Geography of India

A Textbook for Class X

B.S. Parakh

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Foreword

'Geography of India' is a textbook in geography for Class X under the 10+2 pattern of education. It is a thoroughly revised version of the title 'India: Economic Geography' which was first brought out in 1990. Though subsequent editions of this book incorporated minor changes, a thorough revision was overdue in the light of the changes and developments taking place in every field. The present book along with its companion volume entitled 'Understanding Environment' for Class IX, is based on the geography syllabus of the secondary stage, developed by the NCERT as a follow-up of the National Policy on Education, 1986. The relevant core areas such as 'protection of environment', 'inculcation of scientific temper' and 'equality of sexes' as mentioned in the National Policy on Education and Programme of Action have been suitably integrated with the content.

Having acquired sufficient knowledge and understanding of the world patterns of human-environment interactions, the students by now are better placed to study and analyse the spatial and temporal dimensions of economic development of their own country. It should help them develop a broad perspective to understand the contemporary issues and problems rationally.

Keeping in view the broad objectives of teaching geography as part of general education, this book follows a functional approach. Emphasis has, therefore, been laid on the understanding of basic concepts and development of skills. In order to promote 'learning by doing' activities have been selected carefully, which would help the students develop necessary geographical skills such as 'reading and interpreting maps and diagrams' 'computation, visual representation and analysis of data', 'transformation of visual to verbal information and vice versa', and 'drawing inferences and conclusions'. Facts and information given in the book are to be used as means rather than ends in themselves.

The NCERT is grateful to Prof. B.S. Parakh for preparing the new revised edition of the textbook in a very short time. Our thanks are also due to Shri Sanjeev Kumar of Cartographic Services who has drawn the maps and diagrams of this book.

The Hindi version of this book has been prepared in the Department of Education in Social Sciences and Humanities by Professor Savita Sinha. Shri Md. A. Hussain and Dr. Md. Shainul Haque have helped at various stages of finalization and publication of this book. We are grateful to them for their contributions.

The NCERT would welcome comments and suggestions on any aspect of this textbook towards its improvement.

J.S. RAJPUT
Director
National Council of Educational
Research and Training

New Delhi

THE CONSTITUTION OF INDIA

PREAMBLE

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a [1][SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC] and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity;
and to promote among them all

FRATERNITY assuring the dignity of the individual and the [2][unity and integrity of the Nation];

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

1. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Sovereign Democratic Republic" (w.e.f. 3.1.1977)
2. Subs. by the Constitution (Forty-second Amendment) Act, 1976, Sec.2, for "Unity of the Nation" (w.e.f. 3.1.1977)

Part IV A
Fundamental Duties

ARTICLE 51A

Fundamental Duties – It shall be the duty of every citizen of India–

(a) to abide by the Constitution and respect its ideals and institutions, the National Flag and the National Anthem;

(b) to cherish and follow the noble ideals which inspired our national struggle for freedom;

(c) to uphold and protect the sovereignty, unity and integrity of India;

(d) to defend the country and render national service when called upon to do so;

(e) to promote harmony and the spirit of common brotherhood amongst all the people of India transcending religious, linguistic and regional or sectional diversities; to renounce practices derogatory to the dignity of women;

(f) to value and preserve the rich heritage of our composite culture;

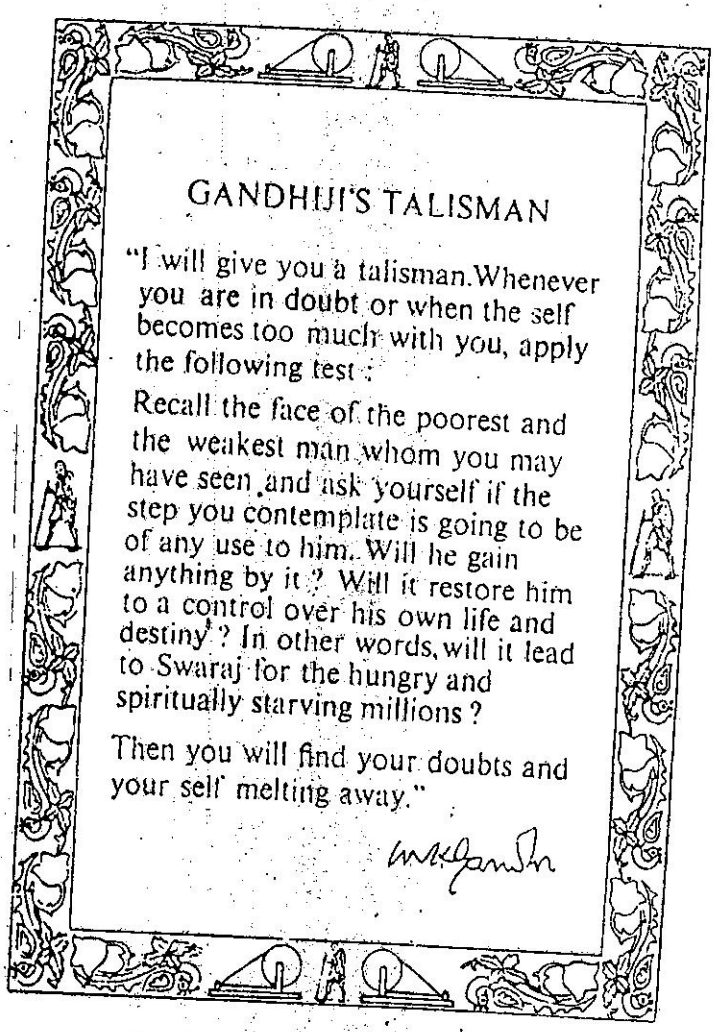
(g) to protect and improve the natural environment including forests, lakes, rivers, wild life and to have compassion for living creatures;

(h) to develop the scientific temper, humanism and the spirit of inquiry and reform;

(i) to safeguard public property and to abjure violence;

(j) to strive towards excellence in all spheres of individual and collective activity so that the nation constantly rises to higher levels of endeavour and achievement.

Contents



UNIT ONE

Physical Setting

The physical set-up of our country, namely its (i) location and size, (ii) structure and relief, and (iii) climatic conditions have to a great extent provided a basis for the growth of our civilization, our world view and some of the basic traits of the Indian psyche. This unit is divided into two chapters, 'Physical Features' and 'Climate', and provides the basic framework within which the pace and progress of Indian economy can be realistically assessed and understood.

These chapters highlight the basic unity of the Indian subcontinent in general and the Indian Union in particular. It throws light on the complementarity of physiographic divisions of India. The location and the orography of India in turn help in understanding our climate dominated by the monsoons. The entire dramatic performance of the monsoons and the climatic unity they superimpose on our diverse land is again contained within the orographic framework of Indian geography. It is against this systematic disposition of the physical set-up that the next unit enables us to understand and assess our natural resource base.

