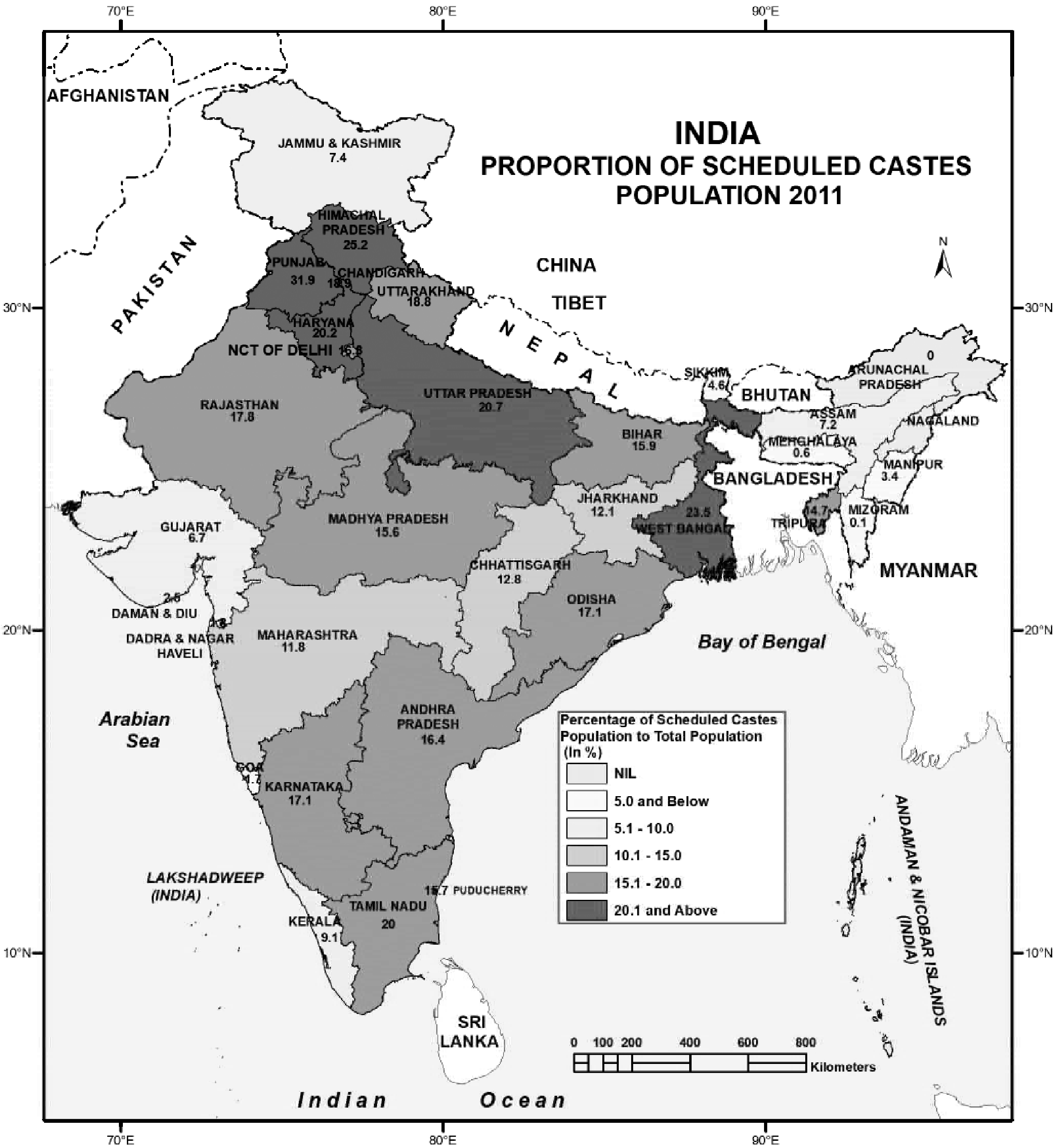


Fig. 22.2 India: Scheduled Caste Population

(i) Areas of High Concentration: There are two major areas with high concentration of Scheduled Castes. They are Indo-Ganga plain and the eastern coastal plain. Both these plains are endowed with fertile soil, adequate water supply and climate suited to the cultivation of a large variety of crops. These opportunities help to develop intensive agriculture which supports a large population.

(ii) Areas of Medium Concentration: The Scheduled Castes are moderately concentrated in the districts adjoining the zone of high concentration which has already been discussed above.

(iii) Areas of Low Concentration: Low concentration of Scheduled Castes is found in the central Vindhyas, Chhotanagpur region, the western dry region of Rajasthan, the hilly tracts of the North-East and the coastal parts of Karnataka and Maharashtra.

(B) Scheduled Tribes

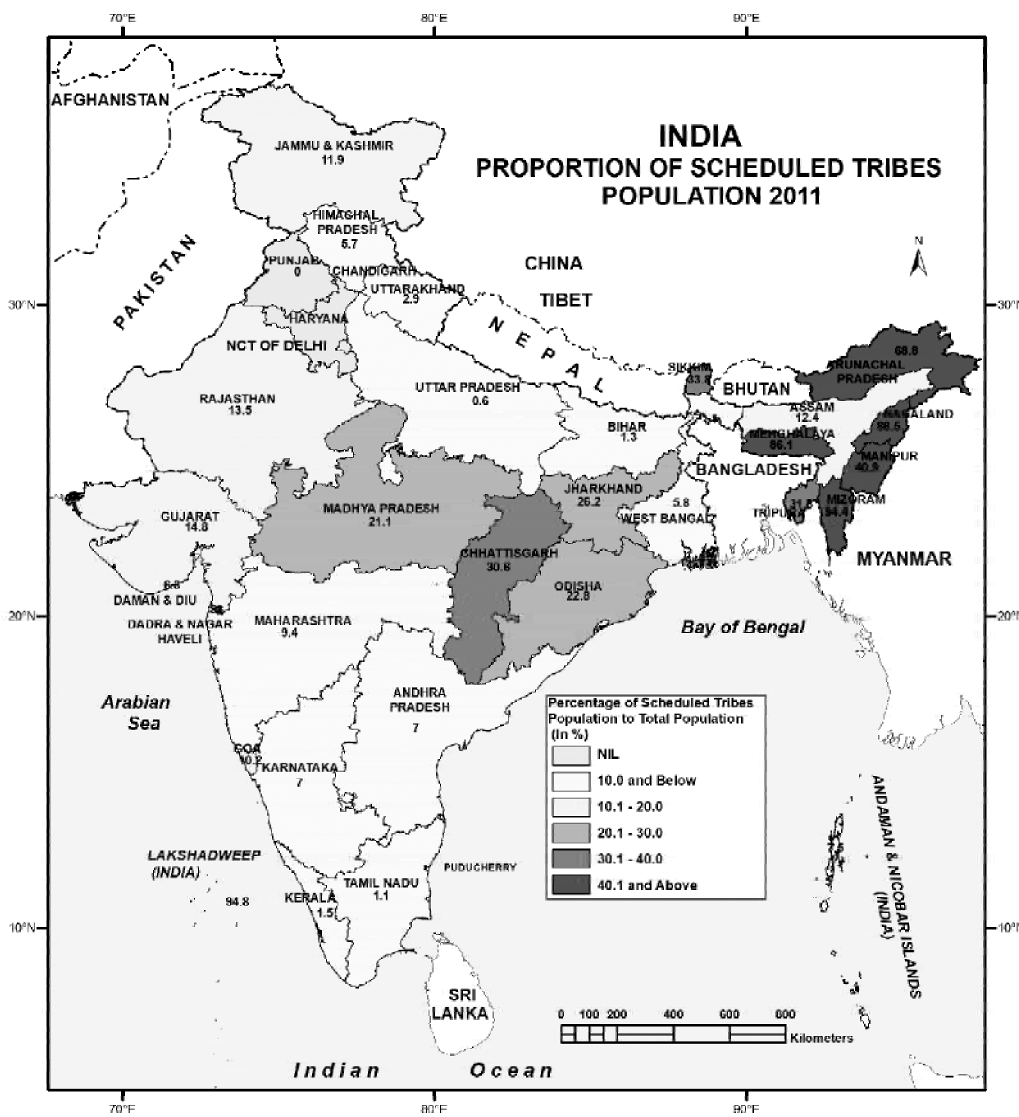


Fig. 22.3 India: Scheduled Tribe Population

The tribal people have a number of distinct characteristics which set them apart from the rest of the people. Generally, they live in isolation in the forested and hilly regions and they profess very old religious beliefs. Most of these groups are illiterate and do not have script of their languages. Most of them belief in super natural powers and super natural beings. The Scheduled Tribes are not uniformly distributed all over the country.

There are three main regions in which most of their population lives. These regions are

(i) the Central Indian belt comprising parts of Rajasthan, Gujarat, Madhya Pradesh, Chhatisgarh, Jharkhand, Orissa and West Bengal,

(ii) the North-Eastern region comprising the hilly areas of Assam, Meghalaya, Manipur, Mizoram, Nagaland, Tripura and Arunachal Pradesh and

(iii) the southern region comprising the hilly tracts of Tamil Nadu, Andhra Pradesh and Andaman & Nicobar Island.

It is evident from the above discussion and also from the map that the tribal population of India is more concentrated in a few specific regions. It will also be clear after a close study of the map that most of the tribal people live in the forested and hilly regions and areas of lower agricultural productivity. Most of these areas suffer from natural difficulties like rough terrain and climatic difficulties and the level of economic development in all these regions is very low. The natural resources have not been developed much and there is little development of means of transport and communication and this factor is also responsible for the low levels of development. Sometimes, it is thought that the levels of economic development in areas of tribal population is low because these areas are inhibited by the tribal people. This, however, is not true. These areas suffer from lower levels of development party due to in hospitable life in these regions is difficult and therefore these areas are occupied by the tribal people. In fact the tribal people originally did not settle in these areas of harsh environmental conditions by their own choice. They were rather pushed by the expanding modern civilization into these areas. Under the pressure of the successive invaders and the migrants, the earlier settlers of the country who could not fight with new powerful comers had to migrate into remote areas to save their cultural identify.

22.7 LITERACY

Literacy is generally defined as a person's ability to read, write and able to understand as well as to do some simple calculation. Despite this liberal definition, the rate of literacy in India is not very high. According to the Census of India 2011, the average literacy rate in India is 74.04 per cent. This percentage does not include the population below 7 years of age-group. The rate of literacy varies a great deal from one part of the country to the other. On the one hand, it is the state of Kerala having literacy rate as high as the 94.00 percent and on the other extreme is the state of Bihar, where this rate is only 61.80 per cent. In the Union Territories, Lakshadweep has the highest rate of literacy where it is 91.85 percent and the lowest rate is in Dadra & Nagar Haveli (76.24 per cent).

The rate of literacy varies between males and females also. The average rate of literacy among the males in India is 82.14 per cent which is higher than the females (65.46 per cent). Kerala has the distinction of highest literacy among both, males and females (96.11 and 92.07 per cent respectively), whereas Bihar has the lowest literacy rate among both males and females (71.20 and 51.50 percent respectively). Though the rate of literacy in India is moderate, it is increasing in each successive census. In 1911 it was less than 6 percent and it could rise to only about 16.7 percent by1951. The most noteworthy progress in this regard has been made after 1951 census. In 1961, the literacy rate was about 24 percent which rose to 74.04 percent by 2011. The most significant development in this regard has been the rate of increase in female literacy. The proportion of literate among the females was only 1.1 percent in 1911 which has increased to 65.46 percent in 2011. To a great extent, this is a result of the policies of the government, emphasising upon the universalisation of Elementary Education. The extended facilities of schools in the rural areas have helped considerably in raising the literacy rate in the country, especially among the females.

Though the literacy rate is increasing percentage wise in successive censuses, the number of illiterate is also increasing in absolute number in each successive census. For the first time in 2001 census, there is a decline in number of illiterates in comparison to previous census i.e. 1991. However their number is still very high. To solve this problem, Government has taken up various programmes like National Literacy Mission, Sarv Shiksha Abhiyan, New India Literacy Programme etc.

INTEXT QUESTIONS 22.5

Fill in the blanks with the most appropriate words out of those given in brackets.

1. (a) One of the areas of large concentration of tribal population in India is ___________________. (Punjab, Haryana, Jharkhand)

   (b) Scheduled castes population constitute the most significant proportion of the total population in the state of____________________. (Uttar Pradesh, Bihar, Punjab)

   (c) According to the census of India 2011, the average literacy rate of India is ____________ percent. (65.38, 74.04, 68.01)

2. Name any two programmes taken by Government of India to increase literacy rate.

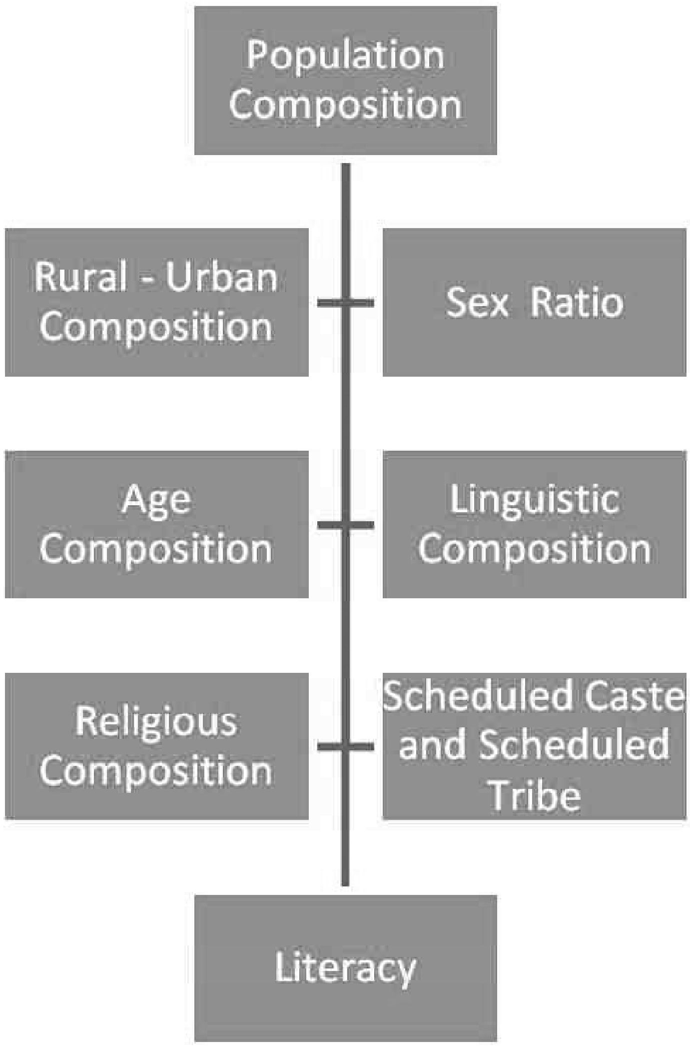
   (i)_________________________ (ii)_________________________

Notes

3. Which state having highest literacy among both males and females?

____

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Discuss in brief the following characteristics of Indian population.

   (a) age structure

   (b) rural-urban ratio and

   (c) sex ratio.

2. Give an account of literacy in India. .
3. What are the factors responsible for the decline in sex ratio? Discuss in brief.
4. Discuss the regional distribution of tribal population in India.
5. To which major linguistic families do most of the Indian languages belong? Give a brief account of the distribution of various linguistic families in the country

ANSWERS TO INTEXT QUESTIONS

22.1

(a) lower (b) primary, secondary and tertiary

(c) increasing (d) 53

22.2

(a) Kerala (b) Haryana

(c) 943

(c) It refers to the number of females per thousand males in an area.

22.3

(a) Santhali (b) Aryan

(c) Tribal areas of central India

22.4

1. In and around Mumbai.
2. TamilNadu, Kerala, Andhra Pradesh & North-Eastregion
3. Uttar Pradesh
4. Maharashtra & Arunachal Pradesh

22.5

1. (a) Jharkhand (b) Punjab

   (c) 74.04
2. National Literacy Mission, Sarva Siksha Abhiyan, New India Literacy Programme etc.
3. Kerala

23

HUMAN DEVELOPMENT

Whenever, we think about development, we normally tend to think about the material and economic development. Materials may include house, landed property, motor vehicle, jewellery etc. Again all these material assets are converted in terms of money, whenever or wherever the need arises. Till today, the entire world is divided into two groups of countries - developed and developing. This classification is mostly based on level of economic development. Though this trend is still continuing but a change in thinking about development was introduced.There has been a change in emphasis on measurement of development from purely economic dimension to a composite socio-economic dimensions. From 1990 onwards, United Nations Development Programme (UNDP), each year calculate Human Development Index (HDI) and publish as a report which is known as Human Development Report (HDR). This report, is published each year in which almost all the countries are placed under three categories, high, medium and low based on the defined parameters.

In this lesson, we will learn about the concept and process of measuring human development index. We will also find out India's position among the various countries in the world. Simultaneously, we will also analyse position of various states of India as far as human development index is concerned. At the end, we will suggest certain measures to improve human development in our country.

OUTCOMES

After studying this lesson, the learner:

- defines the term human development and human development index;
- describes the regional patterns of human development; and
- highlights the need for improvement in inclusive human development.

23.1 CONCEPT OF HUMAN DEVELOPMENT

Do you know who coined the term 'Human Development'? In 1990 economists Dr. Mehbub Al Haque introduced the concept of Human Development. This concept was used for the construction of Human Development Index. In the inaugural issue of Human Development Report - 1990 published by United Nations Development Programme (UNDP), the authors defined human development as "a process of widening people's choices as well as raising the level of well-being". Human development concept is based on the idea of "development as a freedom". It is about building human capabilities - the range of things they can do and what they can be. Individual freedoms and rights matter a great deal. But these freedoms and rights are restricted for some because they are poor, illiterate, discriminated against, threatened by violent conflict etc. To achieve this there is a need for re-orientation of our process of development. In other words, development must revolve around the people, not people around the development.

To know more detail about the concept, let us refer to the writing of MahbubulHaq whopropounded this concept. In his book titled "Reflections on Human Development" discussed about the four pillars of human development. These are equity, sustainability, productivity and empowerment. Let us discuss them briefly.

1. **Equity:** Can you be able to elaborate the meaning of equity. In simpler terms it refers to equal opportunity to everyone without any discrimination of gender,caste,income and social influence. Can you now distinguish between equity and equality?

2. **Sustainability:** The second pillar is sustainability. It means providing continuous access to and availability of resource by keeping in mind the future generation. In other words, all future generations should have access to minimum resources utilized by today. You will read in details about sustainability and sustainable development in the next module.

3. **Productivity:** The third pillar according toMahbubulHaq is productivity.It refers to constantly improving capabilities of human resources for delivery their work.Ultimately people are the real wealth for any nation,if they are more skilled their values certainly will go up.

4. **Empowerment:** The fourth and final pillars of human development is empowerment. Now a days you might be hearing about various schemes by state governments and government of India for socio-economic empowerment of disadvantaged sections of the society. What does this mean? It refers to a type of power which generates choice of freedom in human beings.Good governance and people oriented policy are required to empower human developments.

If you carefully read the definition of human development given in the beginning of this section you can found reflection of these four concepts in the statement.

After knowing the concept of human development and its four pillars, can you differentiate between the concept economic development and human development? The basic difference between economic development and human development is that economic development entirely focuses on the increase of income whereas the human development believes in expanding and widening of all aspects of human life be it economic, social, political, cultural, etc. In economic aspect human development is one of the essential elements. The basic idea behind this is that it is the use of income and not theincome itself that decides the human choices. Since, the real wealth of a nation is its people, therefore, the goal of development should be the enrichment of human life.

Need for Human Development: After knowing the concept of human developmentand , you might be thinkingthat the need for creating another concept to measure the progress in development. Paul Streeten, a development economist identified six reasons in favour of the human development. The reasons are as follows:

1. The ultimate purpose of the entire exercise of development is to improve the human conditions and to enlarge people's choice.
2. Human development is a means to higher productivity. A well-nourished, healthy, educated, skilled alert labour force is the most productive asset. Therefore investments in these sectors are justified on ground of productivity.
3. It helps in reducing the rate of growth of population.
4. Human development is friendly to the physical environment also. Deforestation, desertification and soil erosion decline when poverty declines.
5. Improved living conditions and reduced poverty contribute to a healthy civil society and greater social stability. 6. Human development also helps in reducing civil disturbance in the society and in increasing political stability.

After studying the concept of human development, let us understand the measurement of human development in section 23.2.

23.2 MEASUREMENT OF HUMAN DEVELOPMENT

To measure the levels of human development, a set of indicators were proposed under three dimensions. Therefore, Human Development Index (HDI) is a composite index that measures the average achievements in a country in three basic dimensions of human development. These basic dimensions are a long and healthy life, knowledge and a decent standard of living. The above mentioned dimensions are measured by the following indicators.

1. A long and healthy life is measured by life expectancy at birth

2. Knowledge is measured by mean year of schooling and expected year of schooling

3. A decent standard of living is measured by GDP per capita (Adjusted do purchasing power parity in US dollar)

But we should know that the purpose of its construction is not to give a complete picture of human development rather to provide a measure which goes beyond the traditional measurement of development i.e. income. Therefore, HDI is a barometer for changes in human wellbeing and for comparing progress in different regions.

Apart from Human Development Index (HDI), the other four indicators of human development have been selected which were used by the Human Development Report for the last three decades. These are:

(i) Human Poverty Index for developing countries (HPI-1)

(ii) Human Poverty Index for selected OECD Countries (HPI-2)

(iii) Gender - related Development Index (GDI)

(iv) Gender Empowered Measurement (GEM)

Gender - related Development Index (GDI), together with the Gender Empowerment Measure (GEM), was introduced in the year1995 whereas the Human Poverty Index (HPI) was introduced in the year 1997. There are two indices namely the HPI - 1, which measures poverty in developing countries, and the HPI-2, which measures poverty in OCED developed economies. From the above discussion it must be clear that India is assessed under HPI-1.

Out of these above mentioned five indices, HDI, HPI-1 and GDI are calculated by three common dimensions namely. a long and healthy life, knowledge and a decent standard of living. But some of the indicators are different within these dimensions. Let us know their similarities and differences from the table 23.1 given below.

Table 23.1: A comparative analysis of Dimensions used in HDI, HPI-1 and GDI

Sr. No.	Indices	HDI	HPI-1	GDI
1	A long and healthy life	● Life expectancy at birth	● Probability at birth of nots wimming to the age of 40	● Female and male life expectancy at birth

Notes

2	Knowledge	● Mean year of schooling ● Expected year of schooling	● Adult literacy rate	● Female and male mean years of schooling for adults ages 25 years and older ● Female and male expected years of schooling for children
3	A Decent Standard of Living	● GDP per capita (Adjusted do purchasing power parity in US dollar)	● The percentage of the population not using an improved water source ● The percentage of children under -weight for their age.	● Female and male estimated earned income.

Till now you might have understood the importance of human development and about indicators used by UNDP to measure HDI, GDI and HPI-1. Let us now have a closer look at India's position at international level as far as human development is concerned. We will also try to find out the reasons for low levels of human development in India.

INTEXT QUESTIONS 23.1

1. What is Human Development Index?

2. Differentiate between human development and economic development

3. Name the three dimensions and their respective indicator used for measuring HDI.

   (i)

   (ii)

   (iii)

23.3 INDIA: TRENDS OF HDI

According to Human Development Report 2021-2022 India's rank was 133 out of 191 countries of the world. All the 191 countries are grouped under four categories. These are very high, high, medium and low. The countries which had value 0.800 and above are grouped under very high whereas the countries which had values ranges 0.700 to 0.799 were ranked as high human development. The countries which had value between 0.550 to 0.699 were ranked under medium categories and countries which had value less than 0.550 were ranked as low human development countries.

According to Human Development Report 2021-2022, India ranks 132 out of 191 countries of the world. India was placed almost at the bottom of the table in the medium level category. Our neighbouring countries like China (78), Sri Lanka (73), Maldives (90), and Bhutan (127) remained well above the India's position. Other neighbouring countries like Myanamar (149), Pakistan (161) and Nepal (143) were placed below India. If we compare at global level, the countries which lies below India were mostly from Africa and rest few countries were from Asia.

Analysis of all the four parameters provide us a better picture about the current status. Out of four, India has declined on three parameters and improved on one. Firstly, in health, life expectancy has fallen down from 69.7 to 67.2 years. As far as education is concerned out of two indicators, there is a drop in expected years of schooling, but mean years of schooling have seen an increase. This drop is because of the school closure during the Corona pandemic. Lastly, the standard of living; this is where the Gross National Income (GNI) per capita comes in and for India, it has fallen from \$6,681 to \$6,590.

If we look at India's situation over the time we can definitely say that it has improved a lot over the years. During the last 31 years (1990 - 2021), it has been observed that India has continuously improved its human development score till 2019. In fact, the decline started after 2019 (0.645). There has been a decline in the year 2021 in comparison to 2020 (Table 23.2). This was mainly due to Corona pandemic. This has not only happened with India but also with most of the developed countries those are already in the very high and high category.

Table 23.2: INDIA: Human Development Index Trends in India 1990 - 2021

Years	1990	1995	2000	2005	2010	2015	2020	2021
India	0.434	0.438	0.491	0.534	0.575	0.629	0.642	0.634

This improvement is not sufficient enough. There are many small countries of Asia and Africa like Fiji, Mongolia, Tunisia, etc. are well above India. India has to work very hard to be placed among the top countries in the medium human development category (0.550 - 0.699). If the present trend continues it needs minimum 30 years to enter the high human development category. And for this, a rigorous effort particularly in the social sector like education, health and economic sector particularly reduction of poverty are required.

The following are some of the reasons to keep India at the bottom of human development (a) rapid increase in population (b) large number of adult illiterates and low gross enrolment ratio (c) high dropout rates (d) inadequate government expenditure on education and health, (e) large proportion of underweight children as well as under nourished people (f) very poor sanitation facilities and low access to essential lifesaving medicines.

Apart from HDI, the performance of India is also not very encouraging as far as Gender Development Index (GDI) and Human Poverty Index (HPI) are concerned. According to Human Development Report, 2021-2022, India's GDI stands at 0.849 which is significantly behind the world average. As mentioned in the table 23.1 GDI measures disparities in the HDI by gender.

INTEXT QUESTIONS 23.2

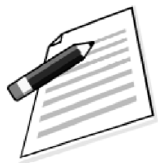
1. What is India's position in Human Development Index according to Human Development Report-2021-2022?
2. What was India's GDI stands as per Human Development Report, 2021-2022?

28.3 HUMAN DEVELOPMENT INDEX - A STATE LEVEL ANALYSIS

Till now we have studied concept, measurement and status human development all over the world including India. But there are variations within India. Certain states are performing well and certain states are still lagging behind. In accordance with UNDP Human Development Report an attempt was made to rank various states of India in to different categories. Global Data Centre of UNDP has analysed the data at sub-national level also. In the below given HDI values of all the twenty eight states are given for the year 1990 and 2021.

Table 23.3: India : Human Development Index of States,1990 and 2021

Sr. No.	States	1990	2021
1	Andhra Pradesh	0.427	0.630
2	Arunachal Pradesh	0.442	0.665
3	Assam	0.412	0.597
4	Bihar	0.379	0.571
5	Goa	0.557	0.605
6	Gujarat	0.474	0.638
7	Haryana	0.471	0.691



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8	Himachal Pradesh	0.484	0.703
9	Jammu & Kashmir	0.498	0.699
10	Jharkhand	0.562	0.589
11	Karnataka	0.447	0.667
12	Kerala	0.550	0.752
13	MadhyaPradesh	0.407	0.596
14	Maharashtra	0.498	0.688
15	Manipur	0.499	0.678
16	Meghalaya	0.461	0.643
17	Mizoram	0.531	0.688
18	Nagaland	0.539	0.670
19	Odisha	0.402	0.597
20	Punjab	0.501	0.694
21	Rajasthan	0.406	0.638
22	Sikkim	0.546	0.702
23	TamilNadu	0.475	0.686
24	Telangana	0.624	0.647
25	Tripura	0.449	0.629
26	UttarPradesh	0.398	0.592
27	Uttarakhand	0.627	0.672
28	WestBengal	0.443	0.624
29	India	0.434	0.633

If we analyse the patterns given in the above Table, it can be observed that there has been significant improvements in all the states of India over the last thirty years (1990-2021). However, as mentioned above the progress is varied. The below given table categorized all the twenty eight states in to four categories as suggested by Human Development Report.

Table 23.4: Levels of Human Development Index among States of India, 2021

S. No.	Levels of HDI	Range	Name of the State
1	Very High	Above 0.800	Nil
2	High	0.700 - 0.799	Kerala, Himachal Pradesh and Sikkim
3	Medium	0.550 - 0.699	Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhatisgarh, Goa, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya. Mizoram, Nagaland, Odisha, Punjab, Rajasthan, Telengana, Tamil Nadu, Tripura, Uttar Pradesh, Uttarakhand, West Bengal
4	Low	Less than 0.550	Nil

If you analyse the above mentioned table, you will find that not a single state of the country is in the very high category (0.800 and above). There are only three states namely Kerala, Himachal Pradesh and Sikkim are in the category of high human development. Rest of the twenty five states are in the medium category of human development.On the other hand, not a single state is there in the category of low human development(Less than 0.550). This has been due to constant efforts by the Government of India and State governments. If we compare the situation in relation to national average there are ten states which are below the national average. Identify these states from the above given tables. Try to find out the reasons responsible for this situation.

INTEXT QUESTIONS 23.3

1. Name any five states of India which are below national average in HDI.

2. Name the three states of India which are in the high category of HDI..

WHAT YOU HAVE LEARNT

The concept of Human Development Index (HDI) was propounded by Prof. Mehbub Al Haque. From 1990 onwards Human Development Report is published by UNDP annually which reflects the status of human development in almost all the countries across the world. HDI is a composite index that measures the average achievements in a country in three basic dimensions of human development. They are long and healthy life, knowledge and decent standards of living. The basic difference between economic development and human development is that economic development entirely focuses on the increase of income where as the human development stresses in expanding and widening of all aspects of human life. In HDI, economic condition is one of the essential elements. Apart from HDI, various types of indices are constructed and published by UNDP. Some of the important indices are Human Poverty Index, Gender Development Index, Gender Empowered Measurement index, etc.

According to Human Development Report- 2021, India's rank is 132 almost at the bottom of the table in the medium level category. The reasons which keep India at the bottom of human development are rapid increase in population, large number of adult illiterates, low Gross Enrollment Ratio, inadequate government expenditure on education and health, large proportion of under-weight children as well as undernourished people, very poor sanitation facilities and low access to essential life saving medicines etc. Therefore, there is an urgent need to improve in health situation, educational attainment and increased standard of living and reduction of poverty level.

TERMINAL QUESTIONS

1. Differentiate among Human Development Index, Human Poverty Index and Gender Development Index.
2. Explain any four reasons in favour of the human development.
3. Write any four factors responsible for keeping India almost at the bottom of human development index table.

ANSWERS TO INTEXT QUESTIONS

23.1

1. The Human Development Index is a composite index that measures the average achievements of a country in three basic dimensions of human development such as long and healthy life, knowledge and decent standard of living.
2. Economic development entirely focuses on the increase of income. The human development stresses in expanding and widening of all aspects of human life.

3. (i) Long and healthy life measured by life expectancy at birth.

   (ii) Knowledge is measured by the adult literacy rate and the combined primary, secondary and tertiary gross enrolment ratio.

   (iii) A decent standard of living is measured by DGP per capita purchasing power parity in US Dollar.

23.2

1. 132 out of 191 countries.
2. 0.849

23.3

1. (i) Haryana, (ii) Himachal Pradesh, (iii) Karnataka (iv) Kerala, any other (Any three)
2. (i) Bihar (ii) Madhya Pradesh (iii) Uttar Pradesh (iv) Rajasthan, any other (Any three)

MODULE -10

Contemporary Issues and Challenges

24. Sustainable Development Goals (SDGs)

25. Environment, Health and Sanitation

24

SUSTAINABLE DEVELOPMENT GOALS

In the previous lesson, you got acquainted with the concept of human development, its regional pattern and need for its improvement. As you know the concept of development, largely focused on the betterment or advancement of human society but the pattern of development is characterised by inequality. For example, all the countries of the world want high income, social equality and a livable environment. But unfortunately, the level of development is inversely related to environmental development. Therefore, in this lesson, you will learn the concept and significance of Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Targets of SDG and its status with special reference to India.

OUTCOMES

After studying this lesson, learners:

- differentiates between MDGs and SDGs;
- describes the key concepts and significance of SDGs;
- explains sustainable development goals and their specific targets and
- elucidates the impact of SDGs on spatial development in Indian context.

24.1 CONCEPT OF DEVELOPMENT GOALS

As you know, Development is a multi-dimensional phenomenon which is a result of man-environment interactions. The goals of development revolve around the advancement of economic, social and environmental aspects. It has a different meaning for different people depending upon their requirements. For example, some people want a high income whereas others want a clean environment.

Natural Resources provides a base for economic development of a nation. A country with rich physical and human resources including radical technological skills are considered developed and vice versa. Initially, man conceptualised the meaning of development with high economic growth but which resulted in social inequality and a degraded environment. There is an inverse relationship between development and environment. Higher the level of development, the poorer the quality of the environment. Environmental degradation is the biggest threat to human survival and biota.

As discussed in the previous lesson, man is transforming its environment,to achieve the goal of economic development. The main aspect of economic development is per capita income or GDP. To achieve higher and higher economic growth, man has been using his physical and mental abilities with technological advancement and exploiting its environmental strengths.

Before World War II, economic development was the only motive of developmental activities, after that our aim of development shifted towards social and human development. In lesson 23, the concept of human development has been discussed. Human development is defined as a process of enlarging people's choices, namely enjoying a healthy life, acquiring knowledge, achieving a decent standard of living, and providing a long-run view of human well-being. Every day, humans are affecting the environment and its quality in a number of ways. For example, in Delhi, daily millions of tons of garbage are being produced, chemical rich unhealthy water is being discharged into the river Yamuna and air is also becoming unhealthy day-by-day due to rising vehicular pollution. Delhi, being the most developed city of India, is becoming unsustainable. Delhi is just an example; all the cities of the world are facing the same environmental problems. To save the planet,in 1963, Rachel Carson triggered an environmental movement in the United States of America.

Table 24.1: Development in the Modern Era

Age	**Discovery and Invention**	**Development Goals**
Mercantilism Era	Industrial Revolution	Economic Development
World War I and II	Socio-economic Inequality widens	
After World War II	Formation of United Nations	Social (Human) Development
Brundtland Commission	Sustainable Development	Environment Development
MDGs	United Nations framed Eight Development Goals	Economic and social Development

SDG's	United Nations incorporated nine more Development Goals in MDGs	Economic, social and environmental development

Notes

Background of Global Development Goals

You must have heard a famous saying that "Rome was not built in a day" similarly the setting up of developments goals was also not a day's job. It was initiated with an International Conference on the Human Environment which was held 50 years ago in Stockholm in June 1972. This was the first conference when representatives of developed and developing nations talked about environmental issues and define the right of human beings to a healthy and productive environment. In this conference, United Nations Environmental Programme (UNEP) was adopted. It was the beginning of an environmental movement in the world and environmental issues have become a part of discussion not only at environmental conferences but also in every international political meets. Its10th anniversary was celebrated in Nairobi in 1982, followed by the United Nations Earth Summit on Environment and Development held in Rio de Janeiro, Brazil in 1992. Sustainable Development was a key focus at the United Nations Conferences; however, the word Sustainable Development was introduced by the Brundtland Report, published by the World Commission on Environment and Development (WCED) in 1987.InOur Common Future, sustainable development has been defined as "compromising the ability of future generations to meet their own need". It Focuses on developing a world where environmental changes are in accordance with sound ecological principles and improving the well-being of everyone.

Commission Definition- It contains two important things for the present and future generations; one needs the poor and other restrictions forced by the state on the environment's carrying capacity.

In 1992, during the Earth Summit,a document was prepared on the future environment of the 21st century in which the linkages among economy, social development and environmental protection were recognized. The Rio Declaration, Agenda 21 and Commission on Sustainable Development were the key products of the Earth Summit and its aim was to achieve global sustainable development by 2000. It is a non-binding instruction plan for governments of the world with the main focus on poverty, population policy, health education, women's, young, underdeveloped countries, food security, pure water, security of water bodies, security from toxic chemicals and hazardous radio actives, proper land use and biodiversity, etc. It was felt that it requires a change in our attitude towards the environment and all human beings. If we are further destroying nature it means destroying ourselves. We have to realise that everybody deserves acceptable living standards but not on the cost of the environment.

Salient features of sustainable development are as follows:

- The rise in per capita income and economic development should be sustained with time.
- The use of natural resources should not be stopped but it should be used in a manner that they are not overexploited.
- There is no reduction in the ability of future generations to meet their needs.
- Sustainable development also discards those activities which increase pollution.
- Dealing with ill effects of climate change, how we can manage gender equality and better health.

In 1997, a Special General Assembly was held in New York which adopted a program for further implementation of Agenda21. Through international consensus, for achieving sustainable development the UN General Assembly accepted MDGs in 2000 for eradicating poverty, preventing deadly diseases, empowering women and ensuring environmental sustainability etc. to be reached by 2015.

After the 1992 Earth Summit, The World Summit on Sustainable Development (WSSD) which was held in Johannesburg, South Africa in the year 2002 evaluated the results and obstacles in the progress. This is also known as Rio+10. It was also addressing the global environment, poverty challenges, Agenda 21, MDGs and new issues like half the global population are without access to basic sanitation. The Earth Summit WSSD (2002) adopted an implementation plan which comprises a set of concrete steps and actions to be taken in order to fulfil targets and goals of development with a more focused approach.

The running SDGs were developed after the UN conference in Rio de Janeiro in June 2012 on Sustainable Development with the 2030 agenda for sustainable development. This is also known as RIO +20. In other words, SDGs are derived from the MDGs with adding new goals for fulfilling the needs of the increasing population and at the same time for protecting depleting resources and their quality, and also fulfilling the responsibility towards the needs of our future generations and prosperity of planet earth.

Table 24.2: Development Initiatives

Conference	Year	Initiatives
UNCHE	1972	Beginning of environmental movement in the world
Our Common Future	1987	"Sustainable Development" word as introduced.
Rio (Agenda 21)	1992	Document was prepared on the future environment of the 21st century

MDGs	2000	Adopted 8 goals for improving the lives of the poorest people of the globe
Rio+10 (WSSD)	2002	Adopted an implementation plan of actions in order to fulfil goals of development with a more focused approach.
RIO+20 (Sustainable Development)	2012	Universally applicable 17 goals were developed by UN for wellbeing for everyone

INTEXT QUESTIONS 24.1

1. When economic development was the main motive of development?
2. Which kind of development, the Brundtland commission report, was based on?
3. Who was Gro Harlem Brundtland?
4. What are the main approaches of Sustainable development?

24.2 MILLENNIUM DEVELOPMENT GOALS

The Millennium Declaration was signed by a gathering of global leaders of 189 nations at the United Nations Millennium Summit in September 2000 with the aim to achieve a better world and better tomorrow. The Millennium Development Goals (MDGs) were derived from this historic declaration. In MDGs, there were a total of 8 goals for improving the lives of the poorest people of the globe. Several measurable targets and indicators were also set for each goal. The targets to meet these goals were set to be achieved by 2015 and monitor the progress from the levels of 1990. Through these goals, the international community tried to expand its vision to combat poverty and pro-poor growth. The 8 measurable goals from poverty to gender equality, improving mortality among children and women and ensuring environmental sustainability targets were as follows.

Table 24.3. Millennium Development Goals and Targets

MDGs	Targets
1. Eradicate extreme poverty and hunger	• Reduce by half the proportion of people living on less than a dollar a day • Reduce by half the proportion of people who suffer from hunger

2. Achieve universal primary education	● Ensure that all boys and girls complete a full course of primary schooling
3. Promote gender equality and empower women	● Eliminate gender disparity in primary and secondary education preferably by 2005, and at all levels by 2015
4. Reduce child mortality	● Reduce by two thirds the mortality rate among children under five
5. Improve maternal health	● Reduce by three quarters the maternal mortality ratio
6. Combat HIV/AIDS, malaria other diseases	● Halt and begin to reverse the spread of HIV/AIDS ● Halt and begin to reverse the incidence of malaria and other major diseases
8. Develop a global partnership for development	● In cooperation with the private sector, make available the benefits of new technologies- Especially information and communications technologies.

In the time span of fifteen years, the MDGs drove progress in some important areas like reducing income poverty, providing much-needed areas to water and sanitation, driving dawn mortality and drastically improving maternal health. It also kick-started a global movement for free primary education, inspiring countries to invest in their future generations. Most significantly, the MDGs made huge strides in combating HIV/AIDS and other erectable diseases such as malaria and tuberculosis.

Main Achievements of MDGs

- Under Goal 1, extreme poverty was reduced significantly from the level of 1990 when 50 percent of people lived on less than $ 1.25 day and that declined to 14 percent in 2015. More than 1 billion people have been lifted out of extreme poverty since 1990.
- Improvement in primary education and in enrolment has increased in developing regions. Especially sub - Saharan Africa is the best example of the improvement in primary education after the MDGs initiative. About 20 % increase was noticed from 2000 to 2015 in net enrolment. It has also fallen in the number of out-of-school children in primary school since 1990.
- Child mortality dropped by more than half between 1990 and 2015. The number of deaths of children under the age of five has declined from 12.7 million (1990) to 6 million (2015). Its annual rate of reduction in mortality was more than five times faster

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during 2005-2013 in the sub- Saharan Africa region.

- About 45 % decline was recorded globally in maternal mortality since 2000. It declined 64% in southern Asia and 49% in sub-Saharan Africa.
- HIV/AIDS infections fell by almost 40 percent (since 2000).
- The services like access to improved drinking water piped drinking water have also improved worldwide. About 147 countries have met the target of drinking water, 95 countries met sanitation and 77 countries have met both targets. More than half of the global population is enjoying a higher level of services.
- Assistance from developed countries and duty-free import from developing countries has increased since 2000. About 95% world population is covered by a mobile signal and very huge growth in internet service to the world population only 6% in 2000 to 43% in 2015. Due to this 32 billion people are linked for content and applications through the global networks.

India has achieved targets of poverty reduction and hunger, gender parity in enrolment of primary, secondary and tertiary education, maternal mortality, and disease like tuberculosis is controlled, increased in forest cover etc. Apart from this, the situation has been improved in access to clean drinking water, controlling emission in greenhouse gases but still remain big challenges.

INTEXT QUESTIONS 24.2

1. When Millennium Development Goals were adopted?
2. What was the base year of measuring progress in MDGs?
3. What were the three most important areas where MDG succeeded?
4. In which goals of MDG, India has achieved the targets?

24.3 SUSTAINABLE DEVELOPMENT GOALS

The word Sustainable Development was used for the first time in World Conservation Strategy (WCS) in 1980 by the International Union for the Conservation of Natural Resources (IUCN). But the concept has been further explained by the World Commission on Environment in 1983. The World Commission on Environment on Development (WCED), Gro Harlem Brundtland was appointed as the chair of the commission and the report was known as Brundtland Commission Report. In the report, several concerns about the negative impact of human activities and developments on planet earth have been raised and also underline that if they are not controlled, the future will be unsustainable.

The development with a sustainable approach is very much correlated with Economic growth, Social equality and Environment protection.

In addition to that, sustainable development has a deeper meaning. For instance, in a sustainable situation, people may have more employment opportunities; everyone can afford nutritious foods, quality education, social and gender equality and human rights. Overall, this is about improving everyone's social status and wellbeing. This is a people-centric initiative.

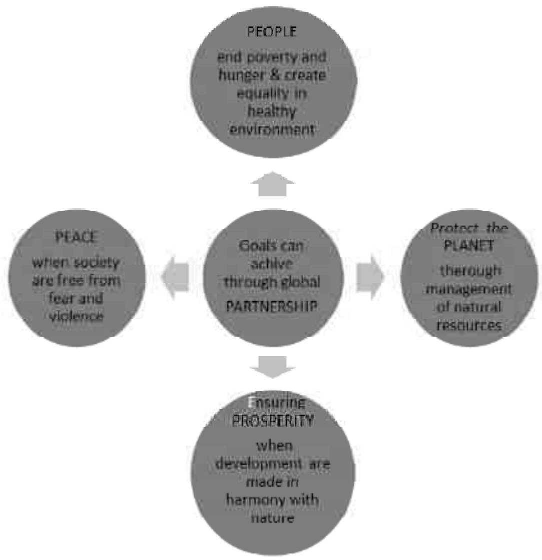

Fig 24.1: Five P's of Sustainable Development

The SDGs are a set of agreements on 17 universal goals adopted by world leaders of 193 countries in the 70th session of the UN general assembly held on 25th September 2015. The adopted document was entitled "Transforming our world: the 2030 Agenda for Sustainable Development". This 2030 agenda is for transforming towards sustainable development or the future we want. It came into operation in January 2016. It is also a succession of MDGs. SDGs accepted by UN member states; provide a blueprint for peace and prosperity for people and the planet earth. All the 4 P's are governed by partnership in sustainable development. The most important aim of this agreement is to end poverty and it covers multiple aspects of growth and development. It is an urgent step towards action by all developed and developing nations in a way of global partnership.

The SDG's are synthesis or integration of MDG's with some new objectives. The SDGs are unique in that they cover issues that affect all of us. They refer to our international commitment to end poverty. Table 2 shows all objectives with their focus targets for action to tackle rising poverty, empower females and addressing the climate emergent situation. Further, it is also recognized that ending poverty and hunger and other goals must go hand in hand with strong

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policy and strategies for inequality, economic growth, improvement of health and education, and dealing with climate change, preservation of land and oceans.

Table 24.4: Objectives of SDG's

SDG	**Objective**
No poverty	End of Poverty in all its forms
Zero hunger	End hunger, achieve food security and improved nutrition & to promote sustainable agriculture
Good health and well-being	Achieve gender equality and empower all women and girls
Quality education	Ensure inclusive and equitable quality education and promote lifelong learning Opportunities for all.
Gender equality	Achieve gender equality and empower all women and girls
Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all
Affordable and clean energy	Ensure access to affordable, reliable and sustainable modern energy for all
Decent work and economic growth	Promote inclusive and sustainable economic growth, full and productive employment and decent work for all.
Industry, innovation, and infrastructure	Build resilient infrastructure, promote inclusive and sustainable Industrialization and foster innovation
Reduce inequality	Reduce inequality within and among countries
Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable
Responsible consumption and production	Ensure sustainable consumption and production pattern
Climate action	Take urgent action to fight climate change and its mpact
Life under water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Life on land	Protect, Restore and promote sustainable use of

	terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Peace, justice, and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Partnership for the goals.	Strengthen the means of implementation and revitalize the global partnership for sustainable development

Pillars of Sustainable Development Goals

Above 17 goals, the focus is now building a sustainable world. The core of all SDGs can be classified in the form of 4 pillars such as human, social, economic and environmental. All goals move and deal around these pillars in others wards SDGs focus on building a sustainable world through these pillars of sustainability for the stability of human civilization and its environment.

- **Human Sustainability:** Human development is a core of SDGs and most of the goals are directly and indirectly related to this. To maintain human sustainability need to improve human capital. Therefore to end poverty and remove hunger need to invest in poverty eradication. Apart from this investment is also required in the health and education sector, access to services, nutrition, and knowledge and skill enhancement for improvement of health and completing economic wellbeing for all. for maintaining good health and wellbeing have to end preventable death of newborns and children of age below 5 years in all countries, ends the epidemics of Aids, tuberculosis, malaria, water-borne diseases and other communicable diseases etc. through development of skills and capacity building, we can promote the wellbeing of communities and society.

- **Social Sustainability:** this is an ability of a community to preserve and maintain social quality like culture, cohesion, and honesty, not for present need but the support of future generations and their wellbeing. For ensuring social sustainability aim to improve social capital by investing and creating services that constitute the framework of our society. To create a socially successful place and healthy and livable communities need to focus nation wise social protection system, ensure equal rights on resources particular poor's, gender equality, empowering the deprived group, social security and provide democratic good quality of life etc.

- **Economic Sustainability:** improvement of the standard of living is the main aim of economic sustainability. Without economic growth, we can't achieve sustainable development. Both quality and quantity of growth are important but will have without harming the ecology and human capital. It is about those practices which support future economic growth without harming our social-cultural and environmental aspects of the community.

- **Environmental Sustainability:** The most important and demanding pillar of sustainability. Aim to achieve environmental sustainability through the protection of our natural capital like air, water, land, and natural resources etc. without the environmental sustainability pillar; we can't achieve the aim of other pillars. For example, the supply of agricultural products can be expanded without damaging our natural resources by adopting sustainable farming methods that preserve agricultural productivity of land while minimising pollution of the soil, groundwater and streams that drown the land.

INTEXT QUESTIONS 24.3

1. In which session sustainable development goals were adopted?
2. What are the important P's in sustainable development?
3. Which Government body is coordinating SDG in India?

24.4 SIGNIFICANCE AND DIFFERENCE BETWEEN MDGS AND SDGS

SDGs can be called as an expanded form of MDGs for carrying forward the unfinished agenda of MDGs and also continuity for addressing the additional environmental, political and economic challenges which are faced by our present generation. The aim of the goals is to encourage development by improving social, economic and environmental conditions in the world's poorest and under-developed countries such as sub-Saharan countries, Latin American countries etc. They are categorised as long-term goals having a duration of 15 years. MDGs were completed in 2015 whereas the target to achieve SDGs will be 2030.

Table 24.5: Difference between MDGs and SDGS

Criteria	MDGs	SDG'S
Aim	To boost development	To achieve both sustainability and development
Origin	MDGs were drawn with a group of experts from UN headquarters.	SDGs have evolved after a long and extensive consultation including 70 open working groups, Civil Society Organization, thematic consultation, country consultations, participation of the general public through face

		to face meeting and online mechanism and door to door survey.
No. of Development Goals	The MDGs were focused with only 8 goals, 21 targets and 63 indicators.	Includes 17 with 169 targets, it's have wider coverage
Funding	In the case of SDGs all countries are within its focus and funds are made available via various global agencies and countries.	As MDGs had focused on developing countries while they assumed that funding would come from via and from rich countries which did not materialise.
Period-Targets of Achievement	MDGs were adopted in 2000 and baseline year was 1990 and completed in 2015.	The SDGs has put more emphasis on real time data and baseline was estimated from 2015 to notice the progress towards these goals according to age, gender, education, health, migratory status and the whole population. 15 Years SDG's would have been accomplished by 2030.
Time Frame	2000-2015	2015-2030
Nature of Goals	At the time of MDGs gender, people participation and local governance were not considered as important while poverty	Goals are more accommodative and comprehensive with an emphasis on gender and environmental dignity. It's also evident that SDGs take into account the nuanced aspect of our social living conditions.
Stakeholders	It was noticed that LDC were in the focus as they were urged to take actions and had no role for the civil society organisation or local bodies.	In SDGs all nations are supposed to act and respond towards the crisis and demand that local self-governance be made functional
Role of private sector	MDGs were more rooted in interg overnmental	SDGs are more clear and welcoming about the role of private players in the development process. It includes a vision of building a

	cooperation and actions.	vibrant and systematic partnership with the private sector to achieve sustainable developments.

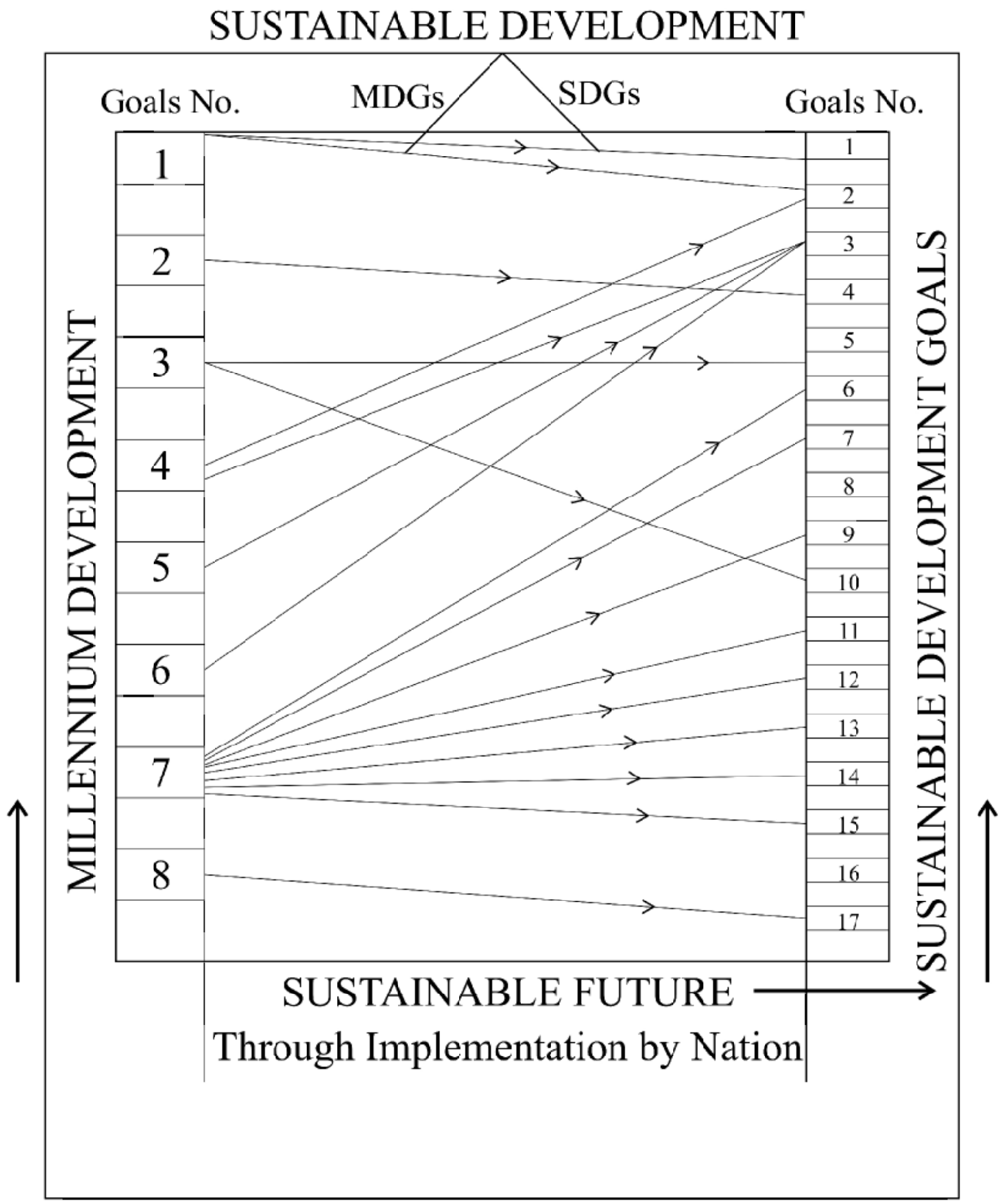


Fig 24.2 : Sustainable-Future through Implementation by Nation

Both categories of goals are known and applicable as global goals, accompanied by goal wise targets and elaborated through indicators of measurable outcomes which are action oriented (Figure 3).

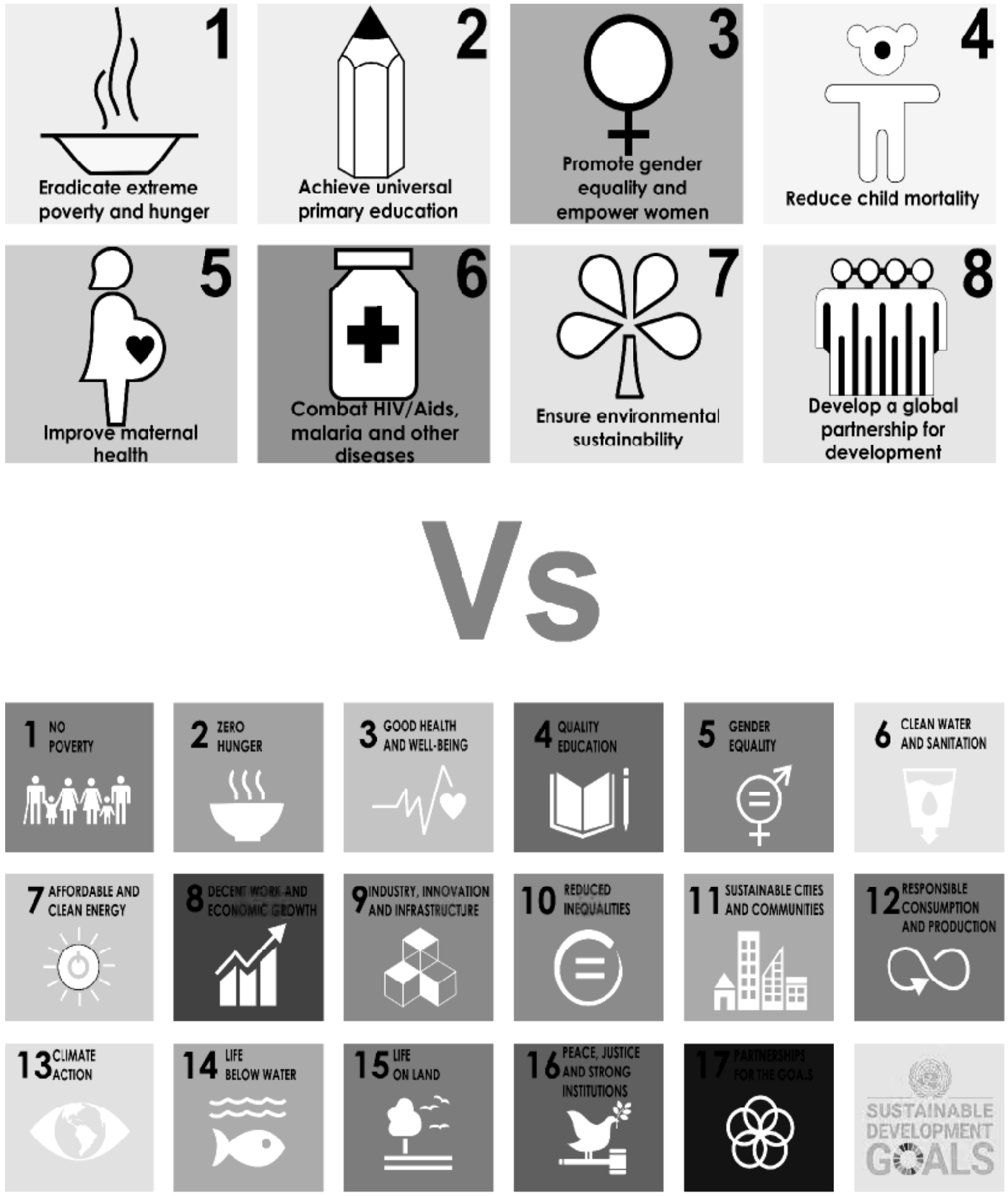


Fig 24.3 : MDGs and SDGs

Constraints With SDGs

The single and most important failure is that achievements of goals were not experienced across the globe. Some regions like southeastern Asia, southern Asia and northern Asia exceeded the goal in poverty reduction by 16%, 12.5%and 1.2% respectively. Sub - Saharan region was most behind in meeting the goals of MDGs.

Sustainable development remains only an environmental issue and it has been competing for only agendas. Global biodiversity of all species is declining, developed countries have not met a commitment to developing countries, many of critical ecosystem services like water, biodiversity, fibre and food is being compromised due to the impact of human development, many countries in the world facing freshwater scarcity, income inequality has also been observed in past 2 decades in many countries and gap between rich and poor is growing etc. indicates the failures of sustainable development agendas.

24.5 INDIA'S PERSPECTIVE AND STATUS IN SDG

Global Sustainable Development 17 goals with 169 targets are a core part of India's national development agenda. India is also giving priorities to achieve high economic growth, streamlining sustainable development and human well-being. Our development focuses on poverty, health, nutrition, sustainable growth, gender equality, quality education and clean water and environment like others several issues to human survival. NITI (National Institution for Transforming India) Aayog is the premier body of the Government of India has been coordinating Sustainable Development Goals with the supported ministry of each target. A comprehensive mapping of SDGs goals and targets with various schemes and programs has been developed so that it brings together economic, social and environmental pillars with a focus on their inter-linkages. On the basis of global agreed goals and targets, NITI Ayog selected priorities indicators by several consultations with all stakeholders and involving Central ministries, States/UTs, civil society organisations, academia, business sector and to compute India's SDG index.

The State and local governments have a key role in India's progress on SDGs agenda and implementation of numerous programmes like National Health Mission, Swach Bharat Abhiyan, SarvaShikshaAbhiyan, National Programme of Mid-Day Meal in school, National Rural Drinking Water Programme, Pradhan Mantri Awash Yojana, Sabka Saath Sabka Vikas, National Urban Livelihood Mission, National Rural Livelihood Mission, National Food Security Mission and Digital India etc. So that no one is left behind. The State / UTs has been divided into 4 categories as per the SDG India index are Aspirant (0-49), Performer (50-64) , Front Runner (65-99) and Achiever (100).

Fig 24.4 : India : SDG Index Score - 2020

About one-third of the journey towards SDGs agenda has already been achieved. In the areas like health, energy and infrastructure, goals of SDGs have shown substantial progress in the country. The overall score of the SDGs index has grown up and progressed largely due to improvement in clean water and sanitation and affordable and clean energy in the country. As per the report of NITI Aayogwhich highlighted the role and significance of partnership among states/UTs.It has been found that15 states/UTs are in the performer category and 22 states/ UTs in the front runner category. The areas like the abolition of poverty and hunger have shown improvement in the index whereas campaigns to improve the access of households to electricity and clean cooking fuel have been important factors of improvement. On other side, the area which showed a decline in the SDG India index is Industry, Innovation and Infrastructure due to the lockdowns enforced by the governments.

The overall state wise analysis depicts that, Kerala has achieved the highest score (75) in the index due to its improvement for the effort to tackle hunger (goal 2) and to provide quality of education of students (goal 4), followed by Himachal Pradesh, and Tamil Nadu with a score 74 (Figure 2). Chandigarh has achieved the top score (79) among UTs followed by Delhi (68). In terms of regional analysis, there has also been a significant difference in the performance between the southwestern and north-central states which indicates socio-economics and governance gaps.

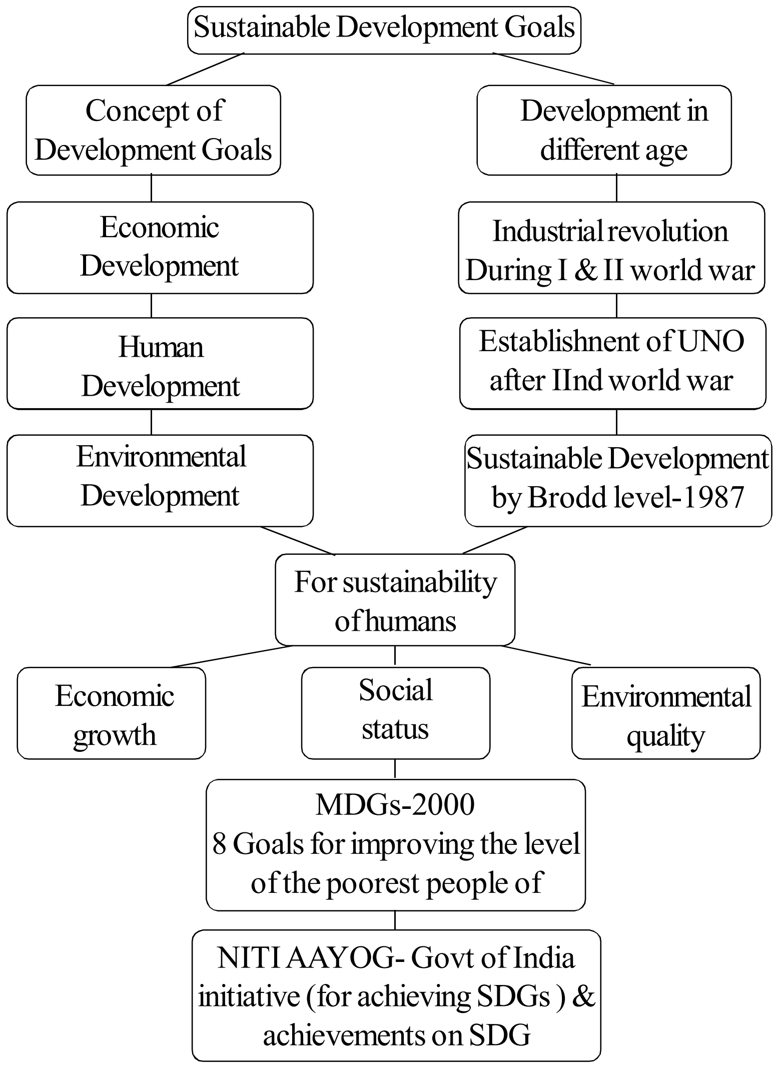
Lack of finance, population growth, recent Covid pandemic, and behaviour towards resource consumption are the challenges in achieving sustainable development in India. For example, India has only 5 percent of the required funding for the implementation of SDG goals, which is very insignificant for the essential sectors like health (1.5%) and education (4%) which is far below the required level. Indian states need to improve their performance on concerns like inequality, reducing poverty; hunger, improving the environment etc. to achieve targets.

All SDGs goals are inter-connected, if we succeed in one affects the success of others goals. The SDGs are well-framed plans to achieve global challenges which we are facing including poverty, inequality, health issues, sanitation, gender issues, climate change, environmental degradation, inequality, poverty, peace and justice etc. to move the world to a more sustainable place. The SDGs are exceptional in that way as they cover issues that affect us all. In short, this is the initiative to improve life for further generations.