CHAPTER 1

Physical Features

Though India is a vast country covering 3.28 million sq. kms., it is a well knit political entity. This is the largest democracy in the world. It has a wide range of diversities. Under varied natural conditions, people speaking different languages, following different religions and living in rural or urban areas, live amicably side by side. This diversity in fact, is the unfailing source of its real strength. We will learn about it in the following pages.

There are many ways of learning. Among them, learning by doing is one of the best. It would provide you with a joy of learning as you draw your own inferences and conclusions. With this end in view, the work suggested here, as also in the rest of the chapters, would be found highly rewarding.

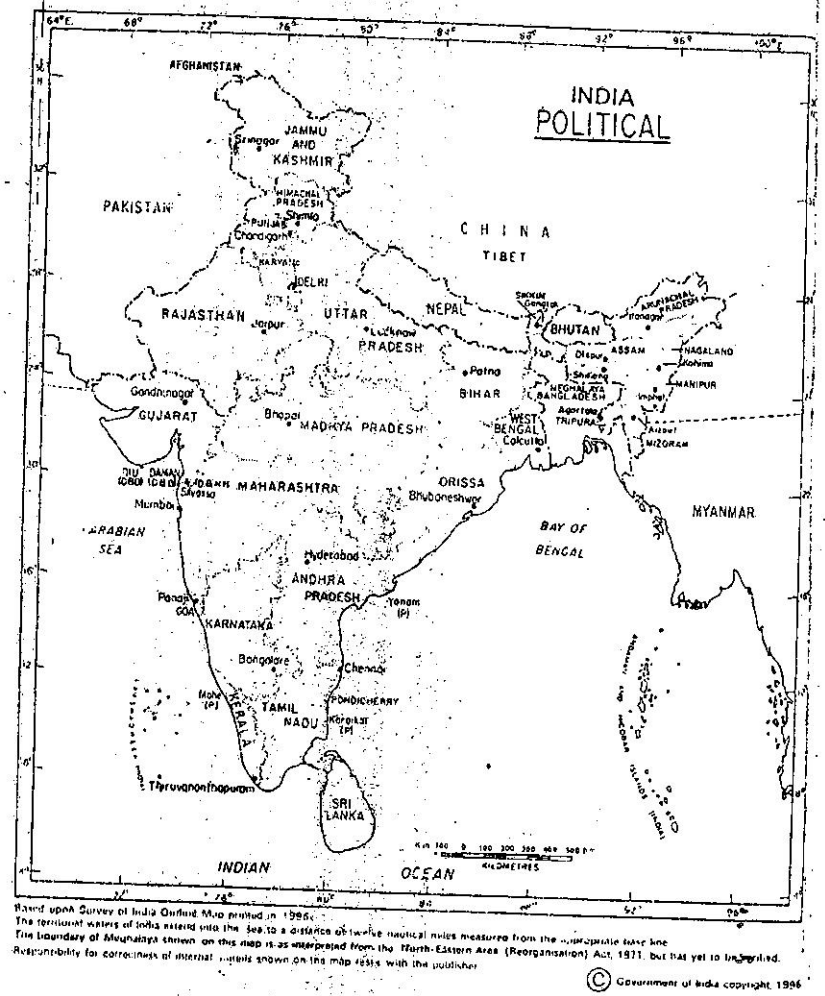
FOR DOING IT YOURSELF

You already possess a fair amount of knowledge about India. The work suggested would help you consolidate your knowledge. It will also prepare you to appreciate the text that is to follow. Comprehension of basic facts and preliminary study have been confined to the following:

(i) Location and Size, (ii) International Boundaries.

(i) Location and Size

(a) Note the degrees of latitude of the southern tip of the Indian mainland.
(b) See by how many degrees it is different from the southern most point of the Indian Union.
(c) Note down the degree of latitude of the northern extremity of India.
(d) Work out the total north-south extent of the country: (i) in degrees of latitude, and (ii) in kilometres. (The distance per degree of latitude is about 111 km.)
(e) Write down the degree of longitude of the western tip of India lying in Kachchh.
(f) Find out the degree of longitude of the eastern tip of India lying in Arunachal Pradesh.
(g) List six countries of the world bigger than India. Compare the area of India with China.



Based upon Survey of India Outline Map printed in 1986.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The boundary of Meghalaya shown on this map is as interpreted from the North-Eastern Area (Reorganisation) Act, 1971, but has yet to be demarcated.
Responsibility for correctness of internal details shown on this map rests with the publisher.

Fig. 1.1 India—Political

The Republic of India consists of 25 States and 7 Union Territories including the National Capital Territory of Delhi. How do you distinguish between State and International Boundaries?

(ii) International Boundaries

(a) Classify the States in four groups each having common frontiers with (i) Pakistan, (ii) China, (iii) Myanmar, and (iv) Bangladesh.
(b) Name the States and Union Territories from north to south situated on the Arabian Sea. See if they are seven in number.
(c) Do the same (from south to north) for those situated on the Bay of Bengal. See if they are six in number.
(d) Name the place said to be situated on three seas. Name the seas as well.
(e) Name the island groups of our country lying in the (i) Arabian Sea, and (ii) Bay of Bengal.

NOW THINK

(a) Reason out why the north-south extent of India is larger than its east-west extent even though the country's latitudinal and longitudinal extent in degrees is almost of the same value.
(b) State the time lag between the sunrise on the eastern-most and the western-most horizons of India.
(c) State the reason for selecting a standard meridian of India with an odd value of 82° 30' E. Has it anything to do with Greenwhich Time?
(d) Reason out why Ahmedabad in the west and Calcutta in the east are able to see the noon sun exactly overhead twice a year but not Delhi in the north.
(e) Reason out why the difference between the durations of day and night is hardly felt at Kanyakumari but it is not so in Kashmir.
(f) Find out why Arunachal Pradesh is a befitting name for our eastern-most state.

India on the Globe

Being situated north of the equator, India belongs to the Northern Hemisphere. The Tropic of Cancer (23° 30' N) divides the country into almost two equal parts. While the southern half coinciding with peninsular India lies in the tropical zone, The northern half, somewhat continental in nature belongs to the subtropical zone.

Situated to the east of the Prime Meridian, India also belongs to the Eastern Hemisphere. A glance at the Eastern Hemisphere is enough to realise its central position. India occupies the south central peninsula of the Asian continent, which is not only the largest but also the most populous continent of the world. Such a location has its economic advantages. In ancient times its location helped in establishing cultural and commercial contacts with the Arab world in the west and the south-east Asia and the Far East.

Look at the central location of India at the head of the Indian Ocean. Towards the west lie the countries of West Asia and Africa. Since the opening of the Suez Canal (year 1869), its distance from Europe has been reduced by 7,000 km. The countries of

The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.