INTEXT QUESTIONS 24.4

1. What was the time duration to complete MDGs?
2. What is the main aim of SDG?
3. How many goals and targets are in SDG?
4. By what time the targets of SDG will be completed?
5. Which states/UTs score highest in India's SDG index?

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Write a short note on millennium development goals.

2. What are the major achievements of MDGs?

3. Describe Sustainable development goals with its targets in brief.

Notes

4. What is NITI Aayog and what is its role in SDG.
5. Explain pillars of sustainable development.
6. Describe progress of Sustainable development goals in India's.
7. Distinguish between the MDGs and SDGs.

ACTIVITY:

Make a list of reasons for the gap of development among developed and developing countries.

ANSWERS TO INTEXT QUESTIONS

24.1

(1) Before World War II.

(2) Sustainable Development.

(3) Gro Harlem Brundtland was the chair of the world commission on the environment and development.

(4) Economic growth, social equality and environment protection.

24.2

(1) In September 2000.

(2) 1990

(3) Extreme poverty, Primary education and Child mortality.

(4) Poverty reduction, Enrolment in primary education and maternal health.

24.3

(1) 70th session of the United Nations.

(2) People, Planet, Peace, Prosperity and Partnership.

(3) NITI Aayog.

24.4

(1) 2000-2015.

(2) To achieve both Sustainability and development.

(3) 17 goals and 169 targets

(4) By 2030.

(5) kerala.

25

ENVIRONMENT, HEALTH AND SANITATION

In the previous lesson, you have learnt about the concept, significance and global pattern of human development and Sustainable Development Goals (SDGs). As you know, there is a close relation between the environment and human development. For example, we have constructed dams for electricity generation, irrigation and to fulfil other purposes but it leads to deforestation and loss of biodiversity. Similarly, industrialization and urbanisation accelerated various types of pollution along with loss of fertile agricultural land which eventually created ecological imbalance on our planet. However, the quality of air, water and landis deteriorating day by day which is impacting human health. In this lesson, you will learn the link between environment, sanitation and health along with the issues, challenges, health risks possessed by them, government initiatives and different types of traditional medicines and health practices. Therefore, in order to understand health, it is very important to get familiar with our environment.

OUTCOMES

After studying this lesson, learner:

- identifies the linkages between the environment, health and sanitation;
- describes environmental management to minimise the health risks;
- explains the overview of government initiatives like Namami Gange, Ujjwala Scheme and Swachh Bharat Abhiyan, and
- elaborates the traditional medicines and health practices for common health issues.

25.1 CONCEPT OF ENVIRONMENT, HEALTH AND SANITATION

The terms environment, health and sanitation seem very simple but they are very complicated to understand as all of them are interrelated to each other. There is a direct relation between environment, health and sanitation. In other words, Sanitation stimulates health and improves the quality of environment.For instance, according to SwachhSarvakshen 2021, Indore is the cleanest city of India which signifies that it maintains hygiene and sanitation and residents of the city fall comparatively less sick and enjoy good health.Now let's understand all the terms in details.

A. Environment

Environment simply means our surroundings. The conditions in which we live, recreate and work is called the environment. There are two types of environment namely physical and human. The physical environment includes air, water, sunlight, land and its attributes like plants, animals etc. On the other hand, the human environment consists of man-made features created and modified by humans such as buildings, dams, roads etc.

Components of Environment

Environment is a composite form of biotic and non-living or abiotic organism within which human beings live and work. It includes natural as well as social, cultural and economic environments. Thus, the environment contains a complex relationship between various living organisms and many external forces which affects lives of organism.Human being totally depends on the environment as it provides all types of resources that are required for their survival.

Factors of the environment have been divided into following components. All of them are closely related, directly or indirectly, to a healthy man and his environment.

- **Physical -** climate, air, water land use land cover, altitude
- **Biological -** Bacteria, viruses, insects, rodents, animals, population size, sex-age structure.
- **Economic-** Occupation, , average wages, inequality, poverty, sectoral makeup of urban economy
- **Social -** Customs, culture, habits, availability of medical establishment and relative size of medical personnel.

B. Health

As you all must have heard a proverb since your childhood that "health is real wealth". When we say we are healthy, it means "Health is something special.

Health is very dynamic by nature and varies from person to person and from region to region. It is an equilibrium between man and his environment. Health is a level of functional condition of a person's mind and body. Generally, health means to be free from illness, injury or pain. Well known definition given by the World Health Organization (WHO) in 1948 has defined health as "a state of complete physical, mental and social well-

Notes

being and not merely the absence of diseases or infirmity". Do you know about World Health day? And when it is celebrated? It is celebrated on 7th April which is World Health Day.

As per WHO three specific dimensions of health are:

1. **The physical -** perfect functioning of the body
2. **The mental -** a state of balance between the individual and the surrounding world.
3. **The social -** quantity and quality of an individual's interpersonal ties and the extent of involvement with the community.

In simple words, health is the absence of illness or disease and the presence of mental, social and physical wellbeing. As per ancient view health implies sound mind, in a sound body in a sound family in a sound environment.

Many health related issues and diseases have their origin in the above environment. Diseases have source area (core), spread (diffuses) through humans along identifiable rates and affect clusters of population (region).

Improving the quality of the environment in key areas such as air, water and noise can prevent many diseases and improve human health.

Health is a complex system of interaction among the environment, human population and cultural behaviour. Sound health is essential to lead a "socially and economically productive life". It is also associated with many other things.

Fig: 25.1 Philosophy of health

From an ecological point of view, diseases are defined as "maladjustment of the human organism to the environment".

Human health is a combination of many factors like nutritional, biological, chemical and psychological. In all factors, the environment has a direct impact and consequences on human health. The types and frequency of various diseases very much depend on environmental conditions. Diseases can be classified in two broad categories: Infectious (communicable) diseases and Life-Style (chronic non- communicable) diseases.

Disease is a product of interaction among the agent,host and environment. The agent and the host mutually interact and both can currently interact with the complex matrix called the environment which is both physical and cultural. The triangle is showing the interaction and interdependence of agent. Example is communicable disease. In this, agent is the cause of disease; the host is an organism, commonly a human or an animal that cause or allow disease transmission: and time account for incubation period, life expectancy of the host or the pathogen and duration of the course of illness of condition.

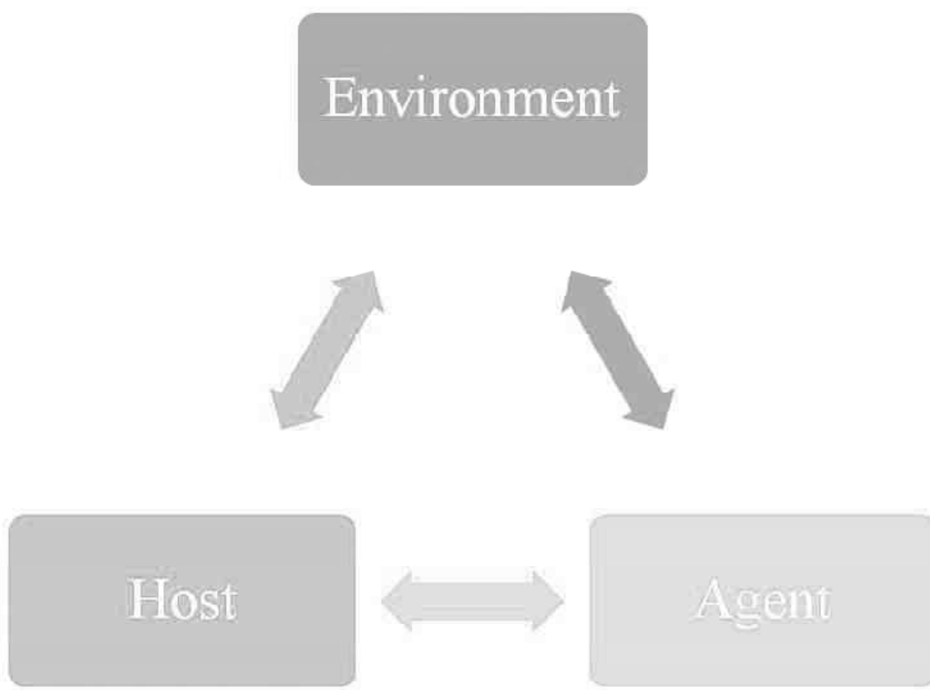


FIG: 25.2 Trilogy of Disease

Health is an inseparable part of the developmental process. Man's poor health can be traced to environmental factors such as pollution, housing conditions, presence of animal and insect vectors or disease which pose a constant threat to man's health. Therefore we can say, Health is linked with environmental conditions.

Health is a real wealth, in order to maintain good health it is the first priority of any human being.Environmental determinants such as air pollution, climate change, contamination with hazardous chemicals, uncontrolled waste generation and disposal. Public health issues like morbidity and mortality both have increased due to increase in pollution level.

Health is determined by following factors such as :

a. Exposure to outer environment

b. Climatic conditions

c. Sanitation condition

d. Living condition

e. Land use/cover

f. Eating habits/ food habits

g. Occupation

h. Daily routine/ life style

To maintain good health, we need to address adequate sanitation, together with safe water. It is a fundamental need for good health and for social and economic development.

C. Sanitation

Sanitation means the prevention of human contact with waste for hygiene purposes. It also means promoting health through the prevention of human contact with the hazards associated with the lack of healthy food, clean water and healthy housing and clean environment.

As per the dictionary meaning of the word Sanitation is the "the science of safe- guarding health".

According to the National Sanitation Foundation of the USA "Sanitation is a way of life."

The term "Environmental Sanitation" has been defined by WHO as "the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical development, health and survival "

Sanitation covers almost controlling the environment with a view to prevent diseases and promote health. It's about quality of living that is expressed in the clean home, clean family, clean neighbourhood and the clean community. Currently, environmental sanitation is the most important health issue. Environmental health is broader than hygiene. It encompasses hygiene, sanitation and many other aspects of the environment. Hygiene generally refers to the set of practices associated with the preservation of health like personal hygiene, household cleanliness, and community cleanliness. The focus is mainly on personal hygiene, diet looks at cleanliness of hair, body, clothing and menstrual hygiene. Environmental health addresses all the physical, chemical and biological factors that are connected to disease transmission.

It focuses on management of wastes produced by human activities. We can break the vicious cycle of diseases by achieving environmental sanitation. Generally, principles of sanitation apply to both urban and rural problems.

There are different types of sanitation relating to particular situation such as given in figure

- Basic sanitation refers to the management of human faeces at the household level. It means access to a toilet; onsite sanitation; the collection and treatment of waste at the place where it is deposited.
- Food sanitation refers to the hygienic measures for ensuring food supply.
- Environmental Sanitation is about the control of environmental factors that form links in disease transmission. It includes solid waste management, water and wastewater treatment, industrial waste treatment, noise and pollution control.
- Ecological sanitation based on the concept of recycling the nutrients from human and animal wastes to the environment.

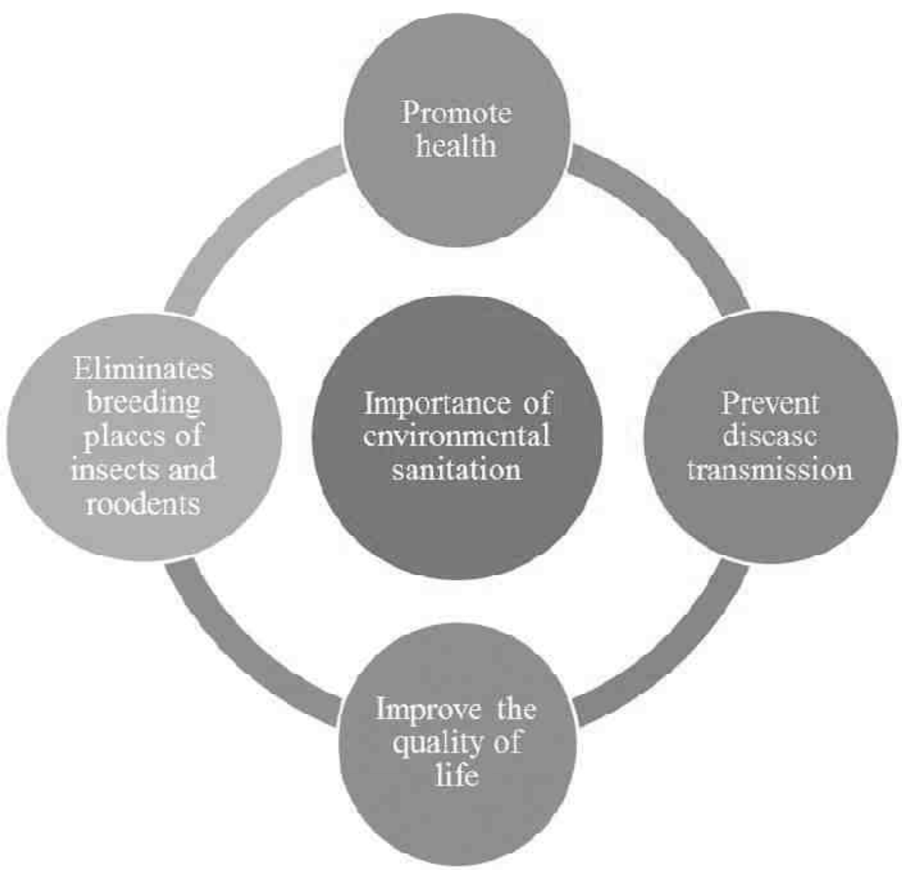


Fig. 25.3: Sanitation and its importance

Sanitation refers to public health conditions like clean drinking water and adequate treatment and disposal of human excreta and sewage. The aim of sanitation systems is to protect human health by providing a clean environment that will stop the transmission of disease, especially through the faecal - oral route. For example diarrhoea, a main cause of malnutrition and stunted growth in children can be reduced through sanitation. Therefore, adequate sanitation means good hygiene and safe water. This is also fundamental to good health and to social and economic development. By improving sanitation, we can improve quality of life and can prevent various diseases. That is the way by which the mortality rate will be reduced particularly in developing countries.

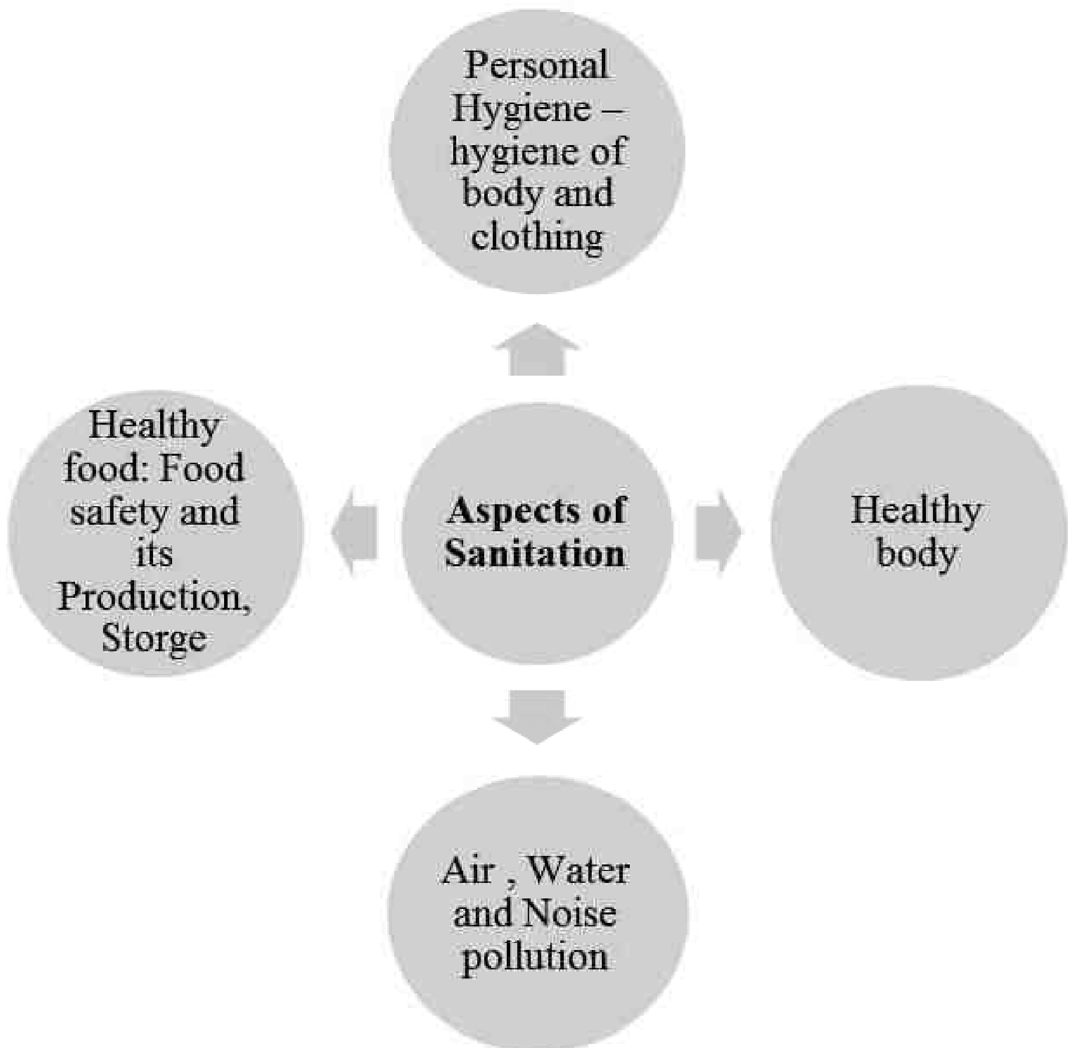


Fig. 25.4: Aspect of Sanitation

For example, preventing human contact through face masks is part of sanitation. Cleaning hands before eating, taking bath every day, and proper hand washing have to follow the basic hygiene and sanitation in our daily life.

Notes

INTEXT QUESTIONS 25.1

1. Fill in the blanks

   i. ……………..Is the level of functional condition of a person's mind and body?

   ii. World Health Day is celebrated on …………

   iii. ………… is a product of interaction among the agent, host and environment.

   iv. ………… refers to the set of practices associated with the preservation of health like personal hygiene, household cleanliness, and community cleanliness.

   v. Human Health is intimately linked to the state of the ……………

25.2 LINKAGES BETWEEN ENVIRONMENT, HEALTH AND SANITATION

You know that, if we live in better environmental conditions we will have higher life expectancy than those who live in a polluted environment.

Both Environment and human health are inseparable. So, the environment should be kept clean and healthy to keep us healthy. After the industrial revolution, the world population transferred from rural areas to urban areas. It brought a huge problem which threatened our environment. This is mainly due to industrial activities along with rapid growth of population. Large population is responsible for lower quality of life, growth of slums and other associated problems like poverty and inequality, technical and scientific development while industrial activity produces industrial waste.

Industrial waste produces three kinds of waste; solid, liquid and gas. Industrial waste pollutes the nearby soil or adjacent water bodies and can contaminate groundwater, lakes, streams, rivers or coastal waters. Industrial waste is often mixed with municipal waste, making accurate assessment difficult.

Industrial waste includes trash, oils, solvents, dust gravel, many harmful gases etc. These are dumped in seas or land without adequate treatment, thus becoming a source of pollution. In areas of poverty (malnutrition), inadequate medical services, poor sanitation, and substandard housing prevail. It is difficult to identify the specific effects of malnutrition on people's susceptibility to disease because so many other factors are present. Direct damage has to health and health determining sectors such as agriculture, water and sanitation. Climate change is the single biggest health threat facing humanity. Health professionals worldwide are already responding to the health harms caused by this unfolding crisis.

Human Health is intimately linked to the state of the environment. Good quality natural environments provide basic needs, in terms of clean air and water, fertile land for material inputs and food production and energy, and forests also serve to regulate climate. At the same time the environment represents an important pathway for human exposure to polluted air, noise and hazards, chemicals etc. Healthy people are those who live in a healthy house on a healthy diet of quality environment.

Since last century environmental degradation has increased as the human population has been increasing. Many indicators of growth and development like agricultural progress, rapid growth of urbanisation, and industrialization. The relationship between the health of the human population and the state of development of a society is complex and varies over time. Good health is a result from complex interaction between man and agent and the environment. If you are living on a busy main road, very close to a source of electromagnetic radiation or near a site of disposing of hazardous waste, you may be more at risk of illness than others who do not live. For example, many areas of Bihar, west Bengal are prone to health hazards due to the consequences of consuming Uranium, Arsenic, Fluoride and Iron through water and vegetables and food grains.

Let us discuss, elements of environmental health which focus on following

1. Global Environmental Health
2. Outdoor Air Quality
3. Surface and groundwater
4. Toxic substances and Hazardous wastes
5. Home and Communities
6. Infrastructure and
   Surveillance

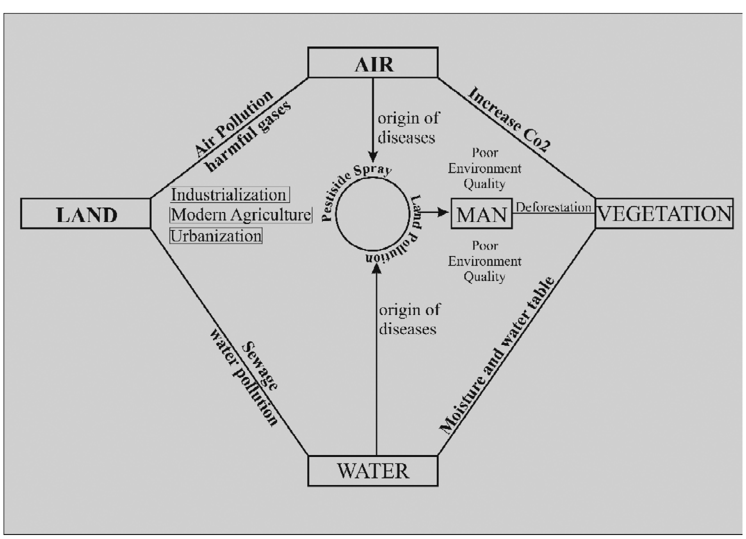


Fig. 25.5: Linkages between Environment health and sanitation

There are following important driving forces which are interlinked in environment health and sanitation processes.

A. Modern Agriculture

Agriculture is a primary activity and the base of any country's development. This is fully based on our environment. All other types of economic activity are directly or indirectly related to agricultural activities. It is a main source of food and nutrition for human beings. Development in this sector has positive as well as negative impact on human health. Health can be a result of under nutrition as well as over nutrition. The excess use of fertilisers or pesticides for higher production has been linked to the elevated incidence of human diseases such as cancer, asthma, obesity, respiratory disease and organ system failure and the risk of groundwater problems in the human population. Pesticides like DDT, DDE, TDEetc. have their impact on all three components of earth i.e. lithosphere, hydrosphere and atmosphere. Pesticides can even enter the body through skin, lungs and digestive tract. Many Diseases can be seen like nausea, vomiting, abdominal cramps, diarrhoea and gastro-intestinal poisoning.

B. Industrialisation

industrialisation means increasing the establishment of industries which in turn has an impact on the environment. Forests are cleared to make way for new industries and cutting of trees causes many harmful impacts on human health and environment. With an expansion in human population more food, materials and shelter are being manufactured at stupendous rates, mostly stemming from forestry. Trees are very important for humans and the environment because they release oxygen and make the environment clean. Industries are continuously polluting indispensable resources like air, water and soil which require millions of years to replenish. In other words, due to industrialisation pollution increasing in rivers and water bodies and in air smoke release everywhere. These pollution and cutting trees affects the environment and causes harmful effects on human health. It also causes diseases like asthma because without trees humans face problems in breathing.

C. Urbanisation

Urbanisation led to migration from rural to urban areas leading to overpopulation and overcrowding thus resulting in poor health practices due to congestion and development of slums.

D. Air pollution

Air pollution is a major threat to human health. The combustion of fossil fuels is the problematic and principal source of air pollution in the urban and industrial areas. Beside

its health impacts, air pollution also poses a threat to the region's food security, water security and climate system. Air pollution such as ozone and sulphur oxides cause crop and ecosystem damage and pose a major concern for food security. Black corban, a component of particulate matter, has been identified as a major contributing factor in the accelerated melting of snowpack and glaciers.

Polluted environment causes various types of diseases, for example infectious diseases are caused by internal dysfunctions such as autoimmune diseases. In a broader sense, disease is a condition that causes pain, dysfunction, distress, social problems or death to the person.

E. Climate Change

Global climatic change is an important issue that concerns mankind. You all know that the "Greenhouse effect"is due to anthropogenic activities which have destroyed the protecting layer of earth's temperature. Global warming is maintaining harmful effect on human health, animal, forest, wildlife, agriculture and water environment. It also adds health risk to poor people. Climate change affects elements of healthy environment as clean air, safe drinking water, sufficient food and secure shelter. Due to it's expected to cause additional deaths per years from malnutrition, malaria, diarrhoea and heat stress.

Climate change puts at risk the food supplies of people in developing and developed nations like flood, drought, more intense hurricanes, heat waves and wildfires can drive down crop yields, destroy livestock and interfere with transport of the food. Rising carbon dioxide levels from human activity can make staple crops nutritious like rice or wheat.

In most of the places where food is grown today, crop yields are likely to be lower because of more frequent heat waves, worse air pollution, floods and droughts. All essential nutrients for people's health represent major risks to people's health in developing nations where deficiencies in zinc, iron and protein lead to major burdens of disease. The diseases range from maternal mortality around child birth to problems with brain development in children.

Climate change influences human health and disease in numerous ways and may vary with location, time and economic base.

Table 25.1: Major pollutants/ contaminant/ wastes, sources and impact on health

Pollutant	Sources	Impact on health
Carbon monoxide	Automobiles due to incomplete combustion	Displaces oxygen in blood, reduces the amount of oxygen to blood tissues, extra burden on anaemic, heart and lung patients.

Notes

Particulates (Smoke, Fly, Ash etc.)	Stationary fuel combustion in industrial process	Occurrence of photo-chemical smog
Oxides of sulphur	Burning of coal and oil as fuel in industrial processes	Harmful for the respiratory system, irritates the upper respiratory tract and lung tissue.
Hydrocarbon	Automobiles, fuel combustion in electric power plants, combustion of solid waste disposal etc.	Help with farming photos - chemical smog.
Oxides of nitrogen	Burning of fuel at very high temperatures as in transport vehicles, power plants and industrial boilers.	Nitrogen oxides combine with hydrocarbons in the presence of ultraviolet rays of the sun to form secondary pollutants called photo-chemical oxidants.
Degradable wastes	Domestic and municipal sewage and other oxygen demanding industrial wastes	Depletion of dissolved oxygen in water , harmful for fish and other aquatic life.
Infectious agents	Polluted, stagnant water breeding grounds for parasites, bacteria, viruses of all kinds.	Cause water-borne diseases and outbreak of epidemics such as amoebiasis , dysentery, cholera, typhoid etc.
Synthetic organic compounds	Such as pesticides, agricultural chemicals, detergents, industrial wastes , DDT etc.	Instance of cadmium, lead and mercury poisoning in human beings. cause neurological impairment and even deaths
Inorganic minerals	other chemicals . Asbestos and acids etc.	Asbestos produces lung cancer. Acids cause allergies, ulcers, skin diseases. Also have a catastrophic impact on fish and aquatic life.
Radioactive elements	Wastes from nuclear power plant and	Potentially hazardous in the event of leakages and induce radiation related illness
Sediments	Soil and mineral particles	Reduce amount of sunlight

	washed into streams or water	available for marine plants cause clogging of filter plants
Thermal pollution	Water used for cooling in electric, thermal, nuclear power plants, when recirculate in water bodies	Can raise lake water temperature by 70-100 c aggravate diminution of dissolved oxygen, kills marine fish and plants life.

Other effects on health like temperature related illness, Extreme weather related effects, effects of food and water shortage, effects of noise pollution etc. Human health and its safety is also affected due to the unsafe environment at home, school and workplace as we spend most of our time in these places and may be exposed to conditions of indoor air quality, inadequate heating and sanitation, structural problems, electrical and power hazards and lead based paint hazards. Environment and health are closely associated with each other. Day by day, due to declining quality of environmental elements and their pollution level, health conditions are becoming worse. Along with this, many other issues like the threat of climate change, poverty, hunger and inequality are challenges for health, sanitation and environment for human survival. Without sound health, there is no meaning to life.

INTEXT QUESTIONS 25.2

1. Write T against the correct statement and F against the incorrect statement

    i. Without sound health, there is no meaning to life.

    ii. Pesticides do not have any impact on the components of earth.

    iii. Air pollution is not a major threat to human health.

    iv. Global warming is maintaining harmful effect on human health, animal, forest, wildlife,

25.3 GOVERNMENT INITIATIVES FOR SANITATION PROGRAMME

We know about these diseases which are a result of the polluted environment due to many anthropogenic activities. Sanitation and environmental quality are necessary requirements for human health. Passing a clean environment to the next generation is a critical aspect for each successive generation. Without safeguarding our environment, we can't keep our environment healthy. That's why our government, with the collective wisdom of all stakeholders, is thinking in terms of sustainable development and environmental management for the future generations.

All of us have a right to live in a quality environment. Environmental protection has become a global motive for all our development and planning. This can be achieved by environmental management programmes, through various ways:

- Decreasing air pollution is an important step in order to create a pollution free healthy environment.
- Protecting water resources by minimising exposure to contamination are an important part of environmental health.
- Reducing exposure to toxic substances and hazardous wastes are a fundamental requirement for environmental health.
- Maintaining healthy homes and communities and free from hazards and unsafe conditions is essential for the safety of our health.
- Others such as to protect biodiversity, educate people to all levels; encourage research for formulating plans, policy and guidelines for the improvement of the quality of the environment.

The Indian government has started various programmes and initiatives towards sanitation, cleaning of rivers, poverty eradication and health facilities. In the present scenario we are over using the national resources and polluting our environment but to keep our environment clean and healthy government initiatives have played a huge role in helping out solutions to the problems.

"Sanitation is a cornerstone of public health" Dr.Margarreet Chan, Director- General, WHO

"Improved sanitation contributes enormously too human health and Well-being, especially for girls and women"

In this regard the following important initiative is going to be discussed.

A. Namami Gange Programme

The NamamiGangeYojana was a part of flagship programme initiated by the central government as an integrated conservation mission in 2014. The objectives of initiatives are conservation, rejuvenation, and effective reductions of pollution to clean the River Ganga. The total pollution level of river Ganga is contributed both ways i.e. domestic and industrial waste water and the non- point resources are agricultural sewerage, solid waste dumping left over religious material etc. The domestic sewage contributes 70 percent of the pollution load whereas industrial waste contributes to 30 percent of the all pollution loads. Under this programme emphasis has been given on pollution elimination, sewerage treatment infrastructure, river surface cleaning, afforestation, industrial effluents monitoring, biodiversity, and river-front developments, development of efficient irrigation methods and rational agricultural practices and public awareness. As per an estimate everyday 500 million litter's wastewater from industrial services are directly dumped into rivers in many places. This programme is divided in entry-level, medium level and long term activities to be implemented within ten years. The Ministry of Drinking Water and Sanitation identified 1674 Gram Panchayats situated on the banks of the River Ganga in 5 States to construct toilets. A consortium of 7 IITs is engaged to prepare the Ganga river basin plan, and 13 IITs adopted 65 villages for developing them as model villages.

B. Swachh Bhrart Abhiyan

Swachh Bharat Abhiyan (SBA) is a country wide campaign initiated by the Government of India on 2nd October 2014. This mission was started with an aim to eliminate open defecation and open defecation free country in five years and construction of individual cluster community toilets. As we know open detection was one of the major causes of death of thousands of children's every year. The aim of this mission was changing people's attitudes, mind-sets and behaviours towards villages to be kept clean. It also encourages cost effective and appropriate technology for ecologically safe and sustainable sanitation facilities through awareness creation and health education.

Have you thought, Why SBA? Why on Gandhi Jayanti because Ghandhiji had rightly said (1923) "sanitation is more important than independence" he was aware of the pathetic situation of rural India and emphasised on cleanliness sanitation. Through this mission it was about bringing an improvement in the general quality of life in the rural areas. The main focus of the mission is on solid and liquid waste management for overall cleanliness of the rural areas. The mission aims to cover around 1.04 crore households, provide 2.5 lakh community toilets, 2.6 lakh public toilets and a solid waste management facility in each town. Under the programme, community toilets will be built in residential areas where it is difficult to construct individual household toilets.

The SBA campaign proved to be a great success. Within four years of the campaign the number of people detected in the open dropped considerably from 550 million to around 150 million. This abhiyan also includes operations like door to door waste collection and their proper disposal. In 1990 deaths due to water and sanitation consisted of 13 percent of the total death across the country. By 2016 the percentages had come down to 5 percentages; which is quite significant.