Fig. 1.2 Location of India in the World

Note the favourable location of India in relation to Eurasia, Africa and Australia. What makes the third largest ocean in the world to be named after India?

south-east Asia lie to the south-east. To their north-east are located the countries of East Asia.

India is favourably situated on the world's highways of trade and commerce both to the east and the west. The oceanic routes serving East and South-east Asia and Australia pass through the Indian Ocean. India is connected with Europe, North America and South America through both the routes—the Suez and the Cape of Good Hope. We can also reach America by crossing the Pacific Ocean.

The Indian Subcontinent

A look at the relief map of Asia will immediately bring home the distinct identity of the Indian subcontinent from the rest of Asia. It is the most natural geographical unit which has developed a very distinctive culture. The bulk of it has been further conditioned by a common foreign rule of over two centuries. The countries that form the Indian subcontinent today are Pakistan in the north-west, India at the core, Nepal in the north, Bhutan in the north-east and Bangladesh in the east. India shares its land frontiers with all of them. But none of them have common border with one another. While India, Pakistan and Bangladesh are republics, Nepal and Bhutan are kingdoms. The island states of Sri Lanka, and the Maldives are our southern neighbours in the Indian Ocean.

Story of the Indian Subcontinent

The present relief features have evolved as a result of changes which have taken place over millions of years. The remains of vegetal and animal life preserved in different layers of the rocks help to determine their age. Geologists have pieced together the story of the Indian subcontinent written as it were in its rocks.

The story takes us millions and millions of years back into the geological past. The world at that time was far different from what it is today. The area now occupied by the Himalayas and the Northern Plains of India was under a sea, called 'Tethys'. It was an elongated and shallow sea sandwiched between the two giant land masses — 'the Angaraland' in the north and 'the Gondwanaland' in the south. The Tethys stretched from the present Indo-Myanmar border in the east and covered a vast area including western Asia, north-eastern and central parts of Africa before

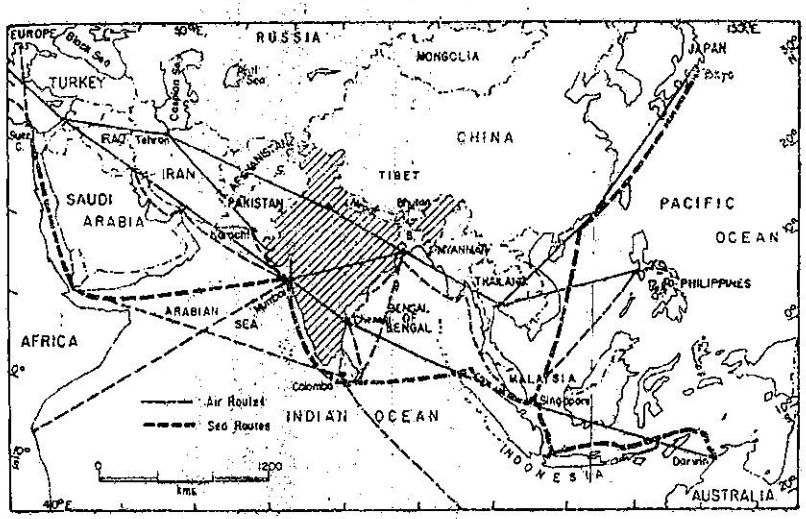


Fig. 1.3 India on the International Highway of Trade and Commerce

Note the location of India on the international trade route

it joined the south Atlantic Ocean in the Gulf of Guinea in the west. For millions of years denudation of the two land masses resulted in deposition of silt into the Tethys. These two giant land masses were slowly but steadily heading towards each other. This lateral compressional force acting from two opposite directions made the sea not only shrink further but also buckle up forming a chain of islands to begin with and over millions of years into the mighty fold mountains such as the Himalayas of today.

As the Himalayas began to gain in height, the rivers and other agents of denudation became increasingly active in eroding them, and carrying huge amounts of silt to deposit in ever-shrinking Tethys.

The result has been what we call the Northern Plains or the Indo-Gangetic plains lying in India and Pakistan. The river Brahmaputra too did the same in the north-eastern part of India and Bangladesh. If you look at the map of the Ganga-Brahmaputra delta carefully, you will get the clues to conclude that the process is still on and the land has been slowly but surely advancing, pushing the sea back.

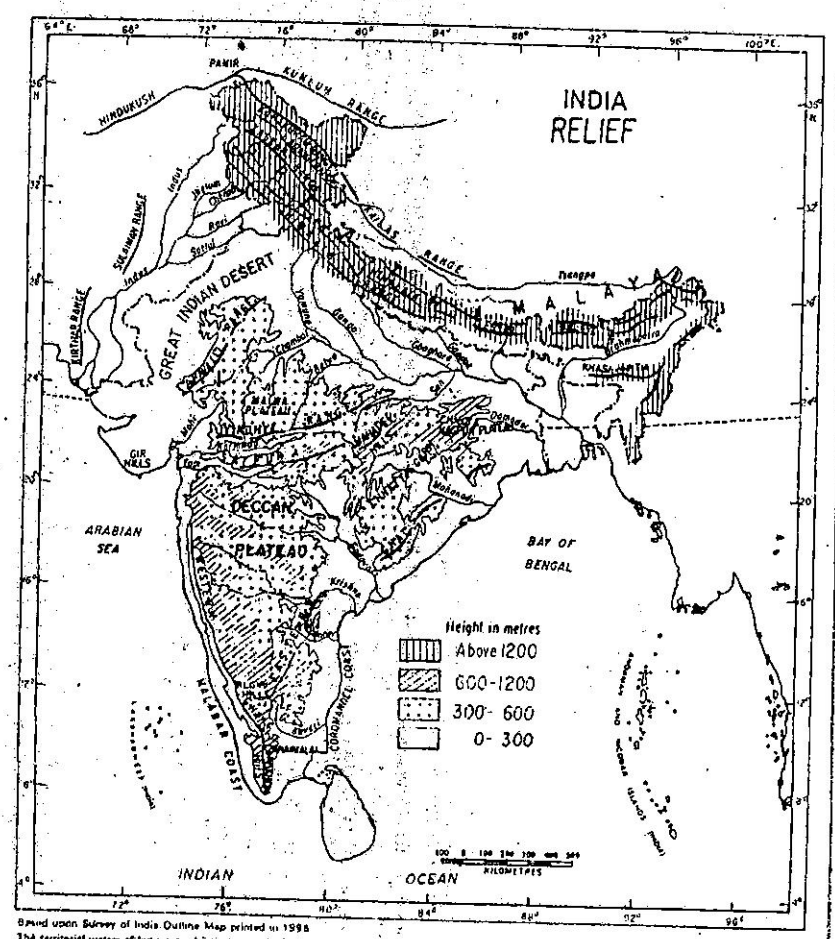


Fig. 1.4 India—Relief

Note the three major physical divisions of India. Also note the rivers draining into the Arabian sea and the Bay of Bengal Which of the two drainage areas are larger?