C. Ujjwala Yojana

The Ujjwala Yojana scheme is a big and path-breaking initiative regarding the health and sanitation of local women and the nation as a whole. It was started in 2016 by the Ministry of Petroleum and Gas, central government for transforming the lives of the poorest of the poor. The scheme PMUY (Pradhan Mantri UjjwalaYojana) aims to provide clean fuel to women and address health hazards due to use of wood, cow dung, free from drudgery of collecting firewood, smoke free house to all etc. in cooking. There was a target to achieve 8 crore households for LPG connection by 2020 and to be covered by 58% population by 2030. It is a greater push towards use of cleaner fuel because there are serious health hazards associated with the burning of fossil fuels. As per an estimate of WHO, 5 lakh people died in India due to the use of unclean cooking fuels. The smoke inhaled by women using nuclear fuel is equal to smoking lots of cigarettes in an hour. By which the air pollution causes respiratory disease or disorders like lung cancer, heart disease, stroke and chronic and obstructive pulmonary diseases

Some diseases are reduced through implementation of this Scheme. In the nation as whole and particularly local rural women are benefiting due to air pollution, clean environment and healthy society.

INTEXT QUESTIONS 25.3

Multiple Choice Questions

1. Namami Gange Programme was initiated in -

   a. 2012 b. 2013

   c. 2014 d. 2015

2. Swatchh Bharat Abhiyan was celebrated on -

   a. Buddha Jayanti b. Gandhi Jayanti

   c Mahavir Jayanti d. Ambedkar Jayanti

3. UjjwalaYojana is an initiative for -

   a. Children b. Men

   c. Women d. none

25.4 TRADITIONAL HEALTH CARE SYSTEM AND MEDICINAL PLANT

The concept of health has evolved over the centuries. Health care system is one of the important aspects of health. Worldwide, there are two types of medical health care systems: one traditional and the other modern. To provide all modern health care facilities to the citizens of a country is difficult especially for a developing country like India. Therefore, we have to use and focus on our traditional health care system. A number of traditional systems have existed and flourished across the world. The Indian traditional system is also known as the natural health care system, for example Ayurveda, Naturopathy and yoga. Natural health care system is based on the philosophy of "nature is the best healer".

This system is fast disappearing due to relatively low income, lack of written documents, deaths of the knowledge bearers, lack of government strategy to protect their knowledge, among the present generation and overall impassive attitude towards traditional healing systems.

The UN SDG 3 focuses on good health. The need of the hour is to develop medicines combining modern medicines, yoga and traditional medicines for sustainable health.

Medicinal plant - we have to learn about medicinal plant uses and their important role in the primary health care system. In the urban areas need to aware of rich knowledge that exists in our traditional health care systems of medicine regarding usage of various plants species for our health care needs.

Many plant species used for medicinal purposes are also used in the field like aromatherapy , fragrance, essential oil , food supplement , herbal tea , cooling purpose, healing powers , and cosmetics purpose etc.

Medicinal plants today are seen only as a source of affordable health care in developing nations but also in the developed world. About 80 percent of the developing countries population uses indigenous medicines based upon plants. Most of the world population believes that local medicine systems based on plants have no side effects. India has strong traditions as a plant based system of medicine like Ayurveda and Siddha which are 3000-5000 years old.

Medicinal plant sector is highly unorganised where traditional healing is often seen as an unrecognised occupation. The large number of healers belong to the poor and aged group. Many medicinal plants have significantly contributed to the maintenance of the health and fitness of masses since ancient times and remain to do so in most of the developing countries even today.

Some examples are mentioned in the following table:

Table.25.2. Information of important Medicinal plants and its health benefits

Plant Name	**Used Part**	**Health benefits**
Ashwagandha	Roots	Reduce stress and tension, control depression, useful in general weakness and gives vitality.
Amla	Fruit	Rich source of vitamin C, useful indigestion and Jaundice, it cures insomnia and is healthy for hair , it is used as Cardio protective
Arjun	Bark	Mainly used in heart disease and it helps strengthen

		the body's natural rejuvenate processes, hastening the replacement of dead or weak cells with fresh, vital ones. the bones,
Ashok	Bark, Seeds and flowers	Bark used in biliousness, dyspepsia, fever, ulcer, dysentery, colic, piles and pimples. Dried flowers used in diabetes and hemorrhagic dysentery, seed used for treatment of bone fractures.
Brahmi	Whole plant	It is an excellent brain tonic, useful for nerves and used in mental diseases, used to improve intellect, treatment of asthma, hoarseness, insanity and epilepsy.
Bahera	Fruit and Bark	Fruit is useful in stomach disorders such as indigestion, diarrhoea. It is useful in asthma, bronchitis, inflammation, sore throat, and treatment of eyes, nose, heart and bladder diseases.
Bael	Fruit, leaves and root	It is a tonic, antibiotic and appetiser, used in the treatment of constipation. Fruit juice is beneficial during summer.
Bach	Rhizomes	It is valued as a rejuvenator for the brain and nervous system and as a remedy for digestive disorders. SUseful in stomach aches and kidney stones.
Gwarpatha	leaves	Leaf pulp used in liver and spleen ailments and for eye troubles, also used in colic and constipation, skin disorders, burns , anti - ageing creams and cuts.
Jamun	Seed and Bark	It is traditional medicine for diabetes and sore throat, seed powder and juice is used for diabetes, Bark used in dysentery and leucorrhea.
Kadipatta	Whole plant, leaves and root bark	Diarrhoea, dysentery, piles, leukoderma, blood disorders.
Shatavari	roots	Used as a general tonic,, useful in nervous disorders, tumours, throat infections, cough, bronchitis and general debility.

Sarpagandha	roots	Root is used as a sedative and for reducing blood pressure, also for relief from nervous disorders including anxiety, insanity, insomnia and epilepsy.
Sadabahar		Leaves, flowers, root Infusion of leaves used in diabetes and decoction of roots is used for hypertension, sedation and in toothache; extract of leaves is anti- carcinogenic.
Tulsi	Leaves , seeds	Widely used in Cough, cold and fever. It possesses anti-fungal, antimicrobial, antiviral, insecticidal, activity. It is used in malaria, bronchitis and gastric disorders, it also lowers blood sugar levels.

Government of India launched National Natural Urban Health Mission of AYUSH for better urban health and wellbeing. The Ministry of AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy) is responsible for reviving the knowledge of the traditional health care system.

Environment balance is a must for the health of man and his environment, and then we can achieve sustainability of the planet earth. When we save our environment from the impact of various types of pollution and give priority to sanitation in daily life, then we will be able to live in a healthy environment and our body will also become healthy.

INTEXT QUESTIONS 25.4

Match the following-

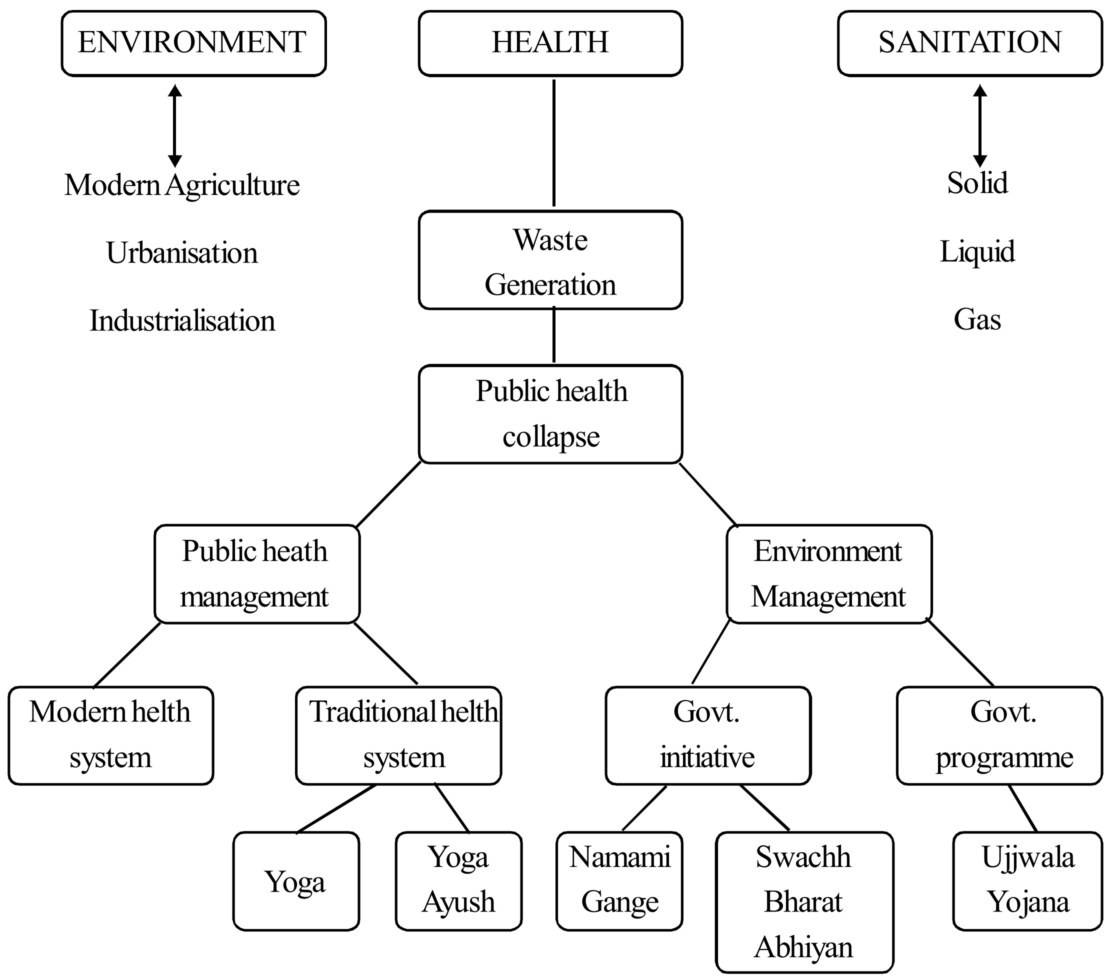
a.	Ashwagandha	i.	Ayurveda
b.	Brahmi	ii.	Stomach disorder
c.	Traditional Health Care System	iii.	Reduce Stress
d.	Bahera	iv.	Brain tonic

ACTIVITY

1. Visit a nearby herbal garden / Park and make a list of the medicinal plants and its utility.

Notes

WHAT YOU HAVE LEARNT



TERMINAL QUESTIONS

1. Which one is correctly matched?

    i) Sanitation is more important than independence - Mahatma Gandhi

    ii) "Sanitation is a way of life." - Dr.Margarreet Chan, Director- General, WHO

    iii) "Sanitation is a cornerstone of public health - According to National Sanitation Foundation of the USA

2. Define Health and explain its 3 specific dimensions.
3. Write about 5 elements of the environment, why it is important for us.
4. How modern agriculture practices are responsible for various health issues.
5. What is Environmental Sanitation?
6. What do you understand about agents of diseases?
7. Elaborate linkages between various aspects of the Environment. Health and Sanitation with the help of a diagram.
8. Make a list of various types of pollutants which are harmful to our health.

ANSWERS TO INTEXT QUESTIONS

25.1

(i.) Health

(ii.) 7th April

(iii.) Disease

(iv.) Hygiene

(v.) Environment

25.2

(i.) True

(ii.) False

(iii.) False

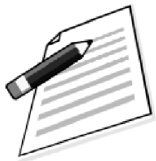
(iv.) True

25.3

(i.) 2014

(ii.) Gandhi Jayanti

(iii.) Women



25.4

(a.) iii.

(b) iv.

(c) i.

(d) ii.

PRACTICAL MANUAL

1. Maps: Types And Elements; Notes Toposheets
2. Geospatial Technologies
3. Data And Statistical Diagrams

1

Notes

MAPS: TYPES AND ELEMENTS; TOPOSHEETS

Sayali and her friend Jemmy were excited to go for the school educational trip to the nearby waterfall. The teacher announced about the picnic cum educational trip today itself and told the students to pack necessary items in the bag, wear a comfortable dress, keep a spare set of clothes, etc. and they will go for the trip in the coming week. Both the friends were wondering where this waterfall is. Therefore, they opened the local map of their place kept in their Geography lab and tried to locate the waterfall. After a while they were able to locate it lying in the outskirts of their town in the East direction. They were all the more excited to find out that while going there, they will pass by the famous rose garden in that area which also has beautiful and big fountains. So, on the day of their trip they knew where they were going and which route their bus would follow. During the journey they could see the beautiful fountains, showed them to friends and enjoyed the trip to the fullest.

Learners, with this story you must have understood the importance of maps. In this lesson, maps will be discussed in detail.

OUTCOMES

After studying this lesson, learner:

- differentiates between general and thematic maps
- constructs linear scales
- recognises map symbols used in topographical sheets and
- interprets the physical and cultural features on toposheets.

1.1 WHAT IS A MAP

As you can make out from the story of two friends Sayali and Jemmy, maps are representations of some physical space. So, maps are simplified representations of whole or a part of the

Notes

earth's surface on a plane surface.You have learnt in the previous classes that earth is in the shape of a geoid which is three dimensional. It is not possible to represent the whole of the earth or a part of it in the same three-dimensional form like a globe. Therefore, we represent if in two-dimensional forms such as, maps. You must be wondering, how a three-dimensional surface is converted into a two-dimensional surface! This is done with the help of projections. Projections help in providing exact position to a place on the map corresponding with the same on the earth. Similarly, is it possible to construct a map of a place exactly of the same size that exists on the earth? No, therefore a scale is chosen. Besides this, various features on the earth are represented in a simplified form using symbols, colours and shades. The representation of the earth's surface as a map is a generalised one and is also at a reduced scale. Let us try to do an activity and understand more about maps as a representation of the globe.

LET'S DO IT

Take a rubber ball with few things drawn on it assuming it is a globe. Make a long cut in the ball vertically. Try opening the ball to make it a flat surface. What do you observe? It is almost impossible to do this. The round ball cannot be flattened into a flat surface.

Try answering the following questions to understand more about maps.

INTEXT QUESTIONS 1.1

i. What is a map?

ii. What is the importance of maps?

Fill in the blanks.

iii. A globe is a ________dimensional representation of the earth whereas a map is a ______ dimensional representation.

iv. A map is the ________________representation of the earth's surface and is drawn at a __________scale.

1.2 ESSENTIAL ELEMENTS OF A MAP

Have you ever thought, since when the maps are being drawn or were the early maps same as that of now? Since early times maps have been created involving various materials and processes. The art and science of making maps is known as Cartography. Earlier maps were made on clay tablets as drawn by the Mesopotamians (2,500 B.C.) and pieces of cloth. After the invention of paper, maps started being drawn on these using inks. One of the earliest maps of the world drawn by Ptolemy can be seen in Figure-1.

Notes

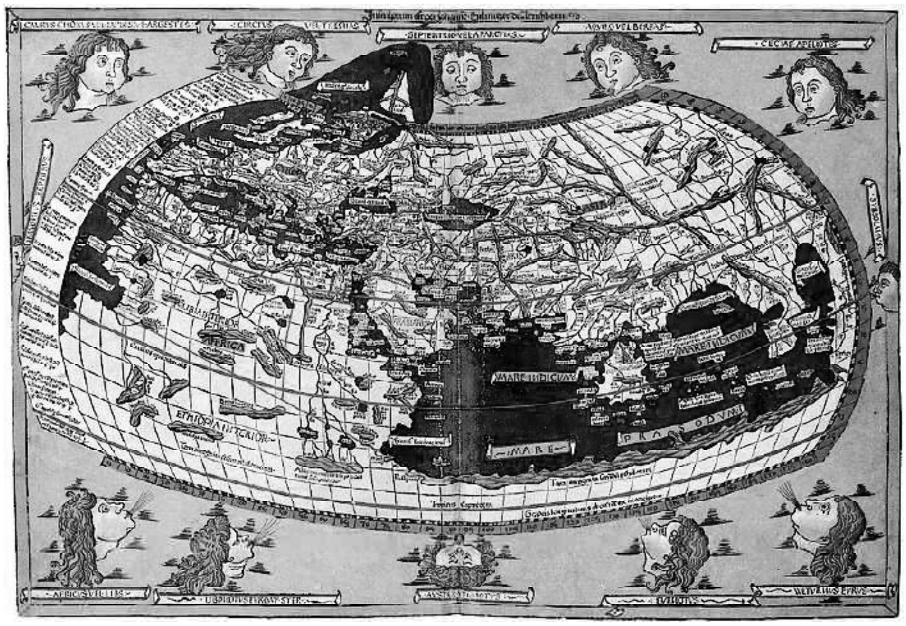


Fig. 1.1: Ptolemy's world map

Greek and Arab geographers were the ones who laid the foundation of modern cartography. In India also cartography started during Vedic times where representations of various places and their features were done as 'sidhantas' or laws. Today, maps are created by the Survey of India with the help of extensive surveys and computer applications.

It becomes important to know what are the essential elements or requirements of a map. Though various types of maps contain various components, there are few most important ones that need to be there in a map. They are:

A. Scale

Scale is the most important component of a map. While we were discussing the definition of maps, we got to know that maps are drawn at a reduced scale. What is a scale then? A scale is the distance on the map representing the actual distance on the ground. It is the ratio of distance between two places shown in the map and the actual distance on the ground. If one has to show a smaller area on map then a large scale of 1:250 is taken. This means 1 cm distance on the map represents 250 km distance on the ground. Similarly, a scale of 1:50 will mean 1cm distance on map representing 50 km on ground. On the other hand, if a map of larger area is to be drawn a smaller scale is chosen for example, 1:250,000 which means 1 cm distance on map represents 2 lakh 50 thousand km distance on the ground. Similarly, a scale of 1:50,000 will mean 1cm distance on map representing 50 thousand km on ground.

Notes

A scale is either written on the map as words (1cm to 2.5 km), in numerals as fraction such as, 1:250,000 and is known as Representative Fraction (RF) or represented graphically like a divided line on map.

If you open your atlas, you will see at the bottom or on the side of any map given there the scale of the map. It may be shown in different ways. Now we will study the different ways of representing scales on maps.

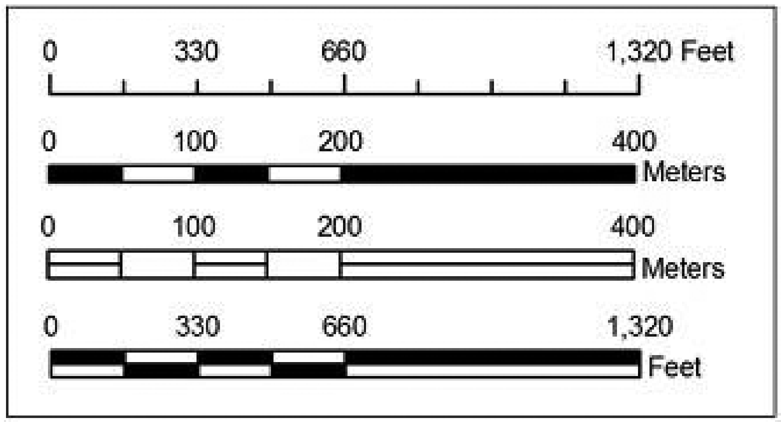


Fig.1.2: Map scales (graphical) and various forms in which they are represented

The scales are expressed on the maps in three different ways:

i. By a statement

ii. By a Representative Fraction, and

iii. By a Graphic scale/Linear Scale

Let us now see what each one of them stands for and what are their merits and demerits.

i. By a statement

In this method, the scale is expressed in words. For example one centimetre to one kilometre. This statement means that a distance of one centimetre on the map represents a distance of one kilometre on the ground.

Merits

1. This method is very easy and simple.
2. It is easy to understand.
3. It is easy to use.

4. Its conversion is easy into other forms of scales.

Demerits

1. A scale represented by this method can be used only in those countries in which the units of measurement used in the statement are followed, for e.g. Kilometres or miles.
2. In this method the difficulty arises when one wants to convert one unit of distance into another unit of distance.
3. It becomes incorrect when the original map is enlarged or reduced.

ii By a Representative Fraction or R.F.

This method of expressing a scale is commonly called a Representative Fraction or R.F. In this method, the distance on the map and the corresponding distance on the actual ground are given in the same unit of measurement. The numerator and the denominator of the fraction are given in the same unit of measurement. The numerator of the fraction represents the distance on the map and the denominator represents the actual distance on the ground. Therefore, representative fraction is written as:

Distance between two points on the map (map distance)

R.F. =

Distance between the corresponding points on the actual ground

Points to Remember

1. The numerator of the fraction is always one, while the denominator keeps on changing, as:

1/1000,000	or	1: 1000,000
1/63,360	or	1: 63,360
1/2500	or	1: 2,500

2. The numerator and the denominator of the fraction represent the same unit of measurement. The unit may be used in centimetres or inches or any other unit.

   1/1000,000 may mean one centimetre = 1000,000 centimetres or one inch = 1000,000 inches.

   1/2,500 may mean 1 centimetre = 2500 centimetres or 1 inch = 2500 inches.

   1/63,360 may mean 1 inch = 63,360 inches or 1 centimetre = 63,360 cm.

Notes

Notes

3. The numerator always represents the distance on the map and the denominator always represents the ground distance for example 1/1,000,000 means that a distance of one centimetre on the map represents a distance of 1,000,000 centimetres on the ground.

Merits

1. The most significant advantage of this method is that a map drawn on this type of scale can be understood universally.
2. Due to the above advantage, countries of the world using different units of measurement find no difficulty in using this method of scale.
3. It remains correct even if a map is enlarged or reduced.

Demerits

1. Representative fraction is a difficult method of representing the scale.
2. A common person cannot easily understand the scale represented by this method because the conversion of the smaller unit of measurement into the larger unit of measurement involves multiplication and division.
   - In Statement of scale, the scale is expressed in words, such as, one centimetre to four kilometres.
   - In Representative Fraction, the distance on the map and the distance on the ground are shown in the same unit of measurement.
   - The numerator of this fraction represents the distance on the map and the denominator represents the actual distance on the ground.

iii Linear Scale

A linear scale is represented by a straight line which is divided into a number of equal parts. The main divisions are called primary divisions and the subdivisions are called secondary divisions. The scale is divided in such a manner that the distances on the map can be easily measured in terms of actual distance on the ground.

Merits

1. In this method, the distance on the map can be directly and easily read in terms of the distance on the ground.
2. The scale has the advantage of remaining true even after enlargement or reduction of a map.

Notes

Demerits

1. This scale can be understood only by those people who are familiar with the units of measurement used in the scale.

2. It is difficult to draw this scale.

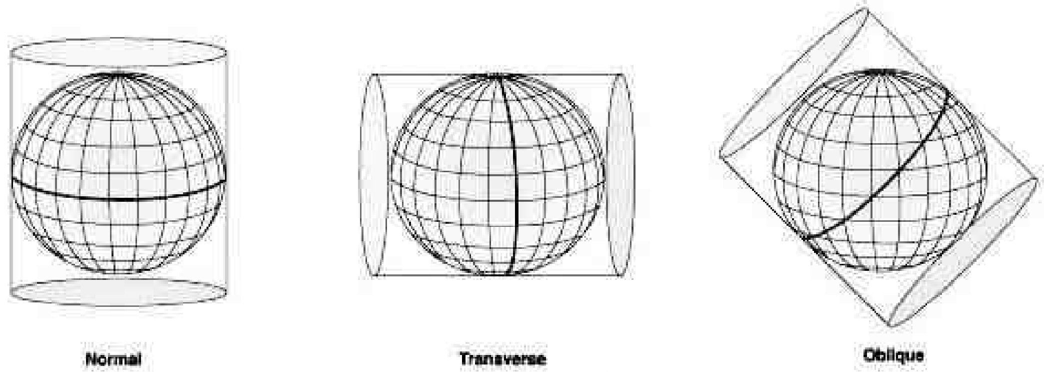
B. Projection

As we know that maps are the simplified representations of the whole of the earth's surface or a part of it, in a two-dimensional surface projections are used in this transformation. A map projection is the system of transformation of the spherical surface to plane surface. This is done with the help of grids of lines representing latitudes and longitudes. As maps are flat, some of the simplest projections are made into geometric shapes that can be flattened without stretching their surfaces. These are called developable surfaces. Some common examples of developable surfaces are cones, cylinders, and planes. A map projection systematically projects locations from the surface of a spheroid to representative positions on a flat surface using mathematical algorithms. Let us have a brief idea of how projections are drawn using various developable surfaces.

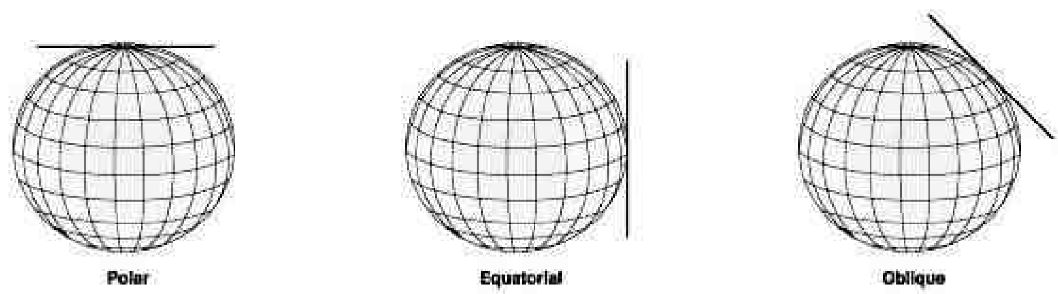
The first step in the construction of a map using projection or projecting from one surface to another is creating one or more points of contact. Each contact is called a point (or line) of tangency. A planar projection is tangential to the globe at one point. Tangential cones and cylinders touch the globe along a line. If the projection surface intersects the globe instead of merely touching its surface, the resulting projection is a secant rather than a tangent case. Whether the contact is tangent or secant, the contact points or lines are significant because they define locations of zero distortion. Lines of true scale include the central meridian and standard parallels and are sometimes called standard lines. Though care is taken to represent the globe exactly onto a plane surface, distortions take place depending upon the location of point of contact. These distortions take place either in terms of shape or size or area. In general, distortion increases with the distance from the point of contact. Many common map projections are classified according to the projection surface used: conic, cylindrical, or planar.

(a) Conic tangent

Notes



(b) Cylindrical Aspect



(c) Plantar Aspect

Fig. 1.3 Various types of developable surfaces

So, depending upon the plane surface on which the earth is being projected and the area (tropical, subtropical, polar, etc.) which is being studied there are several types of projections. An example of projection is given in Figure.

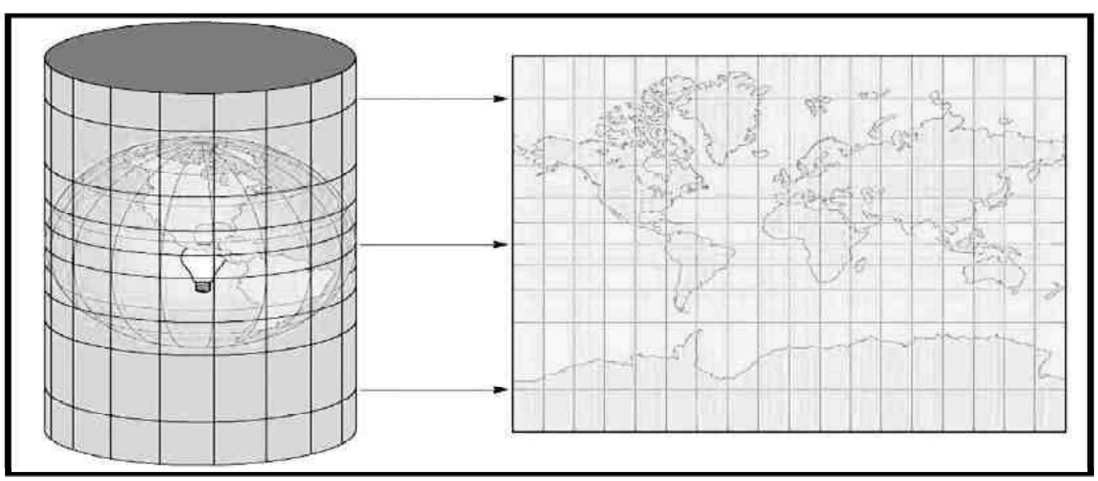


Fig. 1.4 Map projection (Cylindrical projection)

Generalisation- Every place on the earth's surface has some or the other uniqueness. We have understood that maps are drawn at a reduced scale meaning, large areas on the earth are reduced in size to be represented on a map. This leads to ignoring a few uniqueness and details of places. This means generalisation is done keeping in mind the definite purpose for which a map is created. In this process, relevant information (or data) is selected depending on the theme which is to be studied.

C. Conventional symbols- There are large number of features present on the earth's surface. Representing them on a map requires use of various symbols, colours and shades. These symbols are called conventional symbols. Table-1 gives a list of a few conventional symbols used in a map. Conventional symbols are an important entity of a map as they help in understanding various features existing on the earth's surface.

Notes

Road, metalled: according to importance: milestone...............

Road, unmetalled: according to importance: bridge..................

Cart-Track, Pack-track and pass..Foot-path with bridge.........

Bridges with piers without. Causeway, Ford of Ferry...............

Sreams:withrack in bed: undefined, Canal..............................

Dams: masonry or Rockfilled earthwork. Weir/Anicut.............

River banks. shelving: steep. 10 to 19ft: over19ft.....................

River dry with water channel with island & rocks. Tidel river....

Submerged rocks. Shoal. Swamp, Reeds...............................

Wells: lined, unlined Spring, Tanks:perenniel dry.....................

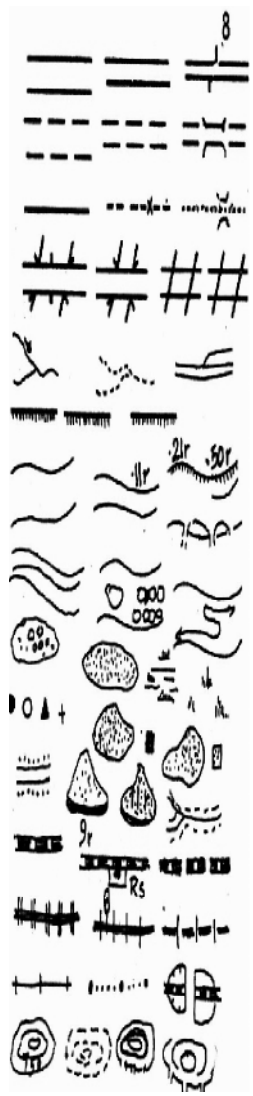
Embankments: road or rail, tank, Broken ground....................

Railway. Broad gauge: Double/Single with station: under constrn

Railways. other gauges: Double/Single with milestone: under constrn

Light Railway or tramway. Telegraph line. Cutting with Tunnel.......

Contours, Formlines, Rocky slopes Cliffs......................................



Notes

Sand featurs;(1) flat (2)sand-hills(permanent)(3) dunes, (shifting).....

Towns or villages: inhabited: desrted Fort..................................

Huts, permanent, temporary. Tower, Antiquities................................

Temple. Chhatri, Church. Mosque, Idgah, Tomb. Graves.................

Light house, Lightship, Bouys: lighted, unlighted, anchorage....

Mine, Vine on trellis. Grass, Scrub..

Palms, palmyra.other Plantain. Conifer. Bamboo Other trees......

Boundary pillers surveyed. unlocated. villaget trijunction.............

Heights. triangulation: station: spot heights....................................

Bench mark: ....

Post office, Telegraph office Combined PT office. Police Station........

Bunglows:dak or travellers: inspection. Rest house............................

Circuit House. Camping ground. Forest: reserved: protected............

Space names: administrative :locality or tribal.............................

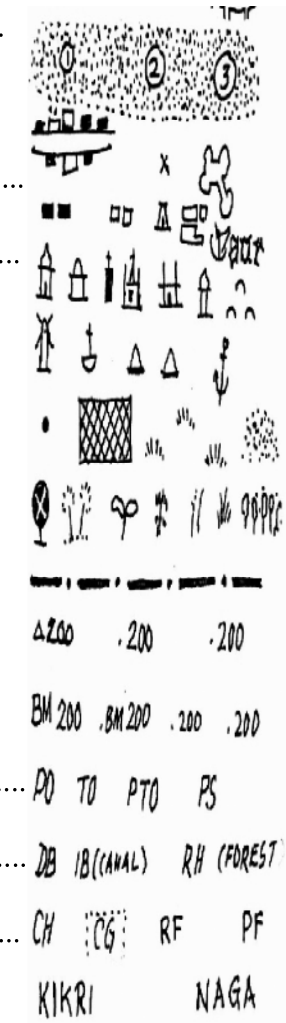


Fig. 1.5 Conventional Signs and Symbols

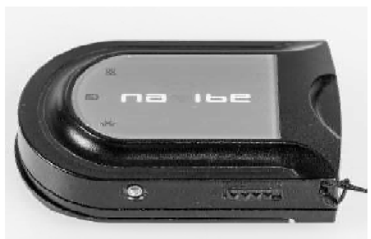
D. Map design

Map design includes, title of the map, latitudinal and longitudinal extent, representation of direction, size and type of text used in a map and the overall aesthetics used in the map. These features help in a better representation and understanding of the themes to be shown in the map.

Direction on the earth's surface is determined with the help of a compass. During ancient times, directions were determined with the help of stars and other celestial bodies. Then the use of hand-held magnetic compass with needles in it representing direction started. With the advancement of technology electronic devices with Global Positioning System (GPS) are used.