The Major Physiographic Divisions

The collision between the two ancient land masses has resulted in the formation of a well-integrated Indian subcontinent. It consists of diverse surface features, which may be grouped as follows: (i) the Great Mountain Wall of the North, (ii) the Northern Plains, (iii) the Great Peninsular Plateau, (iv) the Coastal Plains, and (v) the Islands.

The Great Mountain Wall of the North

In Central Asia, not far from India, lies the well-known Pamir knot. It is often called the roof of the world. From this knot run several mountain ranges. One of them is the Kunlun which moves eastwards into Tibet. Another range, i.e. the Karakoram, enters into Kashmir and runs south-east and includes the plateau of Aksai Chin. It extends further east and is known as the Kailas Range in Tibet. The Karakoram are lofty mountains containing K^2, the second highest mountain peak of the world. The Karakoram pass has now acquired special importance. There are big glaciers, i.e. extremely slow moving rivers of solid ice and snow in this part. The Baltoro and the Siachin are some of the glaciers of this area.

To the south of the Karakoram lie two parallel ranges. They are known as the Ladakh and the Zaskar ranges. Note the Indus river rising in the vicinity of the Kailas peak. It manages to cris cross the Kailas and other ranges before entering India. In Kashmir it flows between the Ladakh and the Zaskar mountain ranges from south-east to north-west.

Note the Nanga Parbat overlooking the Indus in the north The Himalayas extends from the Indus in the west to the Brahmaputra in the east. They form an arc between these two extremes, covering a distance of 2,500 km. The width of the Himalayas varies form 400 km. in the west to 150 km in the east. It is wide in Kashmir and becomes narrow towards the east. The height of the eastern half is greater than the western half.

The *Himalayas are young* fold mountains. By and large there are three distinct ranges running parallel to one another. The northern most range, known as the *Greater Himalaya* on *Himadri*, is the loftiest of all. All the high peaks of the Himalayas belong to this range. Mt. Everest or Sagarmatha is the highest peak in the world. Its height is 8,848 metres. It is located in Nepal. Kanchenjunga is the second highest peak of the Himalaya and lies in Sikkim in India. Nanga Parbat in Kashmir and Nandadevi in U.P. are the other two important peaks of the Himalaya. Namcha Barwa is an important peak (in Tibet) in the east overlooking the Brahmaputra where this range takes a sudden turn towards south to enter India.

To the south of the Greater Himalayas lies the *Middle* or *lesser Himalaya*. It is called the *Himachal*. All the important hill stations such as Dalhousie, Dharmshala, Shimla, Mussoorie, Nainital, and Darjeeling belong to this range. The Pir Panjal in Kashmir and Dhaoladhar in Jammu and Kashmir and Himachal Pradesh belong to the Middle Himalaya; so does the Mahabharat range of Nepal.

The southernmost ranges of the Himalayas are known as the *Outer Himalaya* or the *Shiwalik ranges*. This range is more prominent in the western half of the Himalaya. These are made of unconsolidated

river deposits, and are prone to earthquakes and land-slides. Soil erosion is at its worst in these youngest of the Himalayan family.

The Himalayas are also divided in east-west direction. The Himalayas in Jammu and Kashmir and Himachal Pradesh is known as *Western Himalaya*. In Uttar Pradesh and Nepal, it is known as *Central Himalaya*. In West Bengal, Sikkim, Bhutan and Arunachal Pradesh it is known as *Eastern Himalaya*.

There are important passes in the Himalayas. Shipkila is located in the Satluj valley in Himachal Pradesh. The pass in Sikkim is known as Nathula and is on the way from India to Lhasa, the capital of Tibet. Further east, the Bomdila pass lies in Arunachal Pradesh. In this age of air travel the Himalayas are no more invincible.

The Himalayas are known for some of the beautiful valleys of the world. They have become star attraction to tourists from all over the world. The Kashmir valley is a classical example. It is rightly described as 'paradise on the earth'. The other important valleys are Kulu and Kangra in Himachal Pradesh. The doons in the Kumayun Himalaya of Uttar Pradesh are also well known. All these valleys are known for fruit orchards.

Several big rivers originate from the Himalayas. They flow into the Northern

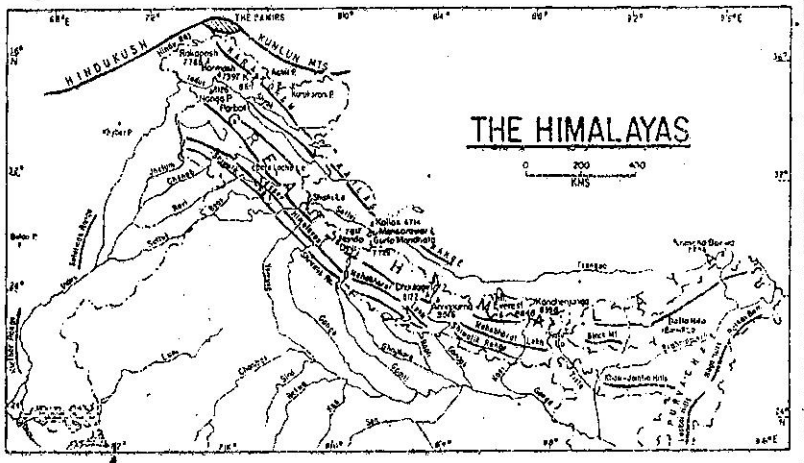


Fig. 1.5 The Himalayas

This great natural barrier between the Indian subcontinent and the rest of Asia has helped this region to grow in peace and prosperity, and develop its own distinctive culture. Do you think that the Himalayas continue to give us the same protection as before?

Plains and empty themselves either in the Arabian Sea or the Bay of Bengal. But more interesting is the fact that three major rivers of the subcontinent, the Indus, the Satluj and the Brahmaputra originate beyond the Himalayas in a region surrounding Kailas and Mansarovar in Tibet. They flow almost parallel to the Himalayan though in different directions for a long distance. Then all of a sudden, they turn to the south piercing through the Himalayan mountain chain, and emerge into the Northern Plains. It indicates that the Himalaya is not a perfect water divide. Moreover, it can be inferred that these rivers existed before the formation of *the Himalayas*. They continued cutting down their valleys faster than the rising Himalayas. As such they make huge and spectacular gorges or canyons. They are also called I-shaped valleys since the rivers on their either side have vertical walls.

As mentioned earlier, the Brahmaputra marks the eastern-most geographical limit of the Himalaya. Mountains along the eastern boundary of India are called Purvanchal. These mountains are less spectacular than the Himalaya. They are of medium height. They comprise the Patkai Bum, and the Naga Hills in the north, and the Mizo Hills in the south. At the centre, they take a westward turn along the Bangladesh-India border in Meghalaya. Here they consist of Jaintia, Khasi and Garo Hills from east to west.

The Northern Plains

The Northern Plains of India are made up of the fine silt called alluvium. It is brought down by the rivers from the Himalayas in the north and the peninsular plateau in the south. Such a plain is called an alluvial plain. If you look at the delta of the Ganga-Brahmaputra, you will find that this work of deposition is still going on. The Northern Plains are divided into two river systems—the Indus in the west and the Ganga-Brahmaputra in the east. Even on the relief map of India one can hardly notice any relief feature acting as a possible water divide between the two river systems.

THE INDUS BASIN : Less than one-third of the Indus basin is located in India (Jammu and Kashmir, Himachal Pradesh and Punjab). The Indus is about 2900 km in length. Its main tributaries are the Satluj, Beas, Ravi, Chenab and Jhelum. Look at the map to see how these rivers join together one by one before they ultimately join the Indus. The Indus plain has a very gentle slope. The plain stretches over 1200 km between the Arabian Sea in the south-west and foothills of the Western Himalaya in the north-east. Over this total distance, the overall fall of the plain is hardly 300 metres or so. The rivers have made the plain very fertile and it now possesses one of the densest networks of canals for irrigation.

THE GANGA BASIN : The Ganga has two main headwaters in the Himalaya: The Bhagirathi and the Alaknanda. Both join at Devprayag and flow as the Ganga thereafter. It enters the Northern Plains at Hardwar. The Yamuna joins it at Allahabad. The Yamuna in turn is joined by the Chambal, Sind, Betwa and Ken. They all flow through the Malwa plateau before entering into the plains. The Son is the only big river to join the Ganga directly from the southern plateau. Further east, the Damodar draining the Chotanagpur plateau joins the Hughali, a

distributary of the Ganga. The big Himalayan rivers joining the Ganga down stream of Allahabad from west to east are the *Gomati*, Ghaghara, Gandak and Kosi. The Ganga river system drains most of Haryana, southeast Rajasthan, northern Madhya Pradesh, Uttar Pradesh, Bihar and major parts of West Bengal. Ambala is located on the water divide between the Indus and the Ganga river systems. The plains from Ambala in the northwest to Sundarbans in the east stretch over nearly 1800 km. During its entire stretch from Haryana to Bangladesh, there is a fall of hardly 300 metres in its slope. The zig-zag or meandering courses of the rivers tell us how level the plains are. The length of the Ganga is over 2500 km.

THE BRAHMAPUTRA VALLEY : The Brahmaputra originates in Tibet near the source of the Indus and the Satluj. It carries a tremendous volume of water. The river is slightly longer than the Indus but most of its course lies in Tibet. It flows parallel to the Himalayan mountains in Tibet, where it is known as Tsangpo. When it takes a hairpin turn around Namcha Barwa (7757m), the undercutting done by this powerful river is of the order of 5,500 metres. Is it not unbelievable? Here and in Arunachal Pradesh it is known as Dihang. After the confluence of the Lohit, Dihang and Dibang, it is called the Brahmaputra. Besides a great volume of water, it also carries huge amount of silt with it. In northern Bangladesh it is known as Jamuna. In the central part after meeting the Ganga, it is called Padma. Further south, the Meghna meets the main stream and the joint stream is also called Meghna.

THE GANGA-BRAHMAPUTRA DELTA : It is the largest and the fastest growing delta of the world. Besides being well-watered, it is also the most fertile. The Ganga and the Brahmaputra split into numerous distributaries in their lower courses. Due to the gentle slope or gradient, the rivers become sluggish, and islands of silt and mud develop in their channel. To circumvent these obstructions, the rivers tend to split into a number of channels. The process is repeated several times to develop a classical delta. The lower part of the delta becomes marshy where fresh water and sea water get mingled owing to high and low tides.

The Great Peninsular Plateau

After studying of the young and folded mountains of the north and a much younger plains to their south, we move further south. It is the oldest structure of the Indian subcontinent. In fact, the slow but steady movement of this landmass towards north and north-east has been responsible for the creation of the *Himalayas* and the Northern Plains in place of the Tethys of geological times. The peninsular plateau is subdivided into the Central Highlands and the Deccan Plateau.

THE CENTRAL HIGHLANDS : The northern part of the peninsular block is called the Central Highlands although they are not really high. It is made of hard igneous and metamorphic rocks. The block consists of two parts demarcated by the west-flowing Narmada. The one lying to the north is bounded by the Vindhyas and its eastern extensions on one side. In the north-west it is flanked by the Aravallis. The plateau extends further west but is covered by the

Fig. 1.6 Peninsular India

Note the triangular shape of the peninsular block. Name the three hill ranges between which the rivers Narmada and Tapi flow. List the major peaks of the region.

sandy and rocky desert of Rajasthan. These are very old fold mountains. On the third side, this plateau merges gradually in the Gangetic Plains of the north. This is known as the *Malwa Plateau*. It is fairly wide in the west and goes on tapering in the east. Its eastern part is known as *Bundelkhand* and *Baghelkhand* in southern Uttar Pradesh. In South Bihar it is known as *Chhotanagpur plateau*. The southern tributaries of the Yamuna and the Ganga drain the plateau.

THE DECCAN PLATEAU : The Deccan Plateau extends from the Vindhyas to the southern tip of the peninsula. This triangular plateau is at its widest in the north. The Vindhyan Range and its eastern extensions namely Mahadev Hills, Kaimur Hills and Maikal Range from its northern edge. Towards the west, the plateau has still much steeper edge, formed by the Western Ghats. This mountain range runs from north to south almost parallel to the Arabian Sea. The Western Ghats are known by different local names. In Maharashtra and Karnataka they are called Sahyadri. Further south, they are called the Nilgiris in Tamil Nadu. Still further south, along the Kerala and Tamil Nadu border, they are known as Anaimalai and Cardamom Hills. The Deccan Plateau is the highest along its western edge and gently slopes towards the Bay of Bengal in the east. The Western Ghats are relatively higher in their southern part. The Anai Mudi, the highest peak, is 2,695 metres above the sea level. Udagamandalam is a well known hill station of the south located in Tamil Nadu.

Unlike the western edge, the eastern limit of the Deccan plateau is less sharp. It is in fact widely broken into small hills by the rivers such as the Mahanadi, Godavari, Krishna and Kaveri. The Eastern Ghats are locally known by different names.