Notes

Magnetic compass



GPS-based compass

LET'S DO IT

With the help of pen and paper, try to draw a rough map of your house and then of your locality. Try comparing both of them and see what all details have you included in both these maps.

Try solving the questions to find out more about map making.

INTEXT QUESTIONS 1.2

i. What is known as the art and science of map making?

ii. Essential pre-requisites or essential features of a map are:

   a. Scale

   b. Projection

   c. Generalisation

   d. Conventional symbols

Notes

e. Map design

f. All the above

iii. The distance on the map representing the actual distance on the ground is known as the ___________________ of a map.

iv. A ______________________ is the system of transformation of the spherical surface to plane surface.

v. What are conventional symbols?

1.3 TYPES OF MAPS

Maps are drawn to serve a certain purpose therefore various features are used to draw maps based on the covered themes. Based on these features maps are classified into various types.

A. On the basis of scale

We have read in the previous section that a map is drawn using a scale. Depending on the type of scale, maps can be categorised as large scale maps and small scale maps.

- **Large scale maps-** As mentioned earlier, large scale maps show smaller areas showing greater details. Some of the examples of such maps are: cadastral maps and topographic maps. Cadastral maps are drawn to show the landed property of people. These consist of field boundaries of agricultural land and location of individual houses. As these represent the ownership of lands, they are prepared by the government agencies and are used for keeping a record and for revenue purposes. These are drawn at a very large scale of 1:4,000.

  Topographical maps are drawn to show topographic and other details of the area and are based on extensive surveys. In India, such maps are prepared by the Survey of India and the scale used for these maps are, 1:250,000 to 1:25,000. The topographic details shown in the maps include relief, drainage, agricultural land, forest, settlement, etc. An example is given in Fig. 1.6.

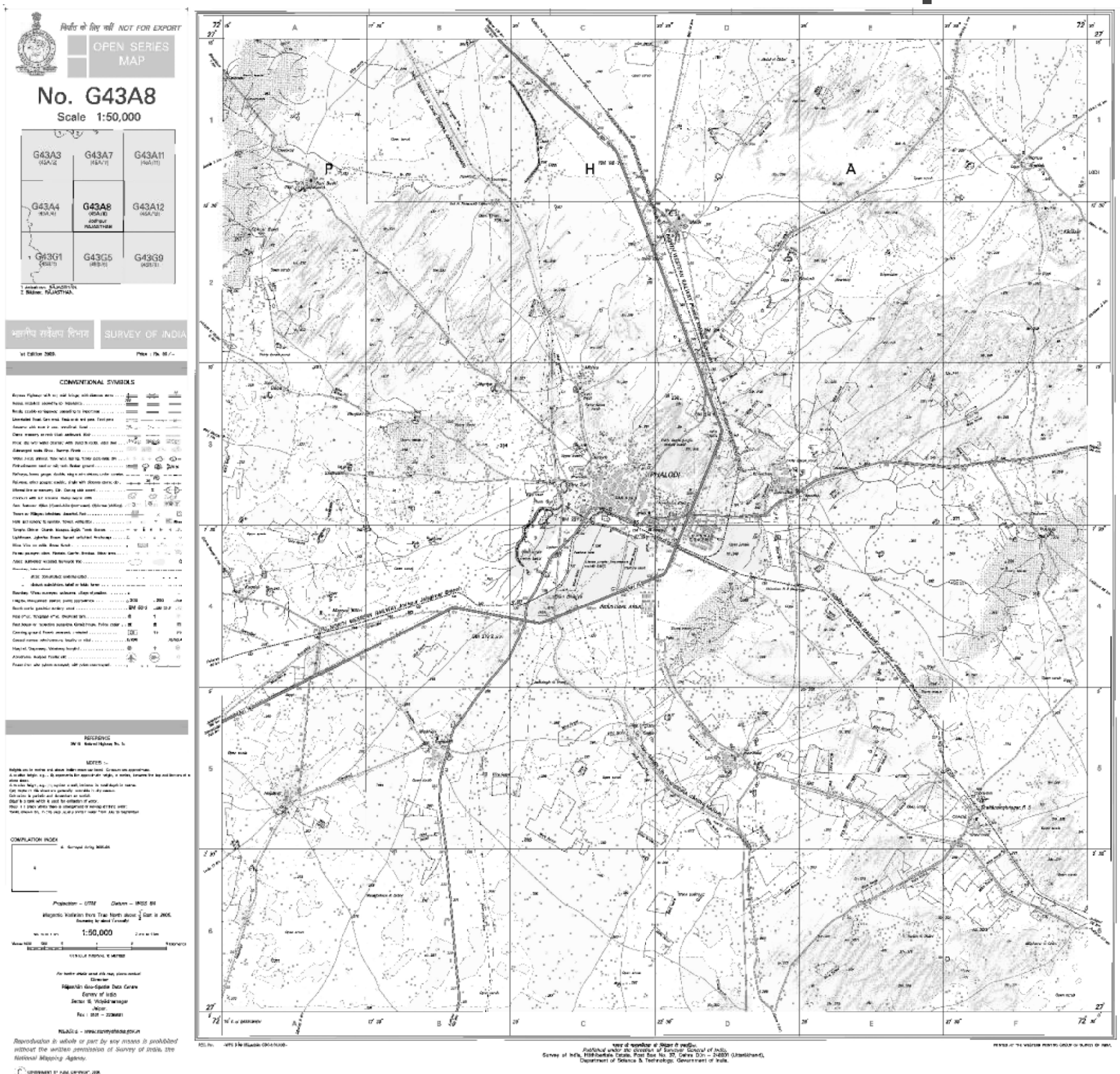


Fig. 1.6: Topographical map of a part of Jodhpur, Rajasthan, India

(Survey of India Topo G43A8 (45A/8) https://surveyofindia.gov.in/pages/educational-map-series)

- Small scale maps- Small scale maps represent larger areas showing lesser details. Wall maps and atlas maps are examples of these maps.

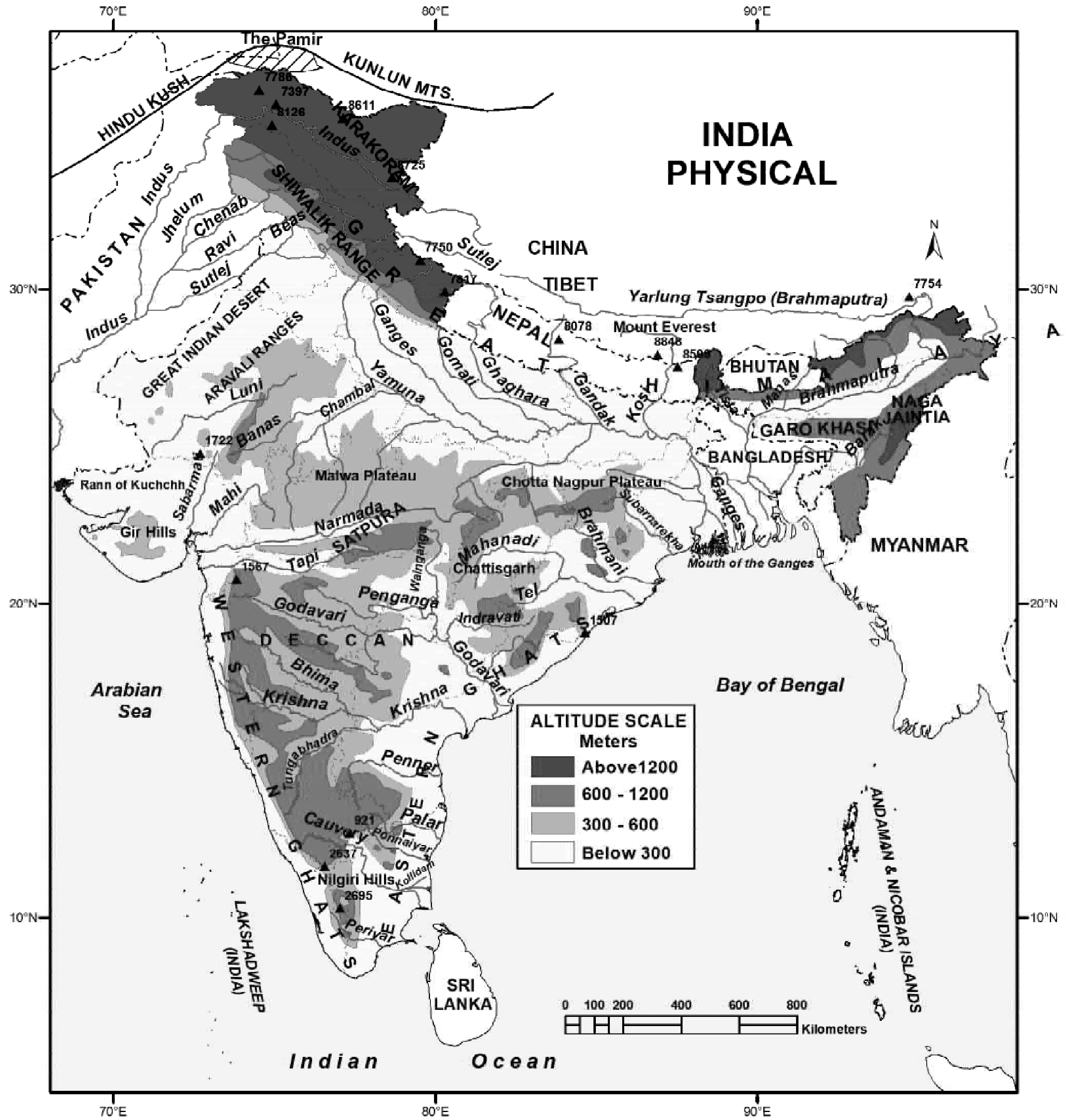
B. On the basis of function:

As we know that a map is drawn to represent a theme based on a purpose. Depending

Notes

upon the function that a map is to perform, maps can be classified into physical and cultural maps.

- **Physical maps-** Physical maps show the physical features. These include relief, geology, drainage, soil, various elements of weather, climate and vegetation, etc. Depending upon the features they represent maps are known as relief maps, geological maps, climatic maps and soil maps, etc. Figure-8 shows a few examples of physical maps.



(a)

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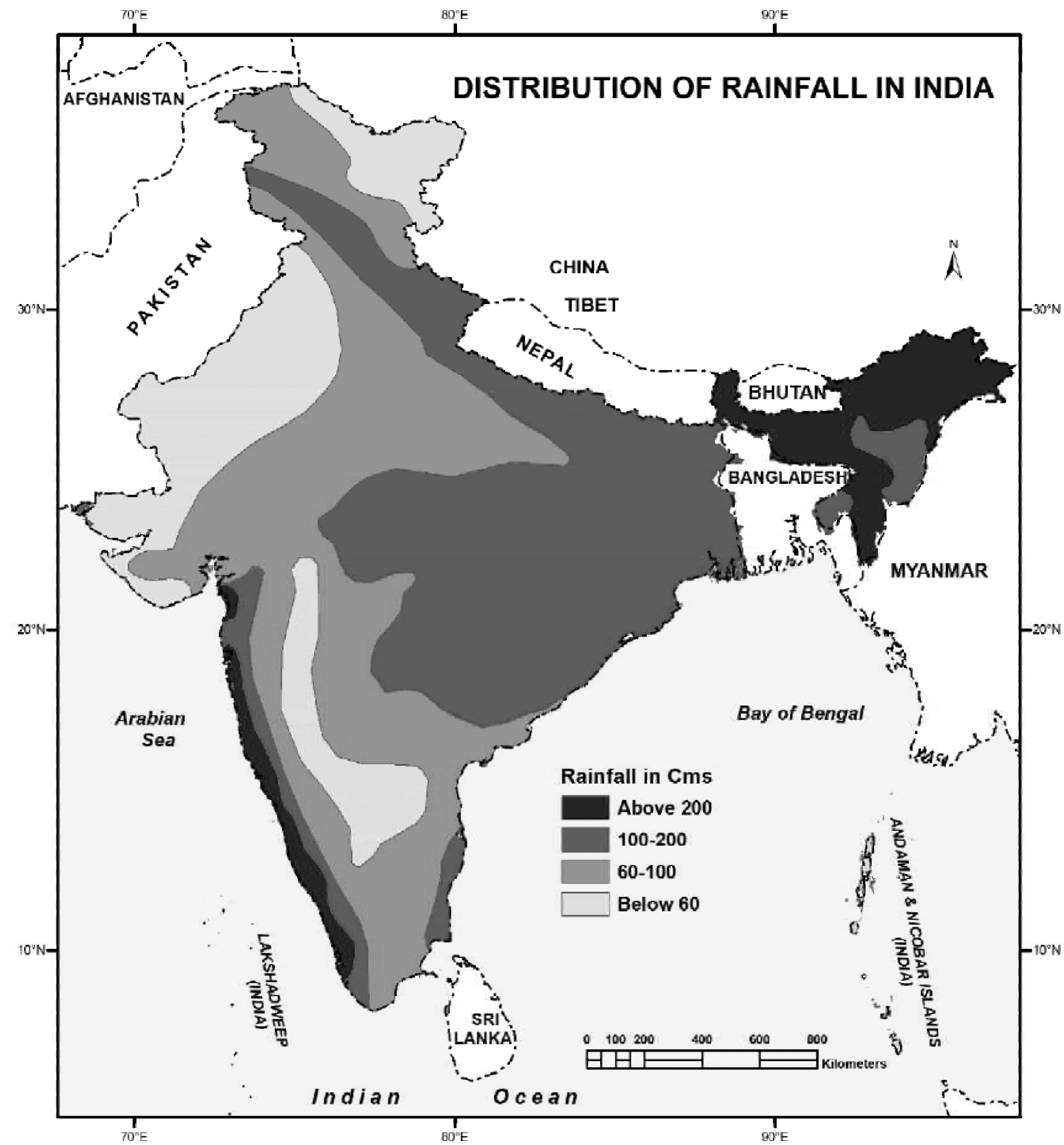


Fig. 1.7: (a) Relief map (b) Weather map

- **Cultural maps-** Cultural maps show cultural features or human-made features existing on the earth's surface. These include maps showing administrative divisions, population distribution, population density, age and sex of population, location of settlement, transportation lines and flow of goods and services from one place to another, etc. Based on the features, cultural maps show they are known as political maps (showing administrative divisions), population maps, economic maps (showing agricultural production, types of crops, minerals, location of industries, etc.), transportation maps, etc.

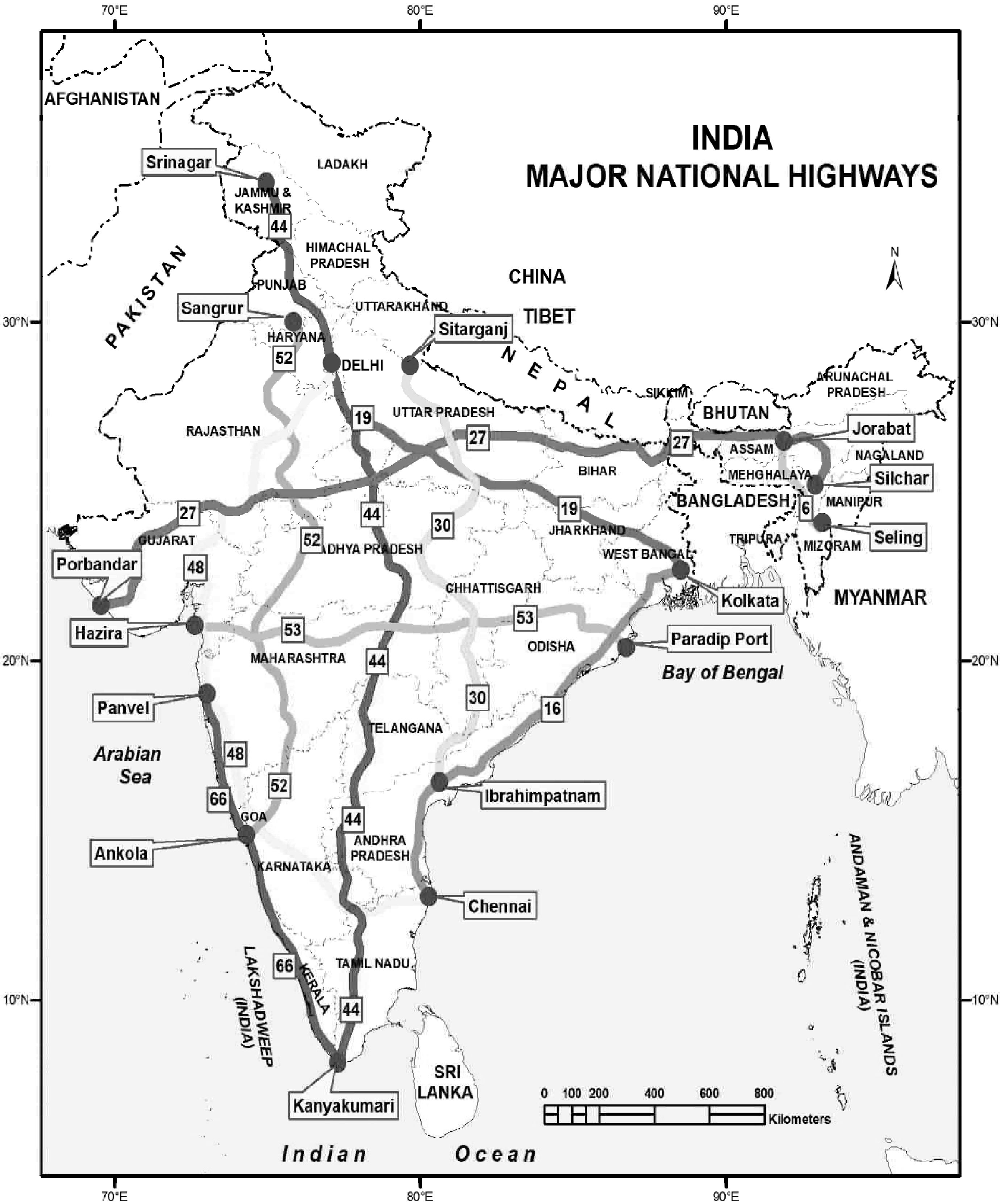


Fig. 1.8: Road map

Notes

Let us try out an activity related to what we have learnt about types of maps.

LET'S DO IT

Take your school atlas. Observe the maps given there. Try to find out various types of maps mentioned in this section. You can categorise them as physical and cultural maps depending upon the functions they serve or the features they represent.

The questions ahead will help you in understanding what you have learnt in a better manner.

INTEXT QUESTIONS 1.3

Mark the options as True or False.

i. Maps can be categorised depending upon the scale into:

   a. Very small scale map and Small scale map

   b. Large scale map and Very large scale map

   c. Small scale map and Large scale map

   d. All the above

ii. ________________________ is the organisation in India that prepares and publishes topographical maps. Fill in the blank.

iii. Depending upon the type of scale, maps can be categorised into how many types? Name them.

iv. Physical maps show physical features. True or False?

v. Transportation lines are shown with the help of cultural maps. True or False?

1.4 TOPOSHEET

Have you ever heard of a toposheet? Do you know what is it? A toposheet is a commonly used name of a topographical map or sheet. As we have learnt earlier in this lesson that toposheets are large scale maps they show greater details of a smaller area. Physical features as well as cultural features, both are shown in it. A topographic map is typically published as a map series, made up of two or more map sheets that combine to form the whole map. The preparation of toposheets started with topographic surveys that were prepared by the military to assist in planning for battle and for defensive emplacements. For this purpose, elevation information was of vital importance. As they evolved, topographic map series became a national resource in modern nations in planning infrastructure and resource exploitation.

Notes

Topographic maps have multiple uses in the present day. This includes any type of geographic planning or large-scale architecture, earth sciences and many other geographic disciplines, mining and other earth-based endeavours and recreational uses such as hiking or, in particular, orienteering, which uses highly detailed maps in its standard requirements. Today, topographic maps are prepared using photogrammetric interpretation of aerial photography, LIDAR and other Remote sensing techniques. Older topographic maps were prepared using traditional surveying instruments.

Let us now try to understand a toposheet. Figure1.9 gives an example of a conventional toposheet whereas Figure-1.10 shows a recent one published by the Survey of India. Let us try to compare both the sheets in detail. Figure-10 gives a labelled toposheet showing the headings and features they show. The details of state (s) represented in the toposheet is given alongwith the districts being covered. The index of sheet with no. is given at one end, latitudinal and longitudinal details, legend with conventional symbols used in the toposheet and other details are mentioned on a toposheet. The newer series as given in Figure-1.10 shows similar features with most of the details given about the toposheet in the left hand side instead of at the top or bottom. The centre of each toposheet shows the details of that place represented by the conventional symbols. For example, red patches show settlement, yellow patches show agricultural land, green patches show forest area, blue lines depict rivers and other water bodies, 2 black parallel lines with vertical lines in between at regular intervals represent railway lines, brown undulated lines and circles are the contours, etc.

Fig. 1.9 Labelled Toposheet

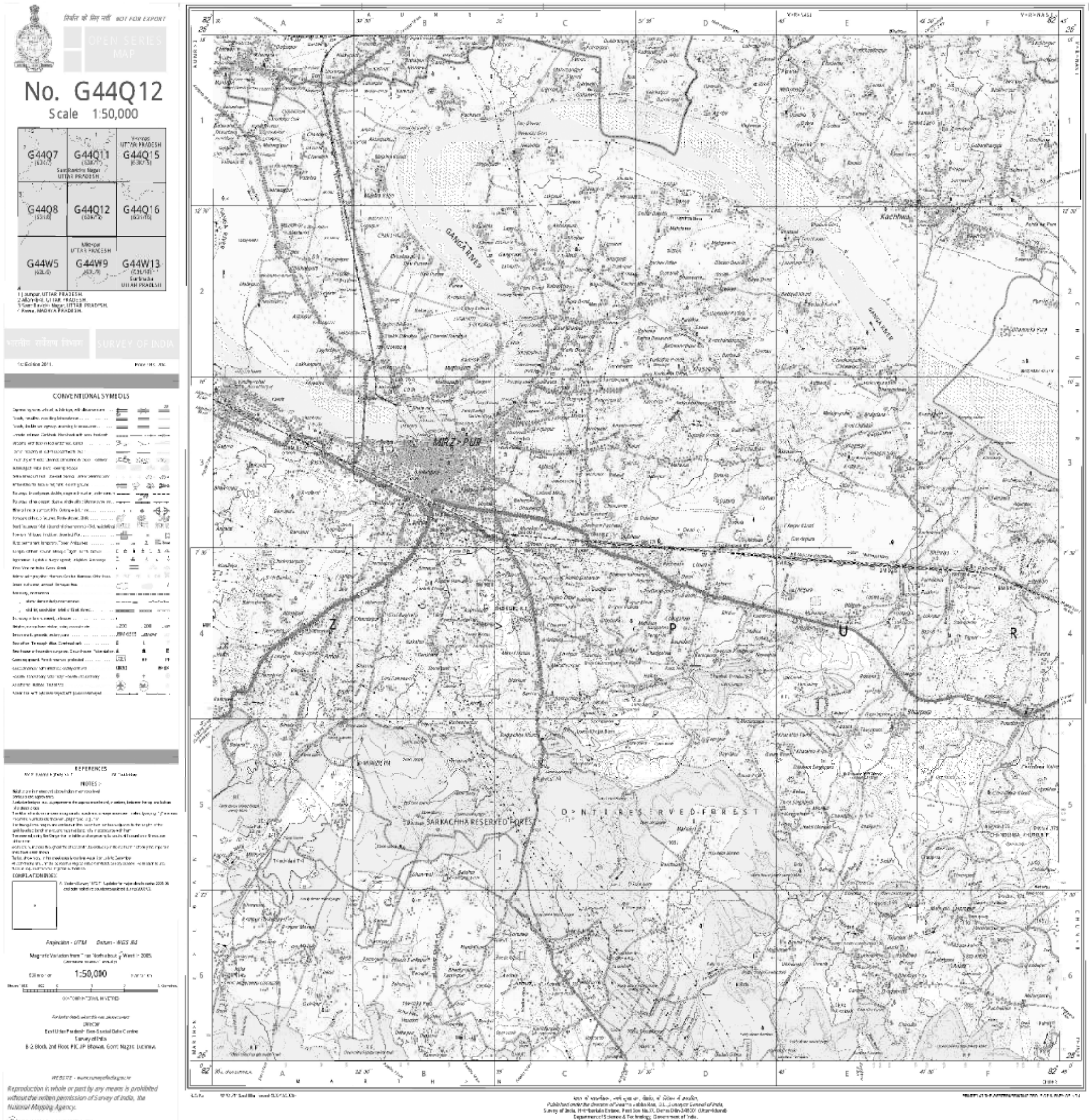


Fig. 1.10 Toposheet- Open Educational Series

Let us try to read a toposheet in brief. The toposheet (Figure-1.10) belongs to Uttar Pradesh covering parts of Mirzapur district. The index no. of the sheet is G44Q12 which is drawn on the scale of 1:50,000 and is drawn using UTM projection. The area represented in the toposheet is located in the northern part of the district. The latitudinal extent of the area is 25 degrees 0 minutes-25 degrees 15 minutes N and the longitudinal extent is from 82 degrees 30 minutes-82 degrees 45 minutes E. The toposheet was published by the Survey of India and it is the 1st edition of this series which came out in 2019.

Notes

In general, the area represented in the toposheet is a plain area as there are few contour lines which do not exceed 200 metres of height and they are placed at larger distances. Though few rocky slopes can be seen in the southern part that are covered with vegetation (green colour). River Ganga passes through the northern part of the area forming meanders and floodplains on both the sides. The plains are used for settlement and agricultural purposes. The southern side of the river has more settlements as the district headquarter of Mirzapur is located here which has a dense compact settlement represented with red coloured dots. A railway line passes through the area from East to West dividing the whole area into two parts. NH135 comes and joins NH35 and is met with several other secondary roads. Settlements of linear type are seen all along these roads. Settlements are surrounded by agricultural land shown in yellow colour and are dotted with various religious features like, temples and mosques, etc. and cultural features like, railway station and post office, etc.

After knowing about maps, elements of a map, types of maps, toposheet and scale let us solve a few questions.

TERMINAL QUESTIONS

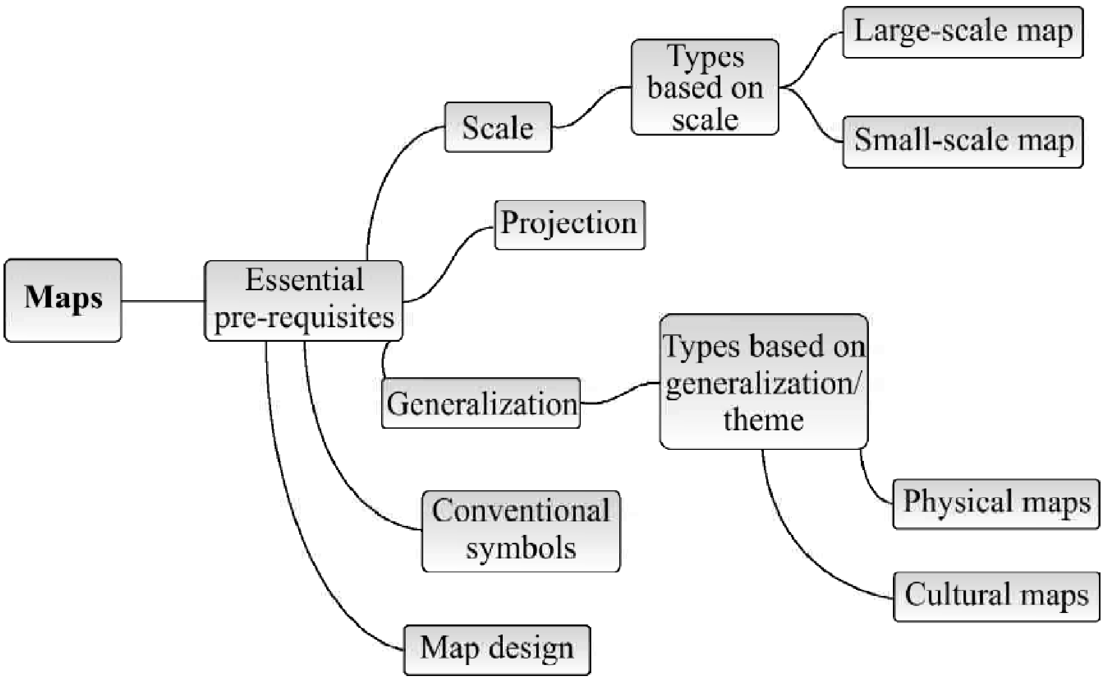
1. Name the scale represented by a straight line.
2. What are the demerits of Linear Scale?
3. What are topographical sheets?
4. Match the correct pair:

a.	1:50	Cultural Map
b.	RF	Physical Map
c.	Soil Map	Small Scale
d.	Population Distribution Map	Large Scale
e.	1:5,000	Representative Fraction

5. What are developable surfaces?

Notes

WHAT YOU HAVE LEARNT



Exercise For Practical Record Book

1. A car running at a speed of 45 Kilometres per hour to reach Ghaziabad from Delhi in 20 minutes. If the distance between Delhi and Ghaziabad is shown on a map by a distance of 2.5 cm, draw a graphic scale for this map and calculate the R.F. also.

2. Construct a graphic scale on a R.F. of 1:40,000 so that one can read kilometres and metres directly on it.

ANSWERS TO INTEXT QUESTIONS

1.1

i. Maps are simplified representations of whole or a part of the earth's surface on a plane surface.

ii. It is not possible to represent the whole of the earth or a part of it in the same three-dimensional form like a globe. Therefore, we represent if in two-dimensional forms such as, maps.

iii. Three, two

iv. Two, different

Notes

1.2

i. Cartography

ii. All the above

iii. Scale

iv. Projection

v. The features present on the earth's surface are represented on a map using various symbols, colours and shades. These are known as conventional symbols.

1.3

i. C

ii. Survey of India

iii. Two: Large-scale and small-scale

iv. True

v. True

2

Notes

GEOSPATIAL TECHNOLOGIES

It is the summer season in Delhi. My 10th board examination was over yesterday and today, I am very much excited at the breakfast table to know that my family is planning to visit Shimla for three days. So, my father has given me a task to check the weather conditions about Shimla from television and internet websites to wear and carry the appropriate clothes. Earlier, as usual, my mother was doing this task. I thought it surprising that 'why meaningless task is given to me, and here we are wearing proper summer clothes; and Shimla is a cool place so we can carry the same winter clothes. But I accepted silently and I said 'Yes dad'. After having breakfast I started watching television news seriously. I know at the end of all news they will provide information about the whole India. I am sitting with a pen and diary to note all the information. When I was watching television they showed a map of India with state names, major towns names as well as some clouds moving from east to west. So different places showed different information. I noted all the information but in my mind lots of questions arise from where they collect this information? How do they collect these? How do they know about the places? How they present this information. The answer is very simple: 'Geospatial Technology'. It seems simple but the task is not so easy to get this information. So here, we will understand about this technology.

Geospatial technologies are the transformative tool which is universally available to empower individuals to advocate and innovate for our common future and provide spatial information. This technology includes remote sensing, geographical information systems and global positioning systems. These technologies enhance our ability to assess and monitor complete geographical characteristics of the earth system. This technology has a huge potential to understand the complexity of our earth system phenomena and management of resources of the earth as well as modelling for the future.

Notes

OUTCOMES

After studying this lesson, learner:

- describes geospatial technologies;
- explains concept of remote sensing, GIS and GPS technology;
- describes type of database use in geospatial technology;
- differentiates between raster and vector data structure;
- explains elements of image interpretation for information extraction;
- applications of Geospatial technologies.

2.1 GEOSPATIAL TECHNIQUES

Geospatial technology is a combination of three words: 'Geo' means Earth; 'Spatial' means space; and technology means tool instruments and methods. So, the literal meaning of geospatial technology is a collection of various technologies that provide information about the earth and provide decision-making capability towards earth's resource management and sustainable development. It is also known as the 'Science of Where'. This technology includes remote sensing, Global Positioning System (GPS) and Geographic Information System (GIS).

The aim of the remote sensing technology is to provide unbiased, near real-time remotely sensed data about the Earth's surface. This data is provided by different characteristics of satellite and sensor specifications which is very much useful to classify and assess thematic information. GPS is a tool, used for fieldwork or survey process that enables us to provide locational information of various features on the Earth's surface as well as useful to verify remotely sensed classified thematic information. GIS is a computer-based technology that provides us a platform to integrate spatial and non-spatial databases which is provided by remotely sensed data, GPS based data, primary and secondary sources of data for different kinds of spatial analyses, manipulation and modelling. So, all these technologies, with their unique characteristics, are complementary to each other in planning and development processes of the Earth's resources. Thus, collectively, all these technologies are known as Geospatial technology. Let's discuss each technology in detail in subsequent paragraphs and learn their application collectively.