The north-west part of the Deccan Plateau merits special mention. It is made up of igneous rocks of volcanic origin. From the earth's highly turbulent interior, lava oozed out through huge cracks or fissures in the earth's crust. It took millions of years and it is estimated that the volume of the lava flow exceeded the volume of the Himalayas. Geologists believe that this activity was closely associated with the birth of the Himalayas.

While all the major rivers of the peninsular block flow into the Bay of Bengal, the Narmada and Tapi are the only two rivers flowing in the opposite direction to fall in the Arabian sea. These long rivers flow through very narrow elongated valleys. The Narmada valley is bounded by the Vindhyas on the north and the Satpuras in the south. To the south of the Satpura lies the Tapi river. These two rivers alleys are said to be old rift valleys. The two rivers join the sea through narrow estuaries.

The Coastal Plains

The Deccan plateau has a coastal strip in the east and the west. The west coastal plain extends form Gujarat to Kerala. The coastal strip along the Arabian Sea in the west is known as Konkan in the north and Malabar in the south of Goa. There are several estuaries—the major ones being those of the Narmada and Tapi in Gujarat. It is blessed with deep natural harbours like Mumbai and Marmagao. In the south, the coast is studded with salt water lakes called *lagoons*. There are also sand bars or spits at their mouths. The coast is known for its placid backwaters. The coastal strip along the Bay of Bengal is broad and more level unlike the western strip. Locate and name the four deltas on the east coast. The coastal strip, but for the deltas, is rocky and highly dissected by small but fast flowing rivers.

The Indian Islands

Lakshadweep Islands, lying opposite to the coast of Kerala, are small but numerous. They are the product of a very quiet work of the short-lived microscopic species—the coral polyps. They flourish only in shallow, warm and mudfree waters. Many islands are generally ring or horse-shoe shaped and are called *atolls*. The Andaman Nicobar Islands, on the other hand, are bigger in size and more numerous. They are of strategic importance to the Indian mainland. They are located on a submerged hilly range in the Bay of Bengal. Some of them are of volcanic origin. The only active volcano of India is located on the Barren Island of this group.

Physiographic divisions of India described above are complementary to each other. The peninsula is the stable block with ample building material. It is a store house of minerals providing base for heavy industry. The northern mountains are the major source of water, and girdle the subcontinent for thousands of kilometres. The Northern Plains are densely populated and act as a granary of India. The partially enclosed character of the subcontinent has helped in strengthening the forces of homogeneity of our people.

EXERCISES

Review Questions

1. Answer the following questions briefly :
   (i) Which countries constitute the Indian subcontinent?
   (ii) How can we determine the age of rocks?
   (iii) Why are the Himalayas called the young fold mountains?
   (iv) Name mountain ranges of the Puravanchal.
   (v) Which river systems constitute the Northern Plains?
   (vi) Name the oldest landmass of the Indian subcontinent.
2. Distinguish between :
   (i) A Delta and an Estuary
   (ii) Western Ghats and Eastern Ghats
   (iii) Western Himalaya and Eastern Himalaya.
3. Give one term for each of the following:
   (i) An elongated and shallow sea of geological times, sandwiched between the two ancient landmasses
   (ii) Slow-moving rivers of ice and snow

(iii) Any gap in a mountain range providing a natural route across
(iv) An I-shaped valley having vertical walls on either side of the river
(v) Flat low-lying lands made of the alluvium.

4. Describe briefly the formation of the Northern Plains.
5. Give an account of the Deccan plateau.
6. Name the major physiographic divisions of India. Write a brief account of the coastal plains and the island groups of India.

Map Work

7. On an outline map of India show the following :
   (i) An important peak of the Karakoram
   (ii) The Zaskar and the Kailas Ranges
   (iii) The highest peak of the Himalayas in India
   (iv) Nathula and Bomdila passes
   (v) The Indus, the Ganga and the Brahmaputra
   (vi) The Chhotanagpur plateau
   (vii) The Nilgiri mountains.

CHAPTER 2

Climate

India has diverse climatic conditions. There are sharp variations in temperature and precipitation from place to place and season to season. While in summer, the mercury occasionally touches 55°C in the western deserts, it drops down to as low as –45°C in winter around Leh. If we take only a single place and confine to temperature recordings for just twenty-four hours, variations are not less striking. In Kerala and in the Andaman Islands the difference between day and night temperatures may be hardly seven or eight degrees Celsius. But in the Thar desert, if the day temperature is around 50°C, at night it may drop down very close to the freezing point. While snowfall occurs in the Himalayas, it only rains over the rest of the country. Similarly, variations are noticeable not only in the type of precipitation but also in its amount. While the annual precipitation is less than 10 cm in north-west Himalayas and the western desert, it exceeds 400 cm in Meghalaya.

What Makes Our Climate

It is true that the determinants of climate go much beyond human-made political boundaries. Many of the factors and phenomena governing the climate of India transgress its four walls namely, (i) situation, (ii) relief, (iii) surface winds, and (iv) upper air circulation.

The Locational and Relief Factors

Situated roughly between 8°N and 37°N latitudes, India is divided in almost two equal parts by the Tropic of Cancer. It runs east-west just half way through the country.

See how India is flanked by the Indian Ocean in the south and girdled by a high and continuous mountain wall in the north. Such a compact physical setting lends it a broad common climatic framework. Also, note the deep arms of the Indian Ocean, namely the Arabian Sea and the Bay of Bengal. They exert moderating influence on much of the Indian subcontinent. More importantly they act as a storehouse of badly needed moisture to this water thirsty landmass.

The mighty Himalaya along with its extensions acts as an effective climatic divide. The towering mountain chain provides an invincible shield to protect the subcontinent from the northern winds. These cold and chilly winds originate near the Arctic Circle and blow across Central and Eastern Asia. Thus the northern mountain wall is responsible for giving the whole of northern India a tropical touch. Relatively high temperatures almost throughout the year and predominantly dry winters are the two characteristic features of a topical climate. Barring the periphery, the Indian subcontinent does exhibit these two dominant characteristics.

FOR DOING IT YOURSELF

1. In Table 2.1 the average mean monthly temperatures and amounts of rainfall of ten representative stations have been given. It is for you to study on your own and convert them into 'temperature and rainfall' graphs. A glance at these visual representations will help you to grasp instantly the similarities and differences between

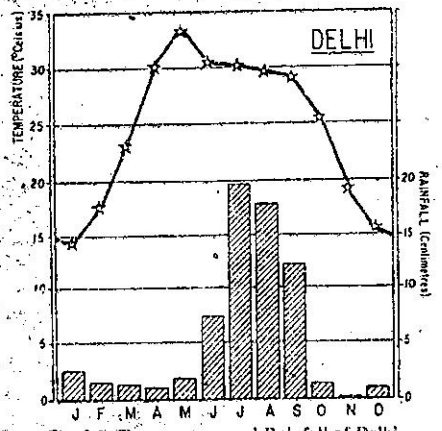


Fig. 2.1 Temperature and Rainfall of Delhi

Note the annual range of temperature and the rainfall. What kind of climate does this indicate?

them. One such graph (Fig. 2.1) is already prepared for you. See if you can arrive at some broad generalisations about our diverse climatic conditions. We hope you are in for a great joy of learning. Do the following activities.