Remote sensing

The term remote sensing is a combination of two words 'remote' means a distance, it may be a centimetre or kilometres and 'sensing' means acquiring information. The simple meaning is sensing remotely or acquiring knowledge from a distance. According to Fussell (1986), "Remote sensing is the acquiring of data about an object without touching it". The acquiring of data from distance or without touching it includes complete processes of acquiring data about the earth surface which is recorded through sensors or camera, mounted on the aircraft or satellite at different platforms. This recorded data is downloaded from the satellite and processed in the laboratory to make usable for different applications for different persons. According to John. R. Jensen (2007), "Remote sensing is the process of collecting data about objects or landscape features without coming into direct physical contact with them". So, remote sensing can be defined as an art, science and technique of collecting real information, without being physical contact with an object or phenomena through the sensor or camera which is working over the wide range of electro-magnetic spectrum from the various platforms by the means of tripod, aircraft or spacecraft or satellite for multidisciplinary activity.

Process of remote sensing

Remote sensing process includes various mechanisms or activities for collecting and disseminating remotely sensed data to the user community. It includes the following processes as shown in the Fig. 2.1

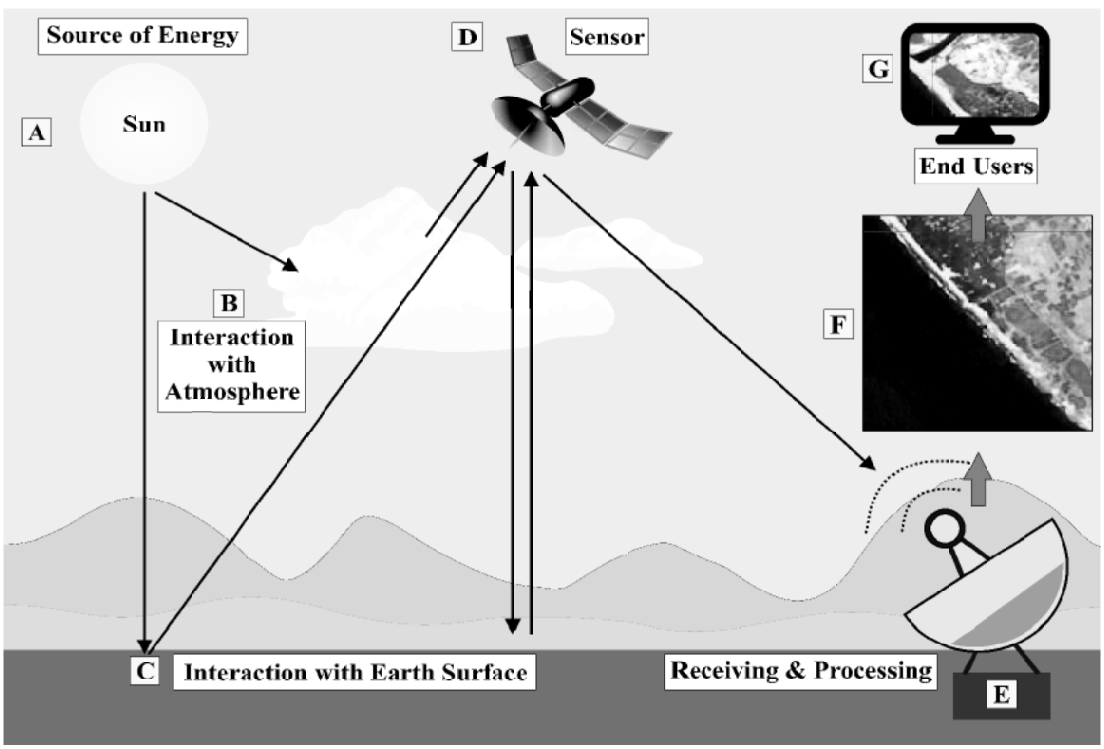


Fig. 2.1 Process of remote sensing

i. Sources of energy

ii. Interaction of electro-magnetic energy with an atmosphere

iii. Interaction of electro-magnetic energy with the earth surface.

Notes

iv. Electro-magnetic received by sensor.

v. Transmission of electro-magnetic energy from sensor to ground station.

vi. Rectification of received data

vii. Disseminate rectified data to the user community.

After discussing the processes involved in remote sensing you might be training on what are the advantages of remote sensing. You might have heard that various countries including India have been investing a huge financial resource for sending Remote Sensing satellites. Let us discuss some of the advantages of remote sensing.

Advantages of remote sensing

i. Remote sensing provides satellite imagery and aerial photographs of earth's features.

ii. It can see beyond the vision of human eye

iii. It can be focus on very specific wavelength

iv. It provides bird eye view

v. It provides repetitive looks at the same area.

vi. Remote sensors operate in all seasons

vii. It provides multi-purpose image data.

viii. It provides unbiased and near-real time data.

ix. Remote sensing data is cost-effective in comparison to traditional methods of data collection.

Principles of remote sensing : In the previous section we have discussed the processes involved in capturing remotely sensed data. Let us now discuss the processes involved in capturing such data.

Electro-magnetic energy and electromagnetic spectrum

Remote sensing depends on the energy known as electro-magnetic energy that travels with the speed of light in a wave pattern. This electro-magnetic energy is a medium of interaction between earth's feature and sensor directly and indirectly by reflection, scattering and re-radiation. There are two sources of electro-magnetic energy. One is natural, namely sun and earth; and another is artificial source, namely camera flashgun and radar. The most important source of this energy is the sun but electro-magnetic energy is also provided by geo-thermal energy emitted by the earth 's surface. The electromagnetic energy propagates through space in two fields, one is electrical and another is magnetic. Due to this reason, it is called

Notes

electromagnetic energy. The three measurements such as wavelength, frequency and velocity are used to describe electro-magnetic energy in a wave pattern. Wavelength is a distance between successive wave crests or troughs, denoted by lamda and measured in metre (m), nanometre (nm or 10-9 m) and micrometre (µm or 10-6 m). Frequency is a number of wave cycles passing through a given fixed point. It is measured in hertz (Hz), corresponding to one cycle per second. The velocity (c) or speed of the electromagnetic energy is equal to the speed of light i.e. 3 × 108 metre/second (3,00,000 km/second or 186000 miles/second).

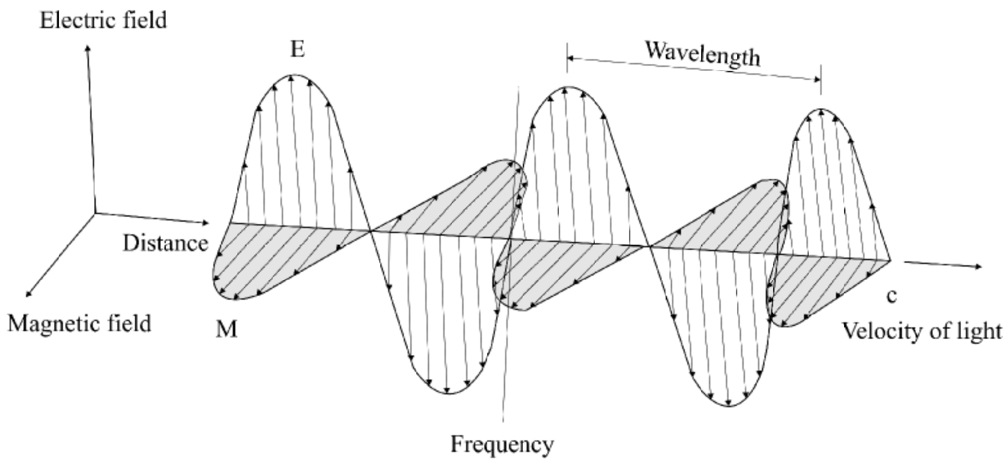


Fig. 2.2 : Electro-magnetic energy

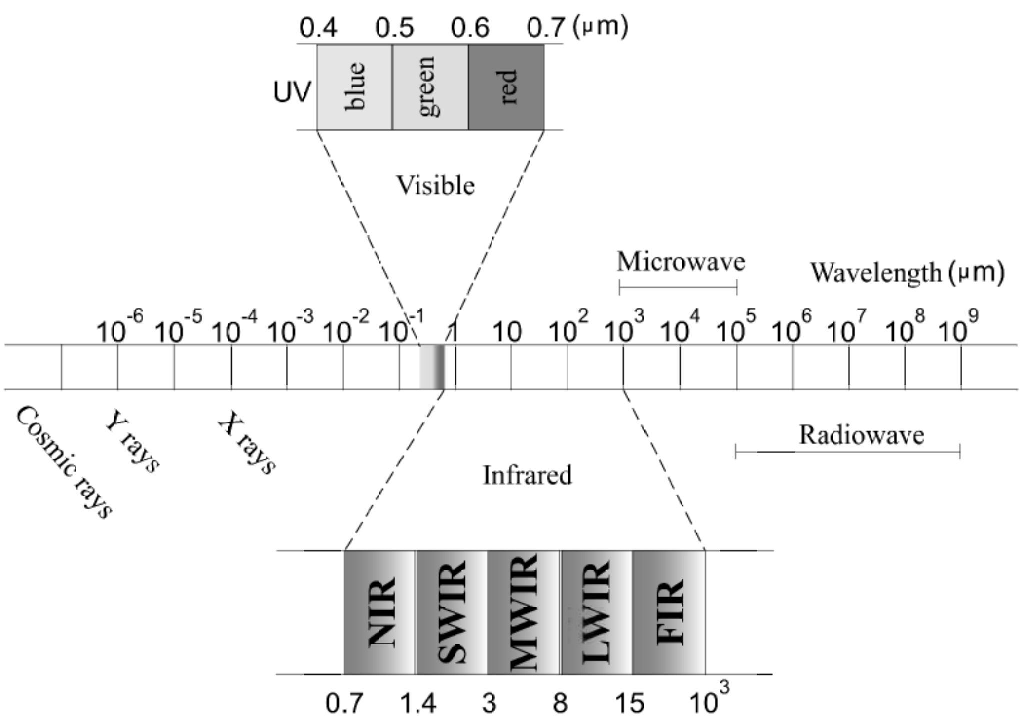


Fig. 2.3: Electro-magnetic spectrum

The electro-magnetic energy category on the scale of wavelength is called electro-magnetic spectrum. It extends from very small wavelengths known as gamma rays to very long wavelengths known as radio waves and in between X-rays region, ultraviolet region, visible region, infrared region and microwave region are found known as spectral bands. These spectral bands that absorb electro-magnetic energy are known as absorption bands or regions and those spectral bands transparent for electro-magnetic energy are known as atmospheric windows. The atmospheric window plays an important role in remote sensing to deploy the remote sensing sensor to receive data.

Platform and sensor

Platform is a place or a stage to mount a camera or sensor aloft to acquire the data about the earth's features. On the basis of altitude above earth, the surface platform may be classified as groundborne, airborne and spaceborne. Groundborne sensors mount near to ground by means of tripod, buildings, hand-held and moving vehicle to acquire data for field work and laboratory simulation studies before mounting the sensor on an airborne or spaceborne platform. CCTV cameras installed in the school building or camera mount on moving vehicles, to monitor and acquire data are examples of groundborne platforms. A sensor mounted on aircraft to collect data from air is known as an airborne platform. Earlier balloons, pigeons and kites were used as airborne but after development of aircraft, a periodic or need based database is acquired for survey within a few hours. The aircraft is operated in our atmosphere which is dynamic in nature such as high wind speed, cyclones, clouds that distract the path of the aircraft and produce errors in the database. To remove the influence of the atmosphere , a spaceborne platform is used. When the sensor is mounted on a satellite and launched to space in a fixed orbit to acquire a database from space is a spaceborne platform. Depending upon the altitude two types of orbit are used as platform to place satellites, one is polar orbit at the height of around 800 km and another is geostationary orbit at the height of 36000 km above the earth's space. Polar orbit satellite is also known as a sun-synchronous satellite because it synchronises with the local sun-time at the same latitude or it passes over all the places on the earth having the same latitude at the same local sun-time. For example, if the satellite passes at 10:30 am on the equator, then every local time satellite passes on the equator at 10:30 am at a different longitude. So, all the remote sensing resource satellites are polar orbiting such as Indian satellite series IRS, American satellite series LandSat, European satellite series SPOT etc. a geostationary orbiting satellite is synchronised with the speed of rotation of the earth. This satellite provides a 24X7 database about the fixed area whose coverage is 70 degree north to 70 degree south latitude and it can view only one-third of the earth. All the telecommunication and meteorological satellites are geostationary orbiting like GSAT and INSAT series.

Sensor is a device that measures and records reflected, scattered or emitted electromagnetic energy into a signal in a form of either digital number or image. Our eyes also act as a sensor to see the object. Camera is one of the examples of sensor, provide photographs in digital or analog form. Our mobile phone is also a sensor to receive electromagnetic radio-waves and convert them into sound waves. On the basis of source of energy, sensors can be passive or active. Passive sensor receives the external source of energy, generally by the sun as reflected energy from the earth's feature as well as from the earth surface as emitted energy. Active sensors use their own source of energy, for example, RADAR is sending its own pulse as energy to illuminate earth's surface and receive the same energy from different earth's features.

The electromagnetic energy received by sensors from interacted features of earth is downloaded at ground receiving stations in the form of digital images. Digital image is a two-dimensional array of cell or picture elements known as pixels. Each pixel has a numerical value representing the energy reflected or emitted from the earth's feature known as pixel value or digital number. This data is a raw image which is not usable to the user community because of positional error and decreased visual distinction. So the raw data is corrected in terms of positional accuracy and visual enhancement technique to increase the quality of the image for image interpretation with the element available in the image.

Element of image and photo interpretation

In satellite imagery or aerial photography, we identify features on the basis of elements visibility. Sometimes a single element is sufficient and sometimes more than one element is required to identify features. For example, green colour denotes vegetation but to identify species we need other elements such as texture or location.

i. **Colour :** in the first instant colour is the most important element to identify the features or to discriminate between two features. For example, healthy vegetation appears green in true colour imagery.

ii. **Tone:** it refers to the differences in the intensity of colour from light to dark colour. In imagery or photography features appear lighter to darker shades of colour depending upon the reflectance behaviour of an object. High reflectance from feature appears lighter tone and low reflectance from feature appears dark tone. For example, laterite soil appears dark tone and salt affected soil appears light tone in satellite imagery or aerial photographs. The tonal variation is represented as a grey scale.

iii. **Size:** features on the imagery can easily identified by their size with reference to length, width, perimeter and area in the context of image or photo scale. Size is a relative term which may be small, medium and large according to the scale of imagery or photograph. For example, size variation in urban settlement which is relatively bigger than rural settlement. The width of the national highway is more than the local road.

iv **Shape:** some features are identified on the basis of the shape that appears in satellite imagery such as pyramids in Egypt or circular shape of Indian parliament or Pentagon building in the USA. Basically, shape refers to geometric shapes like linear, circular,

Notes

square, rectangular, etc. for example, a consolidated agricultural area has a rectangular or square shape. Roads, railways, and canals have fewer curves than streams or rivers. Stadium shape may be circular or elliptical.

v. **Texture:** it refers to the roughness and smoothness of the feature in satellite imagery or aerial photograph. Texture is an arrangement of tonal variation from smoothness (uniform or homogenous or fine texture)to roughness(heterogenous or coarse texture) in imagery or photography. For example, forest and paddy agricultural field colour is green in colour but due to textural variation, forest has coarse texture and paddy field has smooth texture. Another example is water in the lake is smoother than the river or ocean.

vi. **Pattern:** Earth's surface features produce different patterns such as regular, irregular, systematic or unsystematic spatial arrangements. For example, a planned city such as Chandigarh has a checkerboard pattern which is systematic in nature but an unplanned city has a haphazard arrangement. Similarly, forest plantations or orchards have regular tree plantations but natural forests have irregular tree arrangements.

vii **Shadow:** it is a clue to identify vertical features on the earth by casting shadow such as high rise buildings or mountains can be identified in the vertical aerial photograph or imagery. For example, Qutub Minar or Eiffel tower is identified by their shadow.

viii **Site or location:** on the earth some features are site specific or geographic location specific. For example, different types of forest are found in different geographical locations such as evergreen forest found in heavy rainfall areas, coniferous forest found in cold climates. Nuclear power plant situated near a big waterbody is site specific.

ix **Association:** some features on satellite imagery or photographs are identified with the help of associated features. For example, a sugar mill is situated surrounded by a sugarcane field and molasses tank, warehouse etc. is associated with sugar mills. Vegetated area within an urban setting may be a park. Commercial centres will likely be located near major roads, railways or waterways.

x **Resolution:** Image pixel size may be capable of discriminating two closely spaced objects from each other. Resolution may be low, medium or high. Smaller features can easily be identified in the high-resolution photograph or imagery. For example, cadastral level mapping needs high resolution imagery while regional or state or above level mapping needs coarse or low-resolution imagery.

Notes

INTEXT QUESTIONS 2.1

1. What do you mean by remote sensing?
2. Discuss the advantages of remote sensing.
3. What is the electro-magnetic spectrum?
4. How many platforms are used in remote sensing?
5. What is a sensor in remote sensing?

2.3 GLOBAL POSITIONING SYSTEM (GPS)

GPS is a network of satellites that continuous transmit signals to GPS receiver which makes it possible to know the precise location on the earth surface. So, GPS provide the positional information on the earth surface in terms of latitude and longitude. Earlier, GPS refers to a group of U.S. Department of Defense satellites known as NAVSTAR (NAVigation Satellite Timing And Ranging)The first GPS satellite was launched in February 22, 1978 by United States Air Force. Today, many countries launched their own GPS such as Russia launches GLONASS, India has launched Indian Regional Navigation Satellite System (IRNSS) known as NavIC, Chinese has BeiDou Navigation Satellite System, European union has Galileo navigation satellite system and Japan has Quasi-Zenith satellite system (QZSS). GPS signals travels in 'line of sight' means straight and it passes through clouds, glass and plastic, but not penetrate through most solid objects like building and mountains.

Fig. 2.4 : GPS

Notes

Segment of GPS

GPS consists of three segments such as space, ground and user segment. Space segment consists of a constellation of satellites positioned at around 20,000 km above the earth which is about three times of the earth's radius. These satellites are travelling at the speed of 13000 km/hour to complete a circle of the earth every 12 hours. NAVSTAR is a constellation of 24 satellites, in which 21 satellites are operational and 3 satellites are active spares. Russian GPS satellite GLONASS has 24 satellite constellations, Indian GPS NavIChas constellation of 8 satellites, Chinese has BeiDou consist of 28 satellites, European union's Galileo consists 26 satellites, Japan's QZSS has constellations of 4 satellites in the space segment. The ground segment controls the GPS satellite and monitors their position in the outer space, clock offset and uploads navigation data to the satellite as well as ensures the proper operations. NAVSTAR, US based GPS Master control monitoring station at Colorado, USA along with 4 ground tracking stations across the world. IRNSS ground segment centre located at Byalalu near Bengaluru in Karnataka state and their ranging stations located 21 centres across India. GLONASS ground segment System Control Centre (SCC) located at Krasnoznamensk Russia along with 6 centres across the country. Beidou has a Master control Station along with 30 monitoring stations. QZSS has 2 Master Control Stations at Koba and Hitachiota along with 4 other stations to monitor the GPS satellites. The person who carries the GPS receiver is a user segment. People may be in defence, boaters, pilots, hunters and anyone who wants to know their own location in terms of latitude and longitude on earth surface as well as used for their navigation purpose. All kinds of GPS receivers are included in the user segment that may be receiver installed on your mobile phone, moving vehicles like car, bus, train, aircraft, etc. for navigation and tracking purposes.

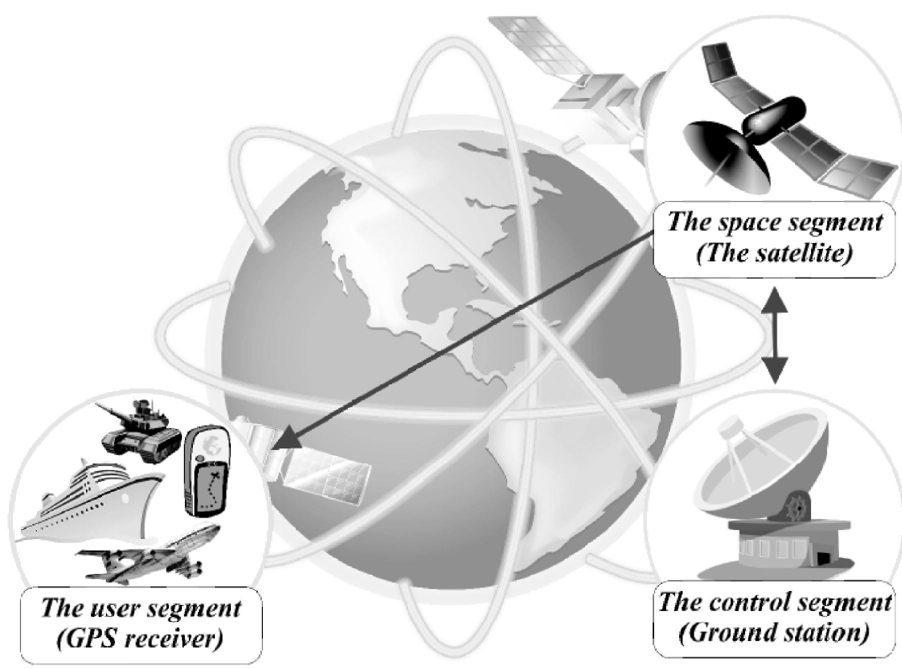


Fig. 2.5 : Segment of GPS

Notes

How GPS receiver determine their location

Let's assume a person carries a GPS receiver on the earth surface at a distance of 18,000 km from the first satellite. Our location would be somewhere on an imaginary sphere which is in the centre with a radius of 18,000 km. The second satellite, at a distance of 19,000 km, would intersect the first sphere to create a common circle. The third satellite, at a distance of 20,000 km, then we have two common points where the third sphere intersects. So, there are two possible locations of a person, they are greatly differing in latitudinal, longitudinal position and altitude. By adding a fourth satellite, at a distance of 16,000 km, whose sphere intersecting the first three spheres at a common point is the actual location in the form of latitude, longitude and altitude of a person who carries a GPS receiver.

Uses of GPS

1. **Location:** it provides precise location who carries a GPS receiver.
2. **Navigation:** it is used in navigation of moving vehicles, ships and aircrafts.
3. **Tracking and monitoring:** it provides information about the movement of vehicles and people such as GPS-enabled police vehicles, taxis, milk vans, trains, etc.
4. **Time:** it provides precise time on a global scale.

Fig. 2.6 : how to locate position

Notes

INTEXT QUESTIONS 2.2

1. What is GPS?
2. List the segment of GPS.
3. How many GPS satellites are in the space segment of NavIC?

2.4 GEOGRAPHIC INFORMATION SYSTEM

The Geographic Information System consists of three words, geographic related to geography, that describe or study about the earth. Geography attempts to acquire knowledge of the earth where we live. The knowledge, about both facts and relationships among the various features of the earth's components like atmosphere, lithosphere and hydrosphere, which should be as accurate as possible. Information is the mean by which human perception and mental processes understand and develop their knowledge on the basis of available data. So information can be extracted by classifying or organising the data in order to convey meaning. For example, we learn English alphabet 'A,B,C,D,...S,T,U,V,...Z', which individually doesn't have any meaning, this is known as data and 'CAT' is a combination/extraction from these alphabet has a meaning a pet animal. A map consisting of geographic information carries some sort of geographical reference to help locate something in the form of symbolic references and numeric references. Systems can be defined as an ordered, interrelated set of elements or things and their attributes, linked by flows of energy and matter, which are linked with each other to fulfil their objectives. The elements within a system may be arranged in a series or interwoven with one another, e.g., a cooler system, political system, hydrological system. In cooler fan, water, electricity etc. are working together to provide cool air.In general, geographic information system is a computer-based processing system that includes computer hardware, software, database, procedure and trained person, is also known as components of GIS, has a capability of data capturing, storing, analysing and displaying geo-referenced spatial and non-spatial database.

Components of GIS

There are five components in GIS which are connected with each other to perform the geographical concept and produce in the form of maps, charts and tabular data in softcopy as well as hardcopy. Let us discuss all the components.

1. Computer hardware consists of input devices, central processing units and output devices. Input devices include keyboard, mouse and scanner. Central processing unit consists of a motherboard, processor, hard-disk, memory cards, etc. output devices include a display unit such as monitor, printer, plotter and audio system. All parts of computer hardware are connected with each other.

Notes

2. GIS software is a set of modules for performing digitization, editing, final map preparation and analysis of databases. GIS software is commercial and open-source. ArcGIS, Erdas Imagine, MapInfo, AutoCAD Map are the commercial GIS software and QGIS, GRASS are the example of open-source GIS software which is freely available on the internet.

3. Databases are categorised into two types one is spatial database and another is non-spatial database. The accuracy of the output map depends on the authenticity and accuracy of the database. The spatial database may be any kind of map, aerial photograph, satellite imagery, sketch, etc. in hard-copy or soft-copy. The soft-copy spatial data can be in the form of raster or vector format.

4. Procedure is a well-defined method or steps to produce accurate and reproducible results. For example, depending on the objective of the map and analysis, we are collecting our database, performing all kinds of methods to prepare maps in the GIS environment, applying different kinds of analysis methods and results in the form of maps and reports are basic procedures.

5. Trained person is the key component in GIS to perform all activity to choose appropriate computer hardware, GIS software and database to apply appropriate procedure to fulfil the objective of a given task. The trained person must have knowledge of geographical concepts as well as computers and their GIS software.

Fig. 2. 7: components of GIS

Notes

Database in GIS

GIS database is a collection of data stored in a structured manner in GIS environment which play an important role in any kind of GIS activity. All the functionalities of GIS such as data capturing, editing, analysis, querying, displaying depends on the type of database it holds in the GIS environment. In the real-world, all features are integrated to each other by cause-and-effect relationship, for example, factors affecting paddy cultivation in particular areas such as temperature, rainfall, climate, soil and water condition, etc. are looked at in an integrated manner. But, in GIS, all these factors or features of the world are stored as feature layer such as water layer, soil layer, temperature layer etc. individually (figure of GIS layer). We are using two kinds of database; one is spatial database and another is non-spatial database in GIS environment.

Spatial database is a geographical or spatial feature of the world which is represented and stored in a map form. There are many sources available such as topographical sheets, census map, aerial photograph, satellite imagery, field sketch, etc. from various organisations like Survey of India, Census of India, National Remote Sensing Centre, National Atlas and Thematic Mapping Organization, etc. These spatial databases are digitally stored in raster and vector data structures in GIS. Raster data structures represent spatial data by cells or grid format termed as pixels having two dimensions length and breadth in square shape. Each pixel is referenced by row and column. The size of the pixel is depending on the resolution of raster data. If the pixel size is very small it is known as a high-resolution image representing detailed features of the earth and vice-versa. Point feature is represented by a single pixel. Line or polyline represented by a number of neighbouring pixels connected in a given direction. Polygon is represented by a cluster or group of adjoining pixels.

Vector data structures represent spatial data in point, line and polygon or area features by locating longitude (x) and latitude (y) coordinates. Geometrically, the point feature is defined as a dimensionless single pair of x and y coordinates. Earth's features such as state capitals, electric poles, and mountain peaks are represented as point features by using unique symbology. Line feature is a one-dimension(length) connection between two or more points and stretches in one direction is also known as polyline. All kinds of linear features of the world such as road-rail network, streams, canals, water pipelines, etc. are represented by polylines. Polygon feature is a two-dimension series of lines, connected with points to form an enclosed boundary to designate area features. The starting point and end point are the same to form an enclosed boundary. All kinds of boundaries like international, national, land parcels, pond, forest, water basin, etc. are represented by polygon features. According to the scale of the map, features can be interchangeable between point and polygon; line and polygon. Suppose you are making a world map in small scale with their capital, so capital is represented by points but if you make Delhi map (capital of India) in large scale, then it would be a polygon. Similarly, the River Ganga on the world map will be represented as a polyline, but on a large scale like the Prayagraj city map would be a polygon.

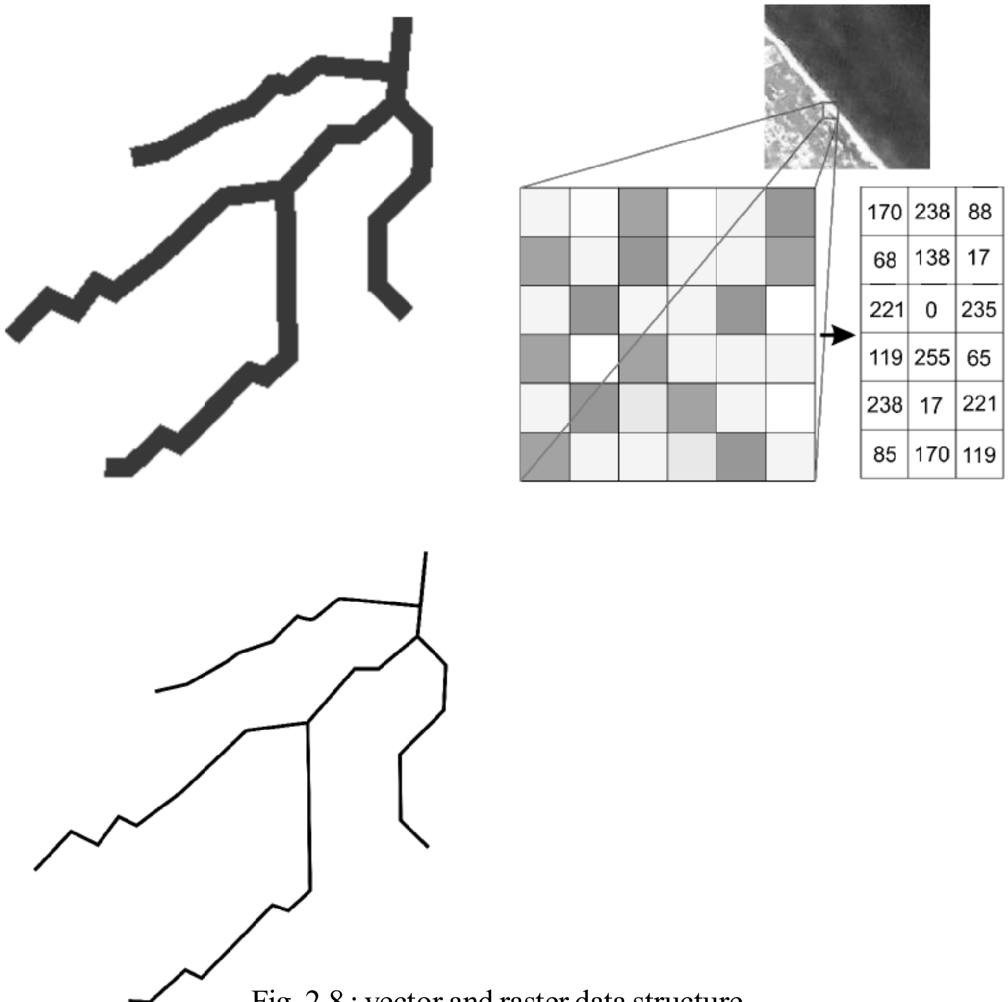
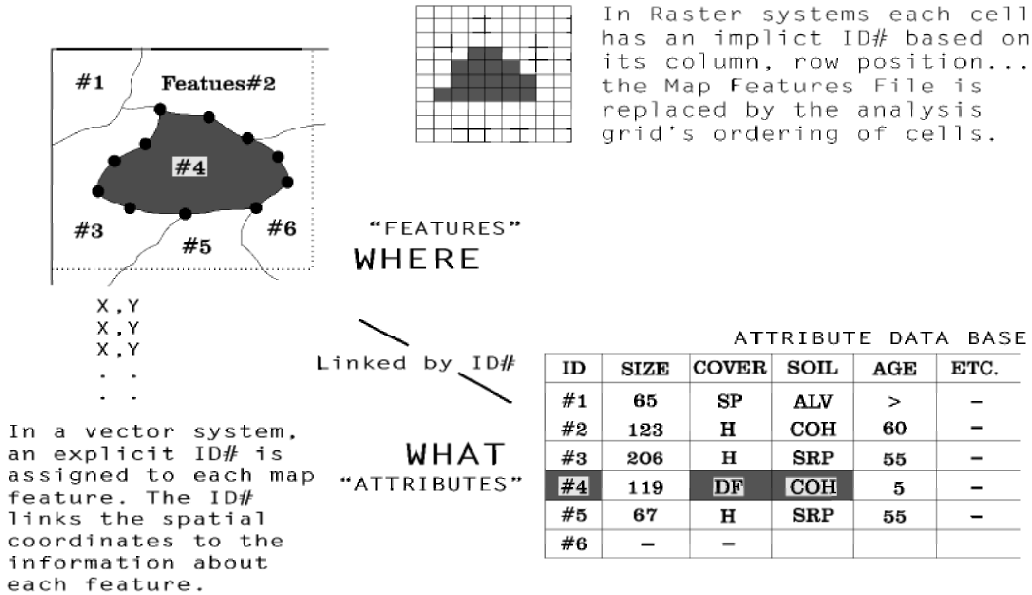


Fig. 2.8 : vector and raster data structure

Non-spatial data represents the characteristics of spatial databases known as attribute data. These data are usually alpha-numeric and provide information such as name, population characteristics, land use, etc. in tabular form consisting of rows and columns. These attribute data, join with the spatial data with relational data structure. In relational data structure, a common column available in both spatial and non-spatial data to relate each other rows which is unique in nature like common identification number (ID) is also called primary key. Each row represents a feature of a map and columns represent the desired characteristic of a particular row or feature. Changes in any feature on map can also change in attribute and vice-versa.