TABLE 2.1

Temperature and Rainfall Data of a few Stations in India

Temperature : Mean monthly in Celsius; *Rainfall* : Average rain in Centimetres

Stations	*Latitude*	*Altitude (Metres)*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May*	*Jun.*	*Jul.*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual Rainfall*
Bangalore	12°58'N	909													
Temperature (Temp.) °C			20.5	22.7	25.2	27.1	26.7	24.2	23.0	23.0	23.1	22.9	18.9	20.2	
Rainfall (RF)	cm		0.7	0.9	1.1	4.5	10.7	7.1	11.1	13.7	16.4	15.3	6.1	1.5	98.0
Mumbai	19°N	11													
(Temp.) °C			24.4	24.4	26.7	28.3	30.0	28.9	27.2	27.2	27.2	27.8	27.2	25.0	
(RF) cm			0.2	0.2	-	-	1.8	50.6	61.0	36.9	26.9	4.8	1.0	-	183.4

Calcutta	(Temp.) °C		19.6	22.0	27.1	30.1	30.4	29.9	28.9	28.7	28.9	27.6	23.4	19.5	
22°34' N	6														
(RF) cm			1.2	2.8	3.4	5.1	13.4	29.0	33.1	33.4	25.3	12.7	2.7	0.4	162.5
Delhi	(Temp.) °C		14.4	16.1	23.3	30.0	33.3	33.3	30.0	29.4	28.9	25.6	19.4	15.6	
29°N	219														
(RF) Cm			2.5	1.5	1.3	1.0	1.8	7.4	19.3	17.8	11.9	1.3	0.2	1.0	67.0
Jodhpur	(Temp.) °C		16.8	19.2	26.6	29.8	33.3	33.9	31.3	29.0	20.1	27.0	20.1	14.9	
26°18'N	224														
(RF) cm			0.5	0.6	0.3	0.3	1.0	3.1	10.8	13.1	5.7	0.8	0.2	0.2	36.6
Chennai	(Temp.) °C		24.5	25.7	27.7	30.4	33.0	32.5	31.0	30.2	29.8	28.0	25.9	24.7	
13°4'N	7														
(RF) cm			4.6	1.3	1.3	1.8	3.8	4.5	8.7	11.3	11.9	30.6	35.0	13.9	128.6
Nagpur	(Temp.) °C		21.5	23.9	28.3	32.7	35.5	32.0	27.7	27.3	27.9	26.7	23.1	20.7	
21°9'N	312														
(RF) cm			1.1	2.3	1.7	1.6	2.1	22.2	37.6	28.6	18.5	5.5	2.0	1.0	124.2
Shillong	(Temp.) °C		9.8	11.3	15.9	18.5	19.2	20.5	21.1	20.9	20.0	17.2	13.3	10.4	
24°34'N	1461														
(RF) cm			1.4	2.9	5.6	14.6	29.5	47.6	35.9	34.3	30.2	18.8	3.8	0.6	225.3
Thiruvananthapuram	(Temp.) °C		26.7	27.3	28.3	28.7	28.6	26.6	26.2	26.2	26.5	26.7	26.6	26.5	
8°29'N	61														
(RF) cm			2.3	2.1	3.7	10.6	20.8	35.6	22.3	14.6	13.8	27.3	20.6	7.5	181.2
Leh	(Temp.) °C		-8.5	-7.2	-0.6	6.1	10.0	14.4	17.2	16.1	12.2	6.1	0.0	-5.6	
34°N	3506														
(RF) cm			1.0	0.8	0.8	0.5	0.5	0.5	1.3	1.3	0.8	0.5	-	0.5	8.5

2. Rearrange the ten stations in three different sequences:
   (i) According to their distance from the equator
   (ii) According to their altitude above mean sea level
   (iii) According to their distance form the nearest sea.

	First	*Second*

3. (i) Name two rainiest stations.
   (ii) Name two driest stations.
   (iii) Two stations with most equable climate.
   (iv) Two stations with most extreme climate.
   (v) Two stations most influenced by the Arabian branch of SW monsoons.
   (vi) Two stations most influenced by the Bay of Bengal branch of SW monsoons.
   (vii) Two stations influenced by both branches of the SW monsoons.

(viii) Two stations influenced by retreating and north-east monsoons.

(ix) Two stations receiving winter showers from the western disturbances.

(x) Two most rainy months for India as a whole.

(xi) The two hottest stations in the months of

(a) February

(b) April

(c) May

(d) June

4. Now Find Out

(i) Why are Thiruvananthapuram and Shillong rainier in June than in July?

(ii) Why is July rainier in Mumbai than in Thiruvananthapuram?

(iii) Why are south-west monsoons less rainy in Chennai?

(iv) Why is Shillong rainier than Calcutta?

(v) Why is Calcutta rainier in July than in June unlike Shillong which is rainier in June than in July?

(vi) Why does Delhi receive more rain than Jodhpur?

5. Now Think Why?

Thiruvananthapuram has equable climate.

Chennai has more rains only after the fury of monsoon is over in most parts of the country.

Jodhpur has a hot desert type of climate.

Leh has moderate precipitation almost throughout the year.

While in Delhi and Jodhpur most of the rain is confined to nearly three months, in Thiruvananthapuram and Shillong it is almost nine months of the year.

In spite of these facts see carefully if there are strong evidences to conclude that the monsoons still provide a very strong framework lending overall climatic unity to the whole country.

The Surface Winds and Air Circulation

Look at the world map of the pressure belts and planetary winds. Notice that India lies in the area of land bearing winds originating from the subtropical high pressure belts. By and large they are moistureless winds. But for the phenomenon of the monsoons, India would have been an arid land or a desert.

The subtropical high pressure belt of the northern hemisphere gives rise to permanent winds. They blow towards the equatorial low pressure belt. While moving towards the south they deflect towards the right i.e. to their west. As a result they blow from north-east to south-west. This is why these permanent winds are known as the north-east trade winds. The German word 'trade' means 'track' and stands for 'blowing steadily in the same direction and in a constant course'. India thus lies in the belt of the north-east trades devoid of any moisture. This is however, only half the story of the Indian climatic phenomenon. Let us find out the other half.

The air pressure does increase by piling of air descending from above. But it is also a function of air temperature. The land and water bodies do not get heated exactly alike. In summer the land gets more heated than the seas. Hence a low pressure develops over the interior of the land masses. This phenomenon is basically responsible for the reversal of wind direction giving rise to the south-west monsoons.