Notes



ID	SIZE	COVER	SOIL	AGE	ETC.
#1	65	SP	ALV	>	–
#2	123	H	COH	60	–
#3	206	H	SRP	55	–
#4	119	DF	COH	5	–
#5	67	H	SRP	55	–
#6	–	–			

Fig. 2.9 : relational data structure

Applications of Geospatial technologies

There are only four major applications of geospatial technologies such as mapping, monitoring, measurement and modelling. These are widely applied in various disciplines like surveying, land resource management, water resource management, forest management, agriculture application, infrastructure management, emergency management, crime management etc. Let us discuss some of these applications briefly.

i **Survey application:** Survey agencies such as Survey of India, Census of India, Forest Survey of India, Geological Survey of India and many more agencies are widely applying geospatial technology for preparing their maps. All the topographical map, administrative maps are prepared by Survey of India by using these technologies. Census of India produced census information through maps such as population distribution map, literacy rate map, etc. Geological survey of India produces geological maps of India, mineral maps by monitoring direct or indirect sources of information. The biomass studies and monitoring by Forest survey of India.

ii **Land Resource Management:** this technology is very much utilised in collecting the information about surface and subsurface. Through remote sensing we monitor and assess land use/cover and their changes. This technology provides near-real time information that can be applied to planning of land resources. The information beneath the earth is a very limited but indirect source of information and inferences made possible for assessing oil and mineral resources as well as mapping of seismic zones and volcanoes distribution map.

iii **Agriculture:** this technology is widely applied to assess the site suitability for various crops, irrigation management, crop estimation and production monitoring as well as market information. Crop modelling can be done with the help of biophysical characteristics of the earth.

iv **Water Resource:** this technology is widely used to monitor seasonal or yearly water resources through remote sensing. It is used to assess surface as well as groundwater resources and their potential by integrating various thematic information like geomorphology, lithology, rainfall, rivers, ponds etc. This is very helpful in site suitability analysis for dams, construction of canals, water recharge structures, snow and water runoff modelling. This technology also monitors and provides the information about sediment or chemical pollutants, oil slicks in water resources.

v **Meteorology:** Daily, we are getting information about weather conditions in newspapers, radio and television. This is one example of geospatial technology applications. Rainfall and temperature data is collected from different weather stations and this data is further interpolated to understand the spatial distribution by various interpolation methods available in the GIS environment. The information about the cloud movement and cyclone monitoring is possible through remote sensing technology. So, this technology played an important role in mapping, monitoring and modelling of meteorological information.

vi **Forest Resource:** the reliable information about forest is foremost important for their management. Here, remote sensing technology provides periodic data about forest species, afforestation, deforestation, encroachment, forest fire and damage assessment in near-real time.

vii **Infrastructure Management:** Planning of road-rail network, education institutions, medical facilities, electricity development, parks, location of fire and police stations, etc, is most important in increasing the quality of life and nation building. Here, geospatial technology is very useful in the planning process for infrastructure development and their management.

viii **Emergency Management:** Remote sensing provides pre to post disaster information such as flood, landslide, avalanches, earthquake, forest fire, etc and GIS technology supporting spatial decision making during these times of extensive damage to property and life. Such kind of information and decision-making tool is foremost important to map hazard zones for planning necessary preventive measures and preparedness.

ix **Crime Management:** geospatial technology is useful in monitoring, assessing and management of crime events such as analysing historical events, identifying crime hotspots and generating future predictions. GIS based analysis is very useful for correlating crime

Notes

events with social conditions as well as deploying law enforcement like installation of CCTV cameras, police check-posts, day-night patrolling, etc.

INTEXT QUESTIONS 2.3

1. What are components of GIS?
2. What is a spatial database?
3. What is a non-spatial database?

WHAT YOU HAVE LEARNT

- Geospatial Technologies
  - Remote Sensing
  - GPS- Segment and uses
  - GIS
    - Components
    - Database in GIS
    - Application of Geospatial Technologies

TERMINAL QUESTIONS

1. Explain the Geospatial Techniques.
2. Explain the process of remote sensing.
3. Write a short note on Element of image and photo interpretation.
4. Differentiate between spatial and non-spatial data.

5. Suggest any three areas where Geospatial technologies can be effectively utilized.

Exercise for Practical Record Book

1. Take any photograph and identify the feature on the basis of photo/image elements such as colour, size, shape, etc.
2. Draw an electromagnetic spectrum on your notebook and identify the range of visible regions.
3. Collect three types of spatial data and describe it.
4. Collect any one non-spatial data describing the rows and columns .

Notes

ANSWERS TO INTEXT QUESTIONS

2.1

1. Remote sensing is the acquiring of data about an object without touching it.
2. Remote sensing provides satellite imagery and aerial photographs of earth's features.
3. The electro-magnetic energy category on the scale of wavelength is called electro-magnetic spectrum.
4. Platforms are three types - groundborne, airborne and spaceborne.
5. Sensor is a device that measures and records reflected, scattered or emitted electromagnetic energy into a signal in a form of either digital number or image.

2.2

1. GPS is a tool, used for fieldwork or survey process that enables us to provide locational information of various features on the Earth's surface as well as useful to verify remotely sensed classified thematic information.
2. GPS consists of three segments such as space, ground and user segment.
3. 8 satellites.

2.3

4. There are five components- Computer hardware, GIS software, Databases, Procedure and trained person.
5. The spatial database may be any kind of map, aerial photograph, satellite imagery, sketch, etc. in hard-copy or soft-copy..

Notes

6. Non-spatial data represents the characteristics of spatial databases known as attribute data. These data are usually alpha-numeric and provide information such as name, population characteristics, land use, etc. in tabular form consisting of rows and columns.

Notes

3

DATA AND STATISTICAL DIAGRAMS

In our daily life we come across different types of information through newspaper, television, computers and conversation. Some of this information is quantitative and others are qualitative, which can not be measured numerically. Statistics is concerned mainly with information that is quantitative or measured numerically. In this lesson we will study about statistical data and their representation through various types of diagrams and maps.

OUTCOMES

After studying this lesson, learner:

- explains the types of data and calculate mean, median, mode and percentile
- constructs simple line, bar, pie diagrams with suitable data
- represents the statistical data with cartographic techniques- dot and choropleth
- explains the suitability, merits and demerits of diagrams and cartographic techniques.

3.1 STATISTICAL DATA : PRESENTATION AND INTERPRETATION

Let us take a poor man from the United States of America (USA) and a rich man from India. If the income of the Indian is higher than the income of the poor man of the USA, can we say that India is richer than the USA? Certainly not. Why? Because comparison is between two specific persons from the USA and India, which does not represent their countries so far as their individual income is concerned. For any such comparison we have to see the income of larger population in the USA as well as in India. For this we will have to collect information about the annual income of individuals, agricultural production, industrial production, unemployment rates, total population of different areas etc. All such information will be numerical and will relate to a large number of individuals or areas. Numerical information related to the

Notes

measurement of groups or masses is termed as data, (singular is datum). When information is related to an individual or event, it is not data.

In geography, statistical data play a very important role. The data gives us numerical information about geographical facts such as temperature, rainfall, agriculture/ industrial production, population, etc. We arrange them, analyse them, draw valid conclusions from them.

Source of Data

There are two sources from where data can be obtained. They are:

1. Primary source and
2. Secondary source

1. **Primary source:** If the data obtained through field investigation is called primary data. It is a lengthy process requiring a lot of time, money and manpower.

2. **Secondary source:** If the data are the published in the form of reports and tables prepared by various public agencies for general use is called secondary data. For the user the data from secondary sources are thus less expensive, time saving and do not require large manpower for their collection. Secondary data, however, is very general. Census of India is one of the best sources of secondary data.

3.2 PRESENTATION OF STATISTICAL DATA

The data collected through various sources needs to be processed statistically for precise explanations. Very often it becomes necessary to obtain a single representative value for the whole data set. The statistical measures that enable us to work out a single representative figure for the entire data distribution, is known as central tendency. Measures of central tendency help us to compare different distributions besides being representative for each distribution. These measures normally denote the central points of values, distance and occurrence in a distribution. The commonly used measures of central tendency are:

i. Arithmetic mean or average

ii. Median

iii. Mode

iv. Percentile

i. Arithmetic Mean

It is most frequently used and is calculated by adding the sum of all individual values in a distribution and dividing the sum by the total number of individuals. For example, the

Notes

production of rice per acre in five districts is 10, 8, 12,9 and 6 quintals. The average production of rice for these districts is :

$$\frac{10+8+12+9+6}{5} = \frac{45}{5} = 9 \text{ quintals per acre}$$

The arithmetic mean is expressed in the form of equation noted below:

$$\bar{X} = \frac{\Sigma X}{N} \qquad ...(i)$$

Where $\bar{X}$ is the mean value,

ΣX = The total of X values

N= Number of individuals/observations.

The arithmetic mean can be easily worked for small ungrouped data. However, when the number of observations are large and data is in the form of frequency distribution of groups, arithmetic mean will be worked out with the help of following equation.

$$\bar{X} = \frac{\Sigma fm}{\Sigma f} \qquad ...(ii)$$

Where $\bar{X}$ is the arithmetic mean,

f is the frequency,

m is the mid value of the classes

Example

Calculate the arithmetic mean from the temperature (in degree celsius) data given in the following table.

Table 3.1

Temperature Classes *x*	**No. of days** *f*	**Mid values** *m*	*fm*
1-05	20	3	60
06-10	24	8	192
11-15	44	13	572
16-20	72	18	1296
21-25	76	23	1748
26-30	60	28	1680
31-35	52	33	1716
36-40	4	38	152

Notes

41-45	8	43	344
	Σ f = 360 days		Σ fm=7760

From the above

$$\Sigma fm = 7760$$

$$\Sigma f = 360$$

$$\bar{X} = \frac{7760}{360} = 21.56°C \text{ temperature}$$

Merits of the Arithmetic Mean

1. It is easy to understand the complete idea of the distribution and simple to workout.
2. It is the average of the values in a distribution. Hence, it has a balancing property in case of sample surveys. Therefore, the mean is the centre of gravity.
3. It is widely used in case of normal distributions.

The arithmetic mean has certain limitations. It is affected by the extreme values especially when they are large. For example, income variations are very wide in case of Indian population.

ii. Median

Median is the middle most positional average. It is worked out by arranging data in an ascending or descending order. For example, the value of the median is worked out by adding 1 to the number of observation and the sum divided by two. It is expressed as:

$$\text{Med} = \frac{N+1}{2} \qquad \text{...(iii)}$$

For example if we are interested in working out the median latitude and longitude for the country, we must arrange these distributions in a tabular form.

Latitudinal Extent of the Mainland of India (8’4’ N to 37’ 6’ N)

Table 3.2

8	9	10	11	12	13	14	15	16	17
18	19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36	37

The median or middle most latitude of India is 23°N which is close to the Tropic of cancer (23° 30' N). Since mainland of India starts from 8° 4’ N which is a part of 9th latitude and extends up to 37° 6' N which covers the 37° latitude completely, hence the latitudinal coverage of India is approximately 29° latitudes. The median latitude is therefore, 23°N i.e.

$$\text{Med} = \frac{N+1}{2} = \frac{29+1}{2} = \frac{30}{2} = 15°+8°+ = 23°\text{N}$$

8° (Southern tip of India)+ 15° (median value)=23° (middle east latitude of India). Similarly, we can also workout the median value for the longitudinal extent of India. The Longitudinal Extent of India ranges between = 68°7' E to 97°25'E.

The median or middle most longitude for the country is 83°E.

Table 3.3

68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87
88	89	90	91	92	93	94	95	96	97

Longitudes are used to calculate local time, standard time of a nation and international time, which is linked to Greenwich Mean Time (GMT). Indian Standard Time is calculated keeping 82°30´E longitude as the base. The median longitude for the country is 83°E which is close to the standard meridian used for Indian Standard Time calculation.

$$\text{Med} = \frac{N+1}{2} = \frac{29+1}{2} = \frac{30}{2} = 15°+68° = 83°$$

Merits of Median

1. Being the middle most value, median remains unaffected by the extreme values in the distribution as in the case of arithmetic mean.

2. It is a partition value which divides the series into two nearly equal parts and remains the centre of gravity.

3. However, it cannot be worked out without putting data in an ascending or descending order. If data are large, it might be a time consuming and tedious job. The values of median will be erratic if one or two items are added or subtracted from the series.

iii. Mode

It is one of the important measures of central tendency. The maximum concentration of items occurring in a distribution is known as mode. The value which occurs most frequently is identified as mode in case of ungrouped data. Similarly, for grouped data the mode can be calculated by identifying the class with the highest frequency. The mode denotes the centrality of the occurrence of an item in the distribution. The distribution of rural settlements in Uttar Pradesh is given below. Workout the mode for the data.

Notes

Table 3.4

Distribution of Rural settlements in Uttar Pradesh (2001)

Size of Rural Settlements	Very small (Below 500 Population)	Small (500-999)	Medium (1000-1999)	Large (2000-4999)	VeryLarge (5000 and above)
Proportion of distribution	16.70	23.45	47.96	10.60	1.29

Solution: Arrange the data in a sequence (either from small to large or from large to small). Put up the frequency values against each. Now compare the frequencies. The distribution registering maximum frequency in medium size of rural settlement (1000-1999) 47.96 is identified as 'mode'.

Merits of the Mode

1. It is the most typical value of a series. Mode can be located easily by the inspection and can be used by common people also.
2. The occurrence of a few extreme values does not affect the mode, since it is the most typical value of series.

It is, however, not a significant measure of central tendency unless the number of observations is large. Both in case of uniform as well as skewed distributions, mode ceases to be a measure of central tendency.

iv. Percentiles

Percentile is a measure which divides a series into 100 equal parts. It helps to understand various classes or categories that constitute a distribution. It is expressed as:

$$P = \frac{P \times N}{100} \qquad \text{... (iv)}$$

Where P is the percentile and N is the number of observations.

There are 99 percentiles, P_1 P_2 ……………P_{99}

Table 3.5

Distribution of Monthly Income Among Households of a locality

Income group (Rs.)	**Actual Number**	**Percentage Distribution**
Economically weaker sections (Below Rs.500)	112	56.0

Lower Income Group (500-999)	41	20.5
Middle Income Group (1000-4999)	29	14.5
High Income Group (5000 and above)	18	9.0
Total	**200**	**100.00**

Notes

Table 3.6

Distribution of Per Capita Monthly Income of the Households of a locality

Income group (Rs.)	**No. of Frequency Households**	**Cumulative Frequency**
Below 500	112	112
500-999	41	153
1000-4999	29	182
5000 and above	18	200
Total	**200**	

Let us calculate 60th percentile as P_{60}.

Now $P_{60} = 60 \times 200 \div 100 = 120$

The income lies in the group 500–999.

3.3 REPRESENTATION OF STATISTICAL DATA THROUGH DIAGRAMS

The data collected either through primary source or through secondary source, are raw and unorganized form. They do not give a clear picture because some values are very large, some are low and some are in between low and high. These are all scattered values lying here and there. The data becomes clear once they are organized and put in to some systematic tabular form. Statistical tables are very handy and represent the data in a systematic and manageable form. A direct-mental comparison of such values is also possible if these are represented through diagrams.

WHY DO WE REPRESENT DATA THROUGH DIAGRAM

The below mentioned points reveals the advantages of diagrams over the raw data. The advantages are as followes:

Notes

i. The diagram creates greater interest in the subject matter which has been represented by it.

ii. It clarifies and simplifies the subject matter.

iii. They help in making quick and accurate comparison of data.

iv. They bring out hidden facts and relationship and can stimulate analytical thinking.

v. It is more illustrative and attractive than the statistical information

Following are important diagrams/maps through which various types of statistical data can be represented:

i. Line graph

ii. Bar diagram

iii. Pie diagram

iv. Star diagram

I. LINE GRAPH

There are certain variables whose values fluctuate with time, like temperature of an area or rainfall etc. There are some other variables which increase or decrease with time like population, agricultural and industrial production and prices of various commodities. The data for all such variables are collected and tabulated with reference to time. If we plot such data on a graph paper in such a way that time is plotted on x-axis and values of the variables are plotted on y-axis and join the points by straight lines what we get is known as a line graph.

Example

Average monthly maximum temperature of a place 'A' is given below for 12 months. Plot the data by a line graph.

Table 3.7

Month	Jan	Feb	Mar	Apr	May	June	July	August	Sep	Oct	Nov	Dec
Temp. ^{0}C	24.5	26.6	32.2	38.1	42.5	44.3	40.4	33.4	30.2	29.7	29.2	25.0

In order to plot the given data, the most suitable diagram would be a line graph since the values of the temperature are given against months. Plot months on the x-axis and temperature on the y-axis. Keeping the temperature of various month, plot 12 points. If we join these points by straight lines as given in figure 3.1 we get the required line graph.

Notes

We observe from the table that the monthly average of maximum temperature is least in the month of January and it rises marginally in February. In March and April it increases rapidly and reaches maximum of 44.3°C in June. It remains quite hot in July also. From August onward the temperature starts declining again.

This conclusion, about the temporal variations or changes in temperature does not require any elaborate description in the presence of the line graph. Anybody looking at the linegraph given in figure 3.1 can quickly make out the picture of this cyclic variations in the temperature of the area.

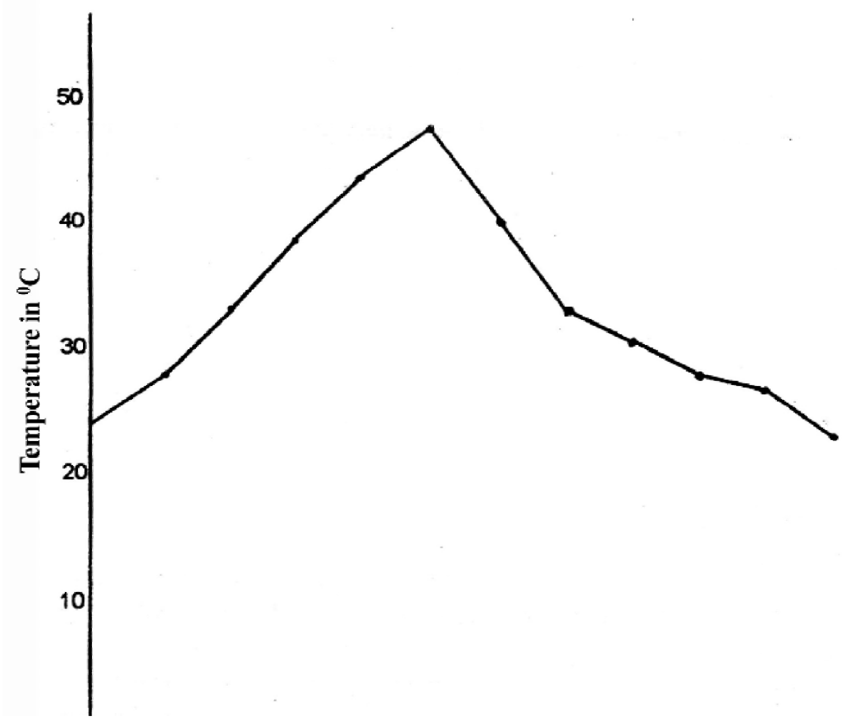


Fig. 3.1 Line Graph

Rules for making line-graph

1. Time which is an independent variable is plotted on x-axis and temperature, rainfall, production or any other variable which is varying over time is plotted on y-axis.

2. All such points obtained by plotting the values on x-axis and y-axis should be jointed with the help of straight lines.

3. Since units of both x-axis and y-axis are different, separate scales should be chosen for these. For x-axis, the time unit-could be hours, days, months, years or any other unit of time. For y-axis the unit-could be °c, cm, tonnes or any other unit.

4. Normally vertical scale should start with zero so that the absolute magnitude of the values are represented. However, if most of the variations start after some fixed value, that value may start from origin of y-axis, for example take the values 12050, 12020,12180,12200,12140, 12040, 1212 etc. As among these values variations are

found after 12000, we can take 12000 as the starting value on the y-axis.

5. In a line graph time variable in most of the cases, is at fixed intervals. It could be hours, days, months or years etc. Although this rule is not a necessary condition but is generally observed for the sake of clarity.

Characteristics of a line graph

1. It shows the past as well as the present trends in the variations of a phenomenon.
2. With the help of it the intermediate values can be estimated (interpolated) as well as future values can also be predicted (extrapolated).
3. In comparison to mathematical relationship between time and the values of a variable, the relationship shown through line graph is only approximate.
4. It occupies more space as compared to a mathematical relationship.

Compound line graph

Some times more than one variable can also be plotted on a line graph to compare their relative changes. For example, we can plot export and import figures on one graph for several years. It will give the changes in export in relation to imports. The difference between the two, will also give trade deficit. Similarly we can plot birth rates and death rates of a country for several years. The difference between the two in this case will give natural growth rate of the population. We may also plot the production of various agricultural crops to see as to which crop is maintaining upward trend and which is going downward. We can also plot the monthly maximum and minimum temperature on the same graph. Difference between the two will give monthly range of temperature.

Example

Line graph showing temporal variations in more than one variable is known as compound line graph.

The estimated Crude Birth Rate (CBR) and Crude Death Rate (CDR) of India are given below for the following years. Plot the data on a line graph.

Table 3.8

Year	1921	1931	1941	1951	1961	1971	1981	1991
CBR (per 1000)	49	47	45	43	44	42	37	30
CDR (per 1000)	49	37	33	31	26	20	15	10

The data is plotted on the graph given in figure 3.2. There are two types of lines representing

Notes

two different types of population data as indicated in the table. The compound line graph of crude birth rates and crude death rates shows a decline in both during 1921-1991. However, the graph shows a steep fall in crude death rate in relation to crude birth rate. This increasing gap is also highlighted on the graph by the shaded area between CBR and CDR.

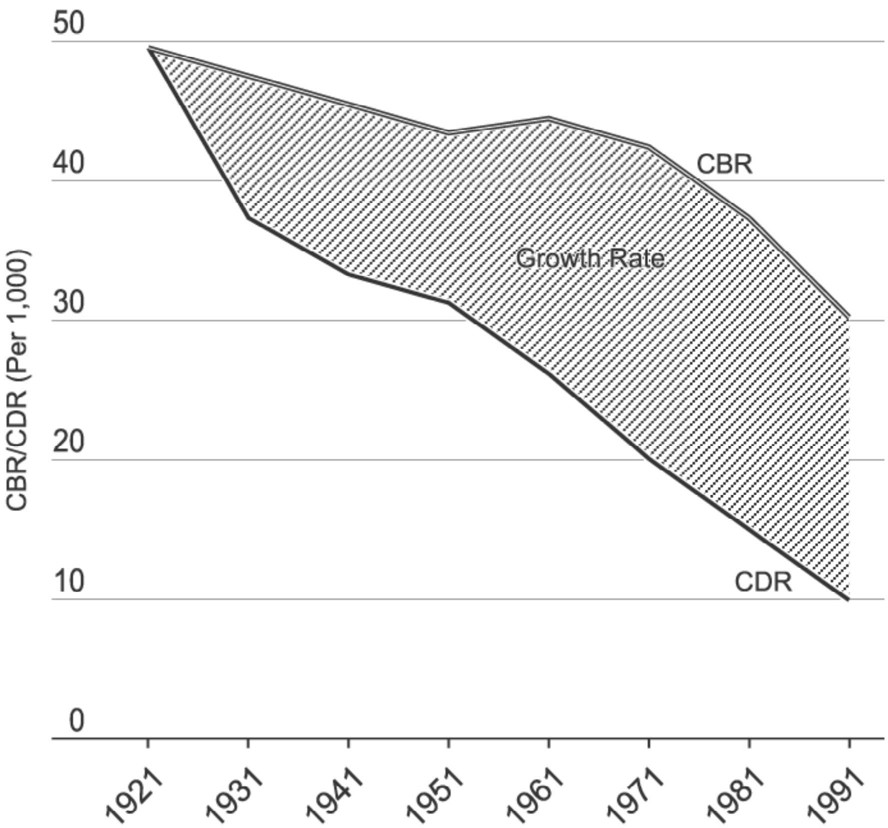


Fig. 3.2 Compound Line Graph

ii. BAR DIAGRAM

Some times the values of a variable are given for areas, commodities or for anything other than time. In such cases these values are represented by bar diagram instead of a line graph.

How to construct a Bar Diagram

1. First of all, constant (or independent variable) data (here major parts) are shown on the 'x' axis and variable data (here tonnage) on the 'y' axis. The bars are drawn vertically.

   Three scales are assumed:

   i. Scale for width of the bars: The width of all the bars must be equal.

   ii. Scale for interval between two bars: The interval should be less than the width of the bars.

Notes

iii. Scale for variable data : It is to be shown on 'y' axis. It should be in round figures. The principle of selecting scales is the same as in case of line graph.

2. Now length of the bars are calculated as per the scale and the data.

3. Then points are marked and bars are drawn.

4. Labelling of the diagram is done in the same manner as is done in the line graph.

Example

Population of the major states in India is given below for 2011. Represent the graphical data using the bar diagram.

Table 3.9

Sl.No.	**State**	**Populattion (in %)**
1.	Andhra Pradesh	6.99
2.	Assam	2.29
3.	Bihar	8.60
4.	Gujarat	3.47
5.	Haryana	1.39
6.	Karnataka	4.99
7.	Kerala	2.72
8.	Madhya Pradesh	6.00
9.	Maharashtra	9.28
10.	Orissa	2.76
11.	Punjab	2.11
12.	Rajasthan	5.05
13.	Tamil Nadu	5.96
14.	Uttar Pradesh	16.50
15.	West Bengal	4.54

***Source: Census of India* 2011**

The above data is plotted on a graph paper by bar diagram as shown in (fig. 3.3). You will note that the states are plotted on x-axis in the order these are given in the table. Equal distance from one state to another state has no meaning here. It is only a nominal distance we have taken to separate anyone state from any other state. On the y-axis, however, the height of the bars in the case of each state is in proportion to their population and it has a scale (half centimeter is equal to 10 million population).

Notes

Some time the states can be rearranged on the basis of ascending or descending order of the population size as per the convenience.

The bar diagrams discussed above are known as vertical bar-diagrams since the bars are shown vertically. We can show these bars as horizontal bars also. In that case it will be known as horizontal bar diagram. In horizontal bar diagram vertical scale i.e. y-axis, will be nominal and horizontal scale i.e. x-axis will be a numerical scale.

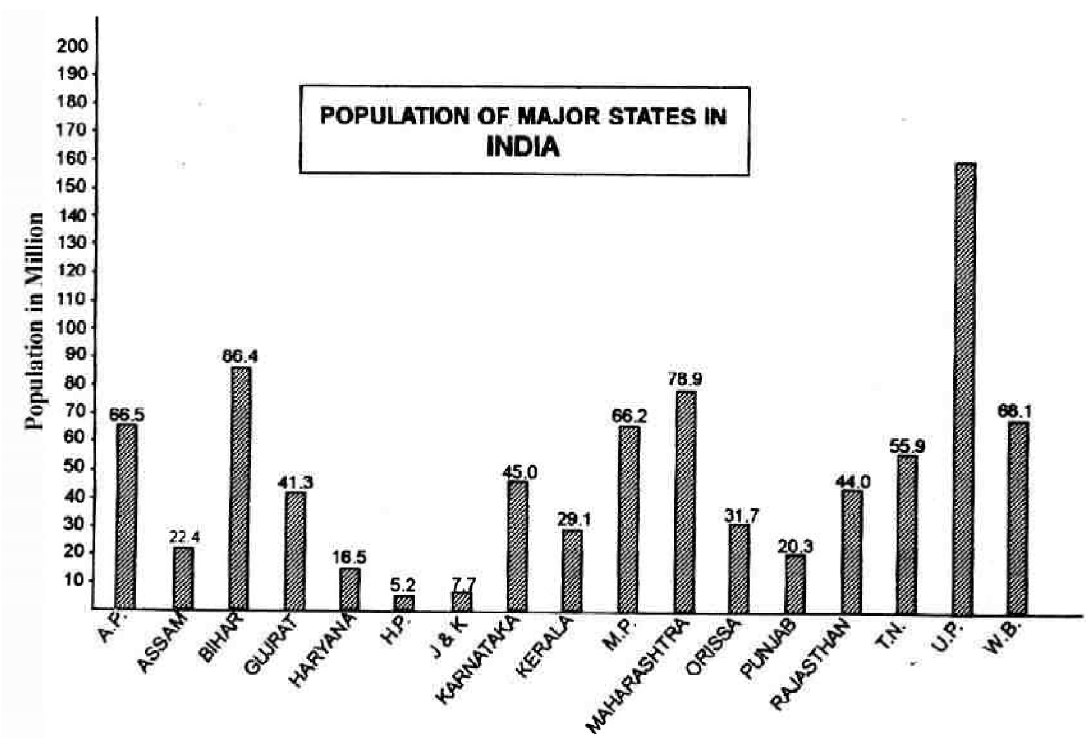


Fig. 3.3 Bar Diagram

Compound Bar Diagram

Quite often the variable being shown by the bars may consist of few different categories. These categories can also be shown on the bar itself. Such a bar diagram shows the magnitude of different values as well as share of its different categories and is known as compound bar diagram. It is also known as stacked bar diagram. In a compound bar diagram alongwith the magnitude bars also show the share of different categories of the variable which is shown by the bars.

Notes

Example

The population of the major states of India is given below with rural and urban breakup. Plot the data on a compound bar diagram showing rural and urban break up of each state.

Table 3.10 Population (in million)

Sl.No.	State	Rural	Urban	Total
1.	Andhra Pradesh	48.6	17.9	66.5
2.	Assam	19.9	2.5	22.4
3.	Bihar	75.0	11.4	86.4
4.	Gujarat	27.1	14.2	41.3
5.	Haryana	12.4	4.1	16.5
6.	Himachal Pradesh	4.7	0.5	5.2
7.	Jammu & Kashmir	5.9	1.9	7.7
8.	Karnataka	31.1	13.9	45.0
9.	Kerala	21.4	7.7	29.1
10.	Madhya Pradesh	50.8	15.4	66.2
11.	Maharashtra	48.4	30.5	78.9
12.	Orissa	27.4	4.3	31.7
13.	Punjab	14.3	6.0	20.3
14.	Rajasthan	34.0	10.0	44.0
15.	Tamil Nadu	36.8	19.1	55.9
16.	Uttar Pradesh	111.5	27.6	139.1
17.	West Bengal	49.4	18.7	68.1

***Source: Census of India* 1991**

Construction of compound bar diagram is not very much different from the ordinary bar diagram. In the final form the bars are divided into their categories using the same scale. These categories are indicated in the index, The above data is plotted by a bar diagram and is shown in fig. 3.4.

In the present case only two categories are there. In some other cases there may be several categories. In such cases each bar will be subdivided into several categories. All these categories, however, will have to be shown in an index.

In some cases the differences in absolute values may not be as important as their proportional distribution in different categories. In such cases the categories are converted into percentages such that these percentages add to 100. Each unit in this case therefore is represented by bar of equal size symbolising total of all the percentages as 100. Percentages of different sub categories are then shown on each bar by different sheds or colours.

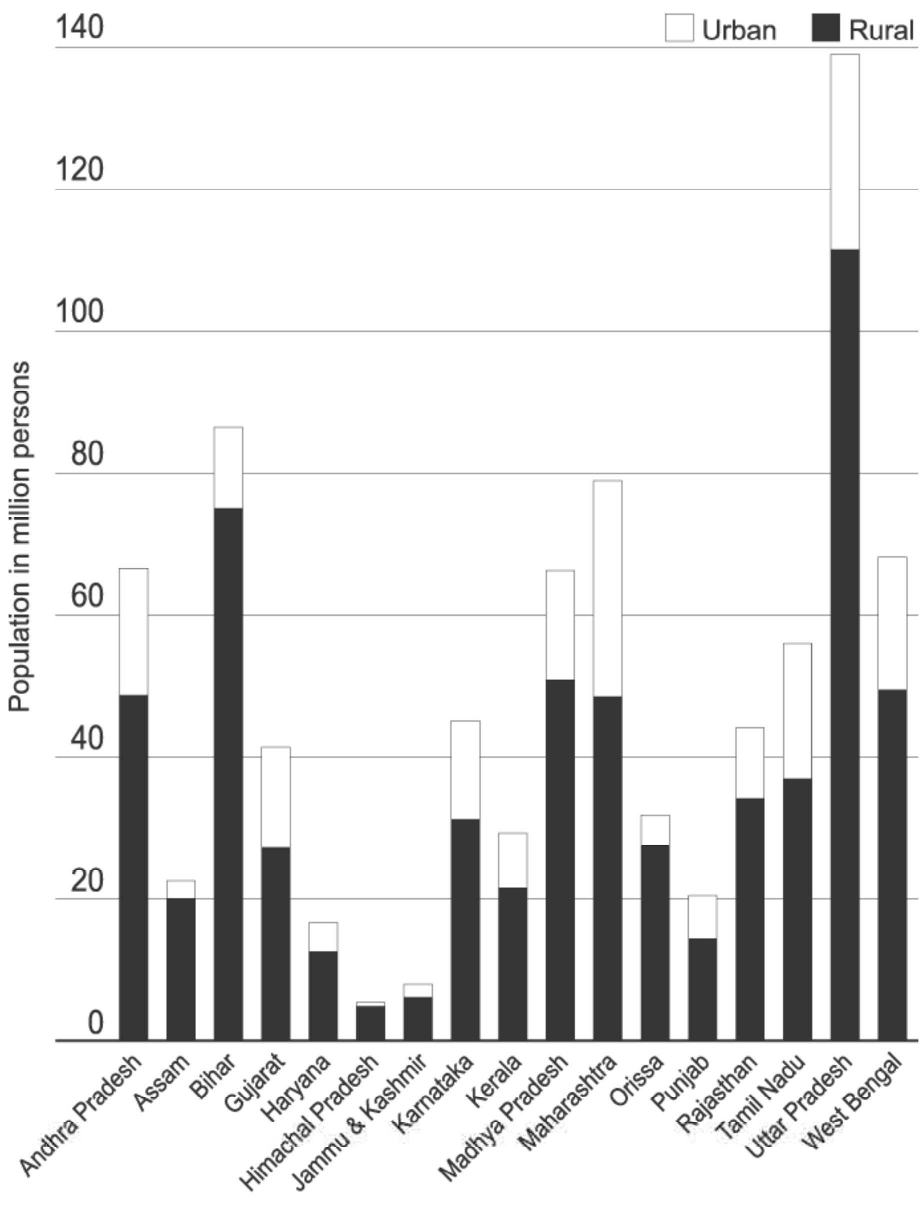


Fig. 3.4 Compound Bar Diagram

Notes

Multiple Bar diagram

Many a times it is more useful to plot sub-categories of a variable side by side. In these cases the bar of one category is placed alongwith the bars of other categories for each area. Each category is shown by a separate shade and is given in the index. The advantage of multiple bar diagram over compound bar diagram is that in this case camparision is direct. In compound bar diagram the categories are placed one over the other, whereas in multiple bar diagram these are placed side by side making comparison more direct and quicker. When there are many categories and less observations/units, multiple bar diagram is more appropriate. On the other hand, there are more observations/units and lesser categories, a compound bar diagram is always better.

Example

Electricity sold for different purposes in four states of India is given below for 1994-1995. Plot the data on multiple bar diagram and compare its use for different purposes.

Table 3.11

Electricity used (in crores kw/h) for different purposes in selected states

Sl. No.	State	Domestic Purposes	Commercial Purposes	Industrial Purposes	Other	Total
1.	Andhra Pradesh	332.0	68.3	754.9	1208.6	2363.8
2.	Bihar	73.6	42.2	637.0	219.0	971.8
3.	Maharashtra	685.3	256.5	1665.1	1481.9	4088.9
4.	Uttar Pradesh	613.3	190.5	482.7	1566.2	2552.4

***Source: Statistical Abstract of India* 1997**

Multiple bar diagram is shown in figure 3.5 there are four categories of uses of electricity there are four bars for each state-one bar for each category. The heights of these bars are proportional to their magnitude of the electricity used (in crores kw/h.)

The multiple bar-diagram given in fig 3.5 very clearly shows that in Maharashtra, Andhra Pradesh and Bihar consumption of electricity for industrial purpose is quite high and in Uttar Pradesh it is very low. The diagram also shows that consumption of electricity for domestic and commercial purpose is strikingly low, in all the four states of India.

Notes

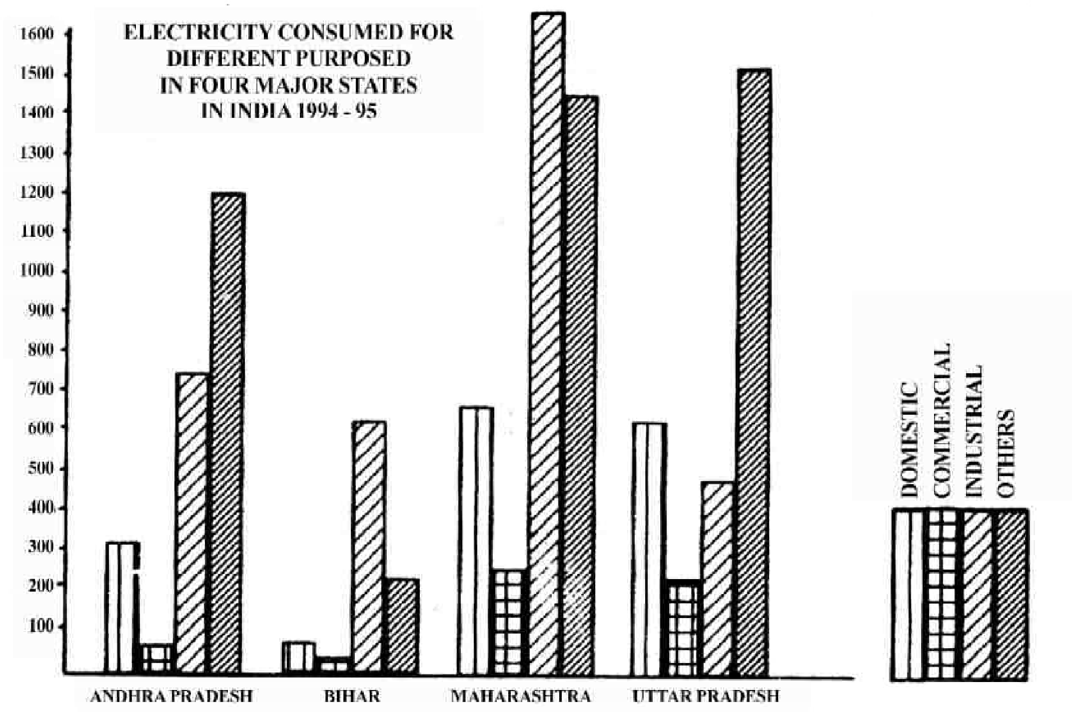


Fig. 3.5 Multiple Bar Diagram

Characteristics of a Bar Diagram

1. Bars give a visual comparison which is more effective than the quantitative comparison.
2. Multiple classifications are easily compared by a bar diagram, compound or a multiple bar diagram.
3. It can be shown on maps also.
4. It is easy to prepare and understand
5. For minor differences bar diagram or any other graph is not suitable because these are less accurate than numerical values.
6. It occupies more space.

iii. PIE DIAGRAM

In a multiple bar diagram we compare categories of a variable for different areas. However, when number of categories increase further and number of observations are only a few, pie diagram is found to be more handy to represent these categories than the bar diagram. In a pie diagram each category is represented by different segments of a circle. The proportional share of each category is reflected in the area of the segment as well in the angle it makes at the centre.

Notes

In the construction of pie diagram one has to find out the angle of each category of the diagram. These angles are then drawn at the centre of a circle of suitable size. It will be observed that the proportional share of each category will be reflected in the area of the corresponding segment as well as in the angle.

The angle of each category is worked out by taking the ratio of the component value (C) to the total value (T) and multiplying it by 360 i.e. (CT)x360. In case component values are given in percentages, each percentage is multiplied by 3.60 to convert it into corresponding angles. Sum of all such angles has to be 360^0. Before making any pie diagram one should always verify this fact.

Example

Land use categories of India are given below for 1950 and 1992. Show the shift in the land use graphically with the help of a pie diagram.

Table 3.12

Land under different uses in India (in million hectare)

Year	Forrest	Non-Ag. use	Barren	Pastures	Groves	Culturable Waste	Fallow	Net Sown Area	Total
1950	40.5	9.4	38.1	6.7	19.8	22.9	28.1	118.8	284.3
1992	68.1	21.9	19.4	11.3	3.7	14.7	23.6	142.5	305.2

***Source: Statistical Abstract of India* 1997.**

The land use categories given above are converted into the angles using the method given earlier.

Year	Forrest	Non-Ag. use	Barren	Pastures	Groves	Culturable Waste	Fallow	Net Sown Area	Total
1950	51.3	11.9	48.2	8.5	25.1	29.0	35.6	150.4	360
1992	80.3	25.8	22.9	13.3	4.4	17.3	27.8	168.2	360

To explain the calculation of angles let us take area under cultivable waste in 1950 which is 22.9. Its corresponding angle would be 22.9/284.3 x 360 = 28.9975° which after rounding upto one decimal place is 29.0. Similarly the angle of the same cultivable waste in 1992 will be 14.7/305.2 x 360 = 17.3394° which after rounding up to one decimal place would be 17.3 only. Note that as has been mentioned in demerits of a bar diagram, all graphical methods are less accurate than numerical methods. Rounding, therefore, upto only one or two decimal places is sufficient. Minute differences can not be depicted on the graph effectively.

The proportional composition of land use categories given in angles are shown below in fig. 3.6

A close look of fig 3.6 will not only show proportional composition of various land use categories but also show a change that has taken place between 1950 and 1992. Pie diagram very clearly shows that forest cover has increased quite substantially between 1950-92. Also it shows a significant increase in net area sown. The diagram on the other hand shows a decline in fallow land, culturable waste, barren land and area under groves.

If we show the categories of two different areas such that one is very high and the other is low, in absolute term the size of the circle of the pie diagram can be taken in proportion to the total size. For example if we show the land utilisation of two states like Uttar Pradesh and Haryana, the size of the circle for these states may be in proportion to their area. Rest of the procedure will remain the same. One of the pie diagrams will be larger and the other will be smaller in size. Internal division of the circle, however, will show relative position of land use in two states.

Notes

Characteristics of Pie Diagram

1. It highlights the proportional composition of a phenomenon in a better way since it uses two dimensional space, unlike bar diagram which uses only heights, length for differentiating the values.

2. When there are large number of components in compound or multiple bar diagram it becomes very difficult to show them. The pie diagram is more convenience way of handling such cases.

3. It occupied lesser space as compared to bar diagram

4. It requires more mathematical calculations

5. It is effective only when proportional comparison of a few units is to be made (say two or three). In case large number of units are to be compared, a Pie diagram may not be preferred over multiple bar diagram.

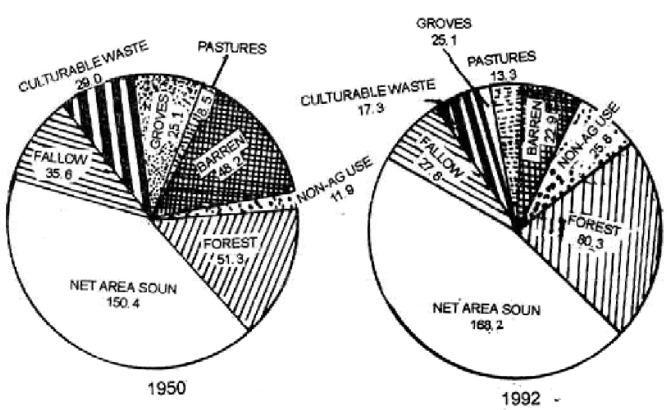


Fig. 3.6 Pie Diagram

Notes

iv. STAR DIAGRAM

In this diagram radiating lines are drawn from a centre to represent a certain quantity or number of days etc. The length of the lines is proportional to the quantity which is to be represented. When the outer points of the lines are joined together, they give the appearance of a star. Hence, the diagram is named as a star diagram. Wind rose is a typical example of star diagrams.

Example

Construct a star diagram for the following data.

Table 3.13

Wind coming from	No. of days
North (N)	51
North East (NE)	22
East (E)	17
South East (SE)	42
South (S)	55
South West (SW)	57
West (W)	32
North West (NW)	52
Calm Days	37
Total	**365M**

How to construct a Star Diagram

The following steps are involved in the construction of a star diagram:

i. There are eight directions from which wind is blowing. Hence, we draw eight lines radiating from a centre indicating all the eight directions of the wind.

ii. Now write eight directions on these lines as N, NE, E, SE, S, SW, Wand NW.

iii. Assume a suitable scale for showing the flow of the wind from various directions keeping the size of the paper in view. Each line will depict the number of days the wind is blowing from each direction. Here the scale is 1cm = 20 Days.

Notes

On the basis of the scale, the length of the lines from Centre will be calculated as under:

L = D ÷ S

Where L stands for length of the line.

D stands for no. of days for which wind is blowing from a direction.

S stands for scale (here 1 cm = 20 days).

Thus the length of lines of each direction will be

N = 2.55 cm

NE = 1.1 cm

E = .85 cm

SE = 2.1 cm

S = 2.75 cm

SW = 2.87 cm

W = 1.6 cm

NW = 2.6cm

Calm = 1.85 cm

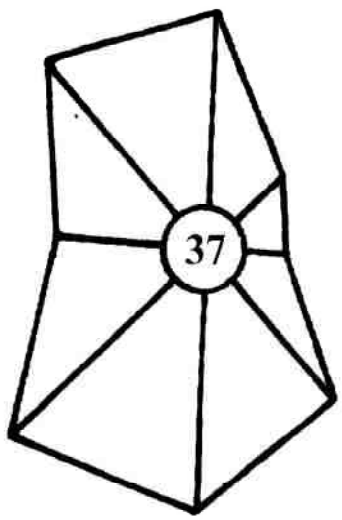


Fig. 3.7 Star Diagram

Now put points for the calculated length on each line. For the number of calm days, a circle of 1.85 cm radius will be drawn at the centre. (see fig. 3.7).

iv. The terminal points of each line are joined together to form the star diagram.

v. Number of calm days is written in the centre of the circle for which it has been drawn.

Characteristics of Star Diagram

1. Construction of star diagram is very simple. It does not involve any mathematical calculation, except the calculation of the length of lines.

2. Star diagrams are shown on climatological maps and pilot charts. They give us an understanding about the weather conditions (windy or calm) in an area of a region.

Notes

3.4 DISTRIBUTIONAL MAPS

Any phenomena or statistical data which pertains to an area is shown on the map. This map is said to be a distribution map. A variety of distributional maps may be prepared like distribution of soil, crops, population, density, literacy, rainfall, temperature, etc. For the preparation of a distribution map, following are needed–

1. An outline map of a region/area/administrative unit.
2. A relief map of the same area showing forested area/water body/marshes and contours.
3. Soil as well as climatic maps of the same area is required when crops are to be shown.
4. To show the distribution of population a map is needed on which at least urban centres are shown.

There may be a number of methods for showing the distribution but here only two methods dot and choropleth have been taken to discuss.

A. DOT MAPS

A dot map provides a visual impression of relative density of phenomena with the help of dots of uniform size. It uses discrete data or absolute figures, which are later converted into certain number of dots.

The *dot* is a point symbol used to represent the spatial distribution of phenomena. A dot map employs either *mono-dot method* or *multiple-dot method* in representing the data. Here, we are concerned with mono dot method only.

In *mono-dot method,* the size of the dots is kept uniform throughout the region to be mapped. The dots in this case may be single coloured, when one phenomenon is to be shown, e.g., Population distribution by numbers; or multicoloured where more than one features of the same phenomena are mapped. For example, in a map showing distribution of tribes, dots of different colours indicate different tribes, but the size of dots is uniform all over, irrespective of the colour.

Example

Fig. 3.8 is a dot map showing population distribution in Madhya Pradesh in 2011 (Table 3.15). In column 4 of the Table 5.15 we have worked out the number of dots to be placed in each district. The scale selected for the purpose is one dot representing 20,000 persons. The method of construction is elaborated in the following paragraphs.

Notes

Table 3.14

Population Distribution in Madhya Pradesh, 2011

Sl. No	District	Population	No. of Dots
1	Indore	3,276,697	164
2	Jabalpur	2,463,289	123
3	Sagar	2,378,458	119
4	Bhopal	2,371,061	119
5	Rewa	2,365,106	118
6	Satna	2,228,935	111
7	Dhar	2,185,793	109
8	Chhindwara	2,090,922	105
9	Gwalior	2,032,036	102
10	Ujjain	1,986,864	99
11	Morena	1,965,970	98
12	Khargone	1,873,046	94
13	Chhatarpur	1,762,375	88
14	Shivpuri	1,726,050	86
15	Bhind	1,703,005	85
16	Balaghat	1,701,698	85
17	Betul	1,575,362	79
18	Dewas	1,563,715	78
19	Rajgarh	1,545,814	77
20	Shajapur	1,512,681	76
21	Vidisha	1,458,875	73
22	Ratlam	1,455,069	73
23	Tikamgarh	1,445,166	72
24	Barwani	1,385,881	69
25	Seoni	1,379,131	69
26	Mandsaur	1,340,411	67
27	Raisen	1,331,597	67

Notes

28	Sehore	1,311,332	66
29	Khandwa	1,310,061	66
30	Katni	1,292,042	65
31	Damoh	1,264,219	63
32	Guna	1,241,519	62
33	Hoshangabad	1,241,350	62
34	Singrauli	1,178,273	59
35	Sidhi	1,127,033	56
36	Narsimhapur	1,091,854	55
37	Shahdol	1,066,063	53
38	Mandla	1,054,905	53
39	Jhabua	1,025,048	51
40	Panna	1,016,520	51
41	Ashoknagar	845,071	42
42	Neemuch	826,067	41
43	Datia	786,754	39
44	Burhanpur	757,847	38
45	Anuppur	749,237	37
46	Alirajpur	728,999	36
47	Dindori	704,524	35
48	Sheopur	687,861	34
49	Umaria	644,758	32
50	Harda	570,465	29

Source: Census of India, 2011

Construction of dot map

First of all you need a base-map of the region to be mapped and the data in numbers. The boundaries of the individual administrative units, for which the figures are obtained are drawn in pencil or light ink. Such administrative units are called unit-areas and the value represented by each dot is the unit-value. In Example, illustrated here, 'district' is the unit-area and "20 persons per dot" is the unit-value. The preparation of dot map depends on:

i. Careful selection of the unit-value and size of the dots;

ii. Determination of uniform and proper size of dots;

iii. Proper placing of the dots.

It is only after the unit-value of the dot and its proper place on the map are decided, the dots of uniform size are put within the unit-areas demarcated on the map.

Notes

i. Selection of unit-value and size of the dots

Unit value determines the number of dots to be placed in each unit area. The first step is to examine the range of quantities involved, and then to select a value to be represented by each dot. The selected unit value is always a round number (and generally a multiple of 10). Secondly, the fractions of the actual figure are never plotted.

The unit value adopted should neither be so low that it creates difficulty in inserting dots in high density areas, nor it should be so high that the area units with low density should loose their significance. The best approach is by experimenting. Dot Map in fig. 3.8 uses the unit value of 20,000 persons per dot.

ii Placing of Dots

The base maps showing physical and cultural features are of great help for the placement of dots on the maps. On the basis of these the positive and negative areas should be marked first. The positve areas are the parts of the region which are favourable for the distribution of the phenomena while negative areas are the relatively unfavourable parts of the region. In population distribution maps, for instance, these negative areas are known as *non-ecumene* areas, viz. the lands unsuitable for human settlements such as deserts, swamplands, flood plains etc.

In placing the dots, care must be taken not to leave the boundary areas blank. Care must also be taken so that the dotting does not inadvertantly produce lines and clusters of dots that do not occur in reality. In fig. 5.8, dots have been placed after a careful study of the districtwise distribution of population in Rajasthan, and the physical and cultural features of the state.

Interpretation of a dot map

As the distributional patterns on the dot map are shown by dots, theoretically one should count the number of dots in each unit area and multiply it with the unit-value assumed for one dot. The following principles should be kept in mind while interpreting a dot map:

Notes

- Divide the entire region into high, moderate and low concentration areas and describe each of them seperately.
- The areas or districts not conforming to the general pattern can be discussed as exceptional cases.
- If necessary, the facts of distribution may be supplemented by the absolute figures given in the respective table.

The above principles may, now, be used to interpret the patterns of distribution of rural population in Madhya Pradesh as shown in fig. 3.8. The distribution is almost even in nature. Because of gentle variation in the data, the nodes of very high concentration do not exist on the map, but the general pattern reveals the fact clearly that the some are more crowded than the other parts.

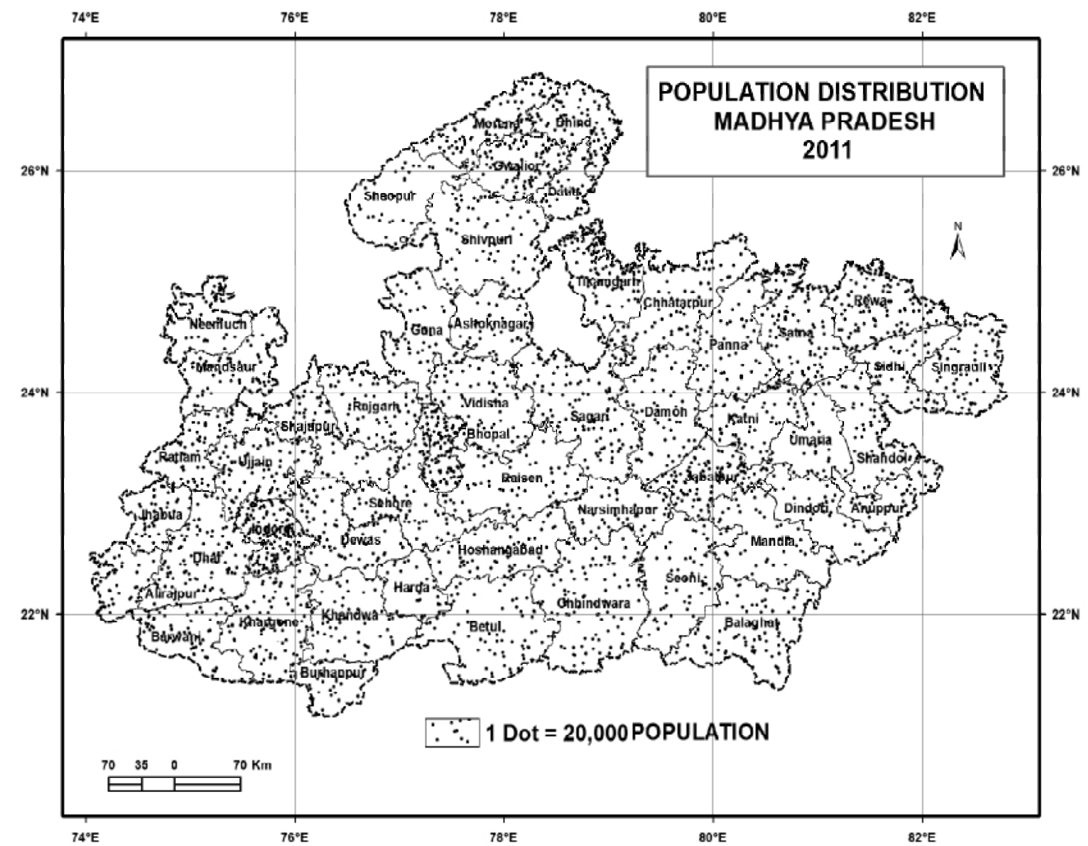


Fig. 3.8 Dot Map

Characteristics of a dotmap

1. A dot map exhibits more vivid picture of the distributional pattern.
2. It is easily commensurable.

Notes

3. A dot map may be converted into an isopleth or choropleth map, but the reverse is not possible.

4. The dot method is sometimes referred to as the "absolute method", because of the absolute ratio between quantities represented and the number of dot employed.

5. Dot maps are comparatively easier to construct. No much computation is required in determining the number of dots required.

6. The dot may not be near the place where feature to be mapped actually exists.

7. Dot method fails to show the distribution of a phenomenon having very uneven distribution.

8. Sometimes the dots coalesce in denser areas and are rarely counted. For precise information one has to turn to the basic source of data.

B. CHOROPLETH MAP

Choropleth is a technique for representing spatial data on map in which shadings are drawn depending upon the intensity/density of information. The raw spatial data is analysied first and different categories are made. An uniform shade/colour is assigned to one category/class. The shades are selected based on certain norms. In general darker shades are allotted to higher values/density/intensity and that of lighter shades to lower values/density/intensity.

Example

Figure 3.9 is a map showing the density of population in Haryana (Table 3.16). Column III and IV show the area of districts and their population, respectively.

The density has been computed by deviding the population of a district by its respective area. Thus it is an average number of people residing in text particular district in our square km of area. The method of construction is elaborated in the following paragraphs.

Notes

Table 3.15

Population Density in Haryana, 2001

S.No. I	District II	Area (Sq.Km.) III	Population IV	Density V
1.	Ambala	1569	1013660	646
2.	Kurukshetra	1217	828120	680
3.	Karnal	2471	1274843	516
4.	Jind	2736	1189725	435
5.	Sonipat	2260	1278830	566
6.	Panipat	1250	967338	774
7.	Rohtak	1668	940036	564
8.	Panchkula	816	469210	575
9.	Faridabad	2105	2193276	1042
10.	Gurgaon	2700	1657669	614
11.	Mahendergarh	1683	812022	483
12.	Bhiwani	5140	1424554	277
13.	Hisar	3788	1536417	406
14.	Sirsa	4276	1111012	260
15.	Riwari	1559	764727	491
16.	Kaithal	2799	945631	338
17.	Yamuna Nagar	1756	982369	559
18.	Fatehabad	2491	806158	324
19.	Jhajjar	1868	887392	475
20.	Haryana	44152	21082989	478

Source : Census of India 2001

Construction of Choropleth Map

Choropleth map in the one where real information is shown, hence a map with its subdivision boundary is needed. The sub-division of map (block/district or even state) as administrative unit becomes the unit area for the construction of choropleth map.

As we know that the people live in clusters like villages, towns or cities. The distribution of population on the space surface is not uniform or continuous. The counting of heads residing in clusters are taken on the total population. If we divide the total population of a block/district by the area of a block/district it gives the density of population. A single value of an administrative boundary is an average density considered to be uniformly distributed for mapping purpose. Hence entire district is shown by that particular shade.

After getting the density/productivity/literacy they are grouped into different classes. All the administrative units falling into that class are assigned the same shading. Therefore, wherever there is greater value darker shade is used and the lighter shade is used for smaller value. In between these two ranges shades are kept in a particular order of values.

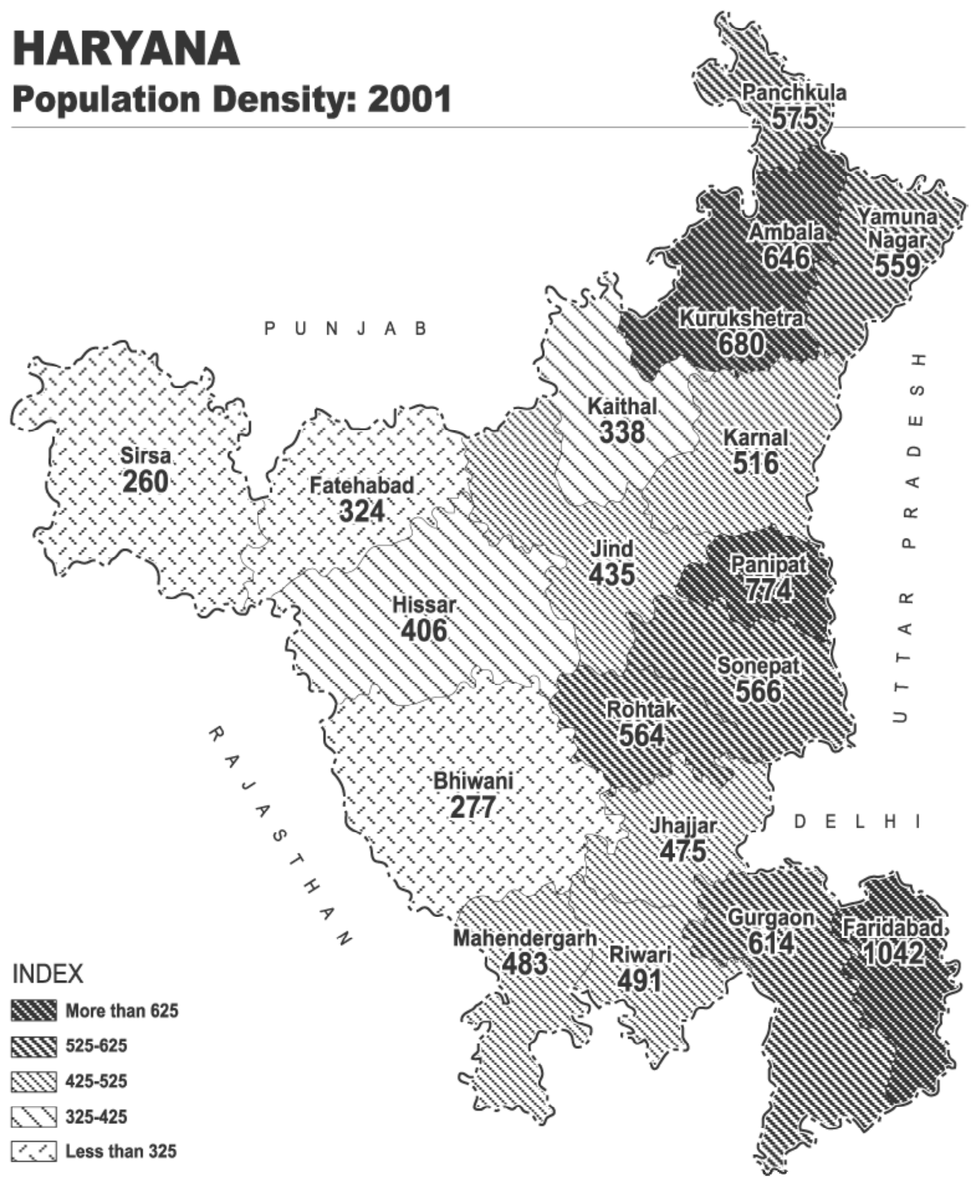


Fig. 3.9 Choropleth Map

Notes

Interpretation of choropleth map

Before making any statement about the interpretation of the choropleth map, one should always keep in mind the general pattern of shading. Pattern may be seen in terms of increasing or decreasing trend on the surface. Sometimes, a few isolated pockets of high concentration of density may be attributed due to some other favourable conditions. Hence, it may be explain in that perspective.

Just by giving a glance on the figure 3.9 it is quite clear that the higher concentration of population density is in the eastern part of Haryana. As one goes from east to west the density decreases and to the north, west and south-west, density is the lowest. Excessively high density (1042 person per Km2) is found in Faridabad, located on the south-eastern most corner. The density map shows five categories of density concentrations; very low, low, moderate, high and very high. The minimum density (260 persons/Km2) is recorded in Bhiwani district in south western part of Haryana. The difference between the highest and lowest is the more than 750 persons/Km2. The high density districts are adjoining to the very high density districts of Haryana. The list of districts falling under different density categories are as follow–

Very High Density – Faridabad, Panipat, Kurukshatra and Ambala;

High Density – Gurgaon, Panchkula, Sonipat, Rohtak and Yamuna Nagar;

Moderate Density – Karnal, Riwari, Mahendergarh, Jhajjar and Jind;

Low Density – Hissar and Kaithel;

Very low Density – Fatehabad, Bhiwani and Sirsa.

Characteristics of a Choropleth Map

1. Choropleth map shows different shadings. The darkness of the shade exhibits the changing scale of the value in an ascending or decending order.
2. The shade of a class / category exhibits the same values, though, the range may vary a lot.
3. The entire administrative unit considered to be uniform in terms of distribution but in reality it may not be true.
4. The administrative boundary represents a sharp divide between adjacent unit.
5. The darkest and the lowest shades may be adjacent to each other.
6. Many a time it may not be able to show the varying trends on the earth surface.
7. Pockets/Patches may appear on the map distinctively.
8. Varrying trend can be compared by preparing two sets of map of two time period.

Notes

EXERCISES FOR PRACTICAL RECORD BOOK

1. Draw a line graph showing growth of population in India from 1901-91.

Years	1901	1911	1921	1931	1941	1351	1961	1971	1981	1991
Population (in million)	23.8	25.2	25.1	27.9	31.9	36.1	43.9	54.8	68.6	84.4

2. Construct a bar diagram showing Annual Rainfall in Thiruvananthapuram.

Months	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rainfall (in mms)	22.9	20.8	38.6	105.7	207.8	356.4	223.0	145.5	137.9	273.3	205.5	74.5

3. Prepare a star diagram to represent the following data:

Direction	**No. of days the wind is blowing**
N	45
NE	110
E	25
SE	27
S	23
SW	15
W	90
NW	20
Calm days	10
Total	**365**

Notes

Feed back on Lesson 1-25

Lesson No.	Lesson Name	Was the content				Was the language		Were the Illustrations		What you have learnt is		
		Easy	Difficult	Interesting	Confusing	Simple	Complex	Useful	Not Useful	Very helpful	Somewhat helpful	Not helpful
14.												
15.												
16.												
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25.												

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