Air currents differ from winds as they are at a very high elevation from the earth's surface. The climate of India is also affected by the movement of jet streams. A jet stream blows fast in a narrow zone in the upper atmosphere. A westerly jet stream in lower stratosphere is placed south of the Himalaya in the winter season. In June, it moves northwards to place itself north of the Tien Shan in Central Asia. In its place an easterly jet stream develops at about 25°N. Low pressure and newly developed jet stream are responsible for sudden outbreak of the monsoons in northern India. Cooling effect of the easterly jet stream causes rain from maritime clouds already hovering over this part. The unstable equatorial oceanic air is able to form rain-bearing dark clouds often up to an elevation of 9 to 15 km high up into the sky. This explains the occurrence of widespread storms, thunders and great advance of monsoons all over India often in just eight to ten days.

The Mechanism of Monsoons

The word monsoon, as is well known, has been derived from an Arabic word 'mausim' which literally means season. The word monsoon, therefore, denotes a season in which the wind regime is completely reversed. The moist monsoon winds, after crossing the equator in the Indian ocean, acquire southwesterly direction as they area attracted towards the low pressure are in Northwest India and Central Myanmar. The dry and hot land-bearing trades are thus completely replaced by sea-bearing winds full of moisture. Based on the difference between tropical continental air and equatorial maritime air, the meteorologists' definition of the monsoons is very simple. According to them it is a complete replacement of the dry hot air by the equatorial maritime air up to an altitude of three to five kilometres over the land and water surface.

The phenomenon of the monsoons is certainly very old, but its exact nature and cause are being discovered only recently. The real breakthrough has come when it was studied at the global rather than regional level. By and large this phenomenon is confined to tropical lands lying between 20°N and 20°S. But in the Indian subcontinent it is greatly influenced by the Himalayan ranges bringing the whole subcontinent un-

der the sway of these moist equatorial winds for a season ranging between two to five months. It accounts for 75 to 90 per cent of the annual rainfall just from June to September.

The nature and mechanism of the monsoons is understood with the help of meteorological data which are collected form stations on land, ships in the oceans and from upper air. It was originally thought that monsoon was a phenomenon of surface winds. It is now known that upper air currents also play an important role in the mechanism of the monsoon.

It has also been found that the intensity of monsoons can be broadly predicted by measuring the difference in pressure between Tahiti (roughly 18°S and 149°W) in French Polynesia in east Pacific and Port Darwin (12°30'S and 131°E) in Northern Territory of Australia in the Indian Ocean southeast of Indonesia.

Cycle of Seasons

The climatic conditions of India can best be described in terms of an annual cycle of seasons. Four main seasons may be distinguished. These are:
(1) Cold weather season; (2) Hot weather season; (3) Advancing monsoon season; and (4) Retreating monsoon season.

The Cold Weather Season

December, January and February are the winter months almost all over the country. During this season high pressure prevails over the Northern Plains. During this season north-east trade winds prevail over the country. They blow from the land to the sea over most part of the country; and hence the dry season. The temperature goes on decreasing from south to north. While January mean temperatures in Chennai and Calicut are 24°-25°C, they are between 10°C and 15°C in the Northern Plains. The days are generally warm and the nights are cold. Slight frost is not uncommon in places at high altitudes.

In the northern part of the country a feeble high pressure area is developed. Light winds with a low velocity of about 3 to 5 kilometres per hour begin to blow outwards. By and large the topography of the region influences the wind direction. They are westerly or north-westerly down the Ganga Valley. They become northerly in the Ganga-Brahmaputra delta. Free from the influence of topography they are clearly north-easterly over the Bay of Bengal.

The weather is fine and really delightful. It is borne out by the facts such as clear skies, low temperatures and humidity, cool breeze and rainless days.

The fine weather conditions, however, at intervals get disturbed by shallow cyclonic depressions. Also known as western disturbances, they originate over the east Mediterranean Sea and travel eastwards across west Asia, Iran-Afghanistan and Pakistan before they reach the north-western parts of this country. On their way, their moisture content gets augmented form the Caspian Sea in the north and the Persian Gulf in the south.

These Western Disturbances cause in their wake light rainfall. Although the amount is meagre, it is highly beneficial to the rabi crops especially the wheat. The precipitation is in the form of light rains in the plains and heavy snowfall in the western Himalayas. It is this snow that sustains the flow of water in the Himalayan rivers during summer months. The precipitation goes on decreasing from west to east in the plains and from north to south in the mountains.

These Western Disturbances are generally preceded by warm weather or sudden rise in temperatures. The rainfall brought by the Western Disturbances spreads over a couple of days, which is followed by clear skies and drop in temperatures. Occasionally drop in temperature is 5 or more degrees from the normal, causing cold waves.

The only part of India benefitting from the north-east trade winds lies in the far south namely Tamil Nadu. For instance Chennai gets fair amount of rainfall from these winds.

In the Indian context these winds are popularly known as north-east monsoons.

The Hot Weather Season

From March to May the belt of great heat shifts from south to north owing to the apparent northward movement of the sun. In March, the highest day temperatures are found in the Deccan plateau. They are around 38°C. In April, the heat belt moves further north to Gujarat and Madhya Pradesh where they are around 42° to 43°C. In May, the heat belt moves further north. In the north-western part of the country, temperatures around 48°C are not uncommon.

The summer months are a period of rising temperature and falling air pressure in the northern half of the country. Towards the end of May an elongated low pressure area is developed. It is called the monsoon low pressure trough. It extends from the Thar Desert in the north-west to Patna and Chotanagpur plateau in the east-southeast. Circulation of air begins to set in around this trough.

In the heart of the low pressure trough in the north-west, the dry and hot winds blow in the afternoon and very often they continue even up to midnight. These hot and dry day winds are locally known as *loo*. Direct exposure to these scorching winds may prove fatal at least in some cases. Dust storms in the evening are very common during May in Punjab, Haryana, eastern Rajasthan and Uttar Pradesh. Temporary though, they bring a welcome respite from the oppressing heat since they bring with them light rains and pleasant cool breeze.

Occasionally, the moisture-laden winds are attracted towards the periphery of the trough. A sudden contact between dry and moist air-masses gives rise to local storms of great intensity. These local storms are associated with violent winds, torrential rains and even hail storms.

Towards the close of summer, premonsoon showers are a common phenomenon in Kerala and the coastal areas of Karnataka. Locally they are known as mango showers since they help in the early ripening of mangoes. Incursions of the premonsoon showers and early advance of monsoons further north is checked by a belt of relatively high air pressure lying over the Deccan plateau.

The dreaded north-westerly and northerly winds in Bengal and Assam also cause very sharp showers. They are essentially evening thunder storms. Their notorious nature can be understood from the local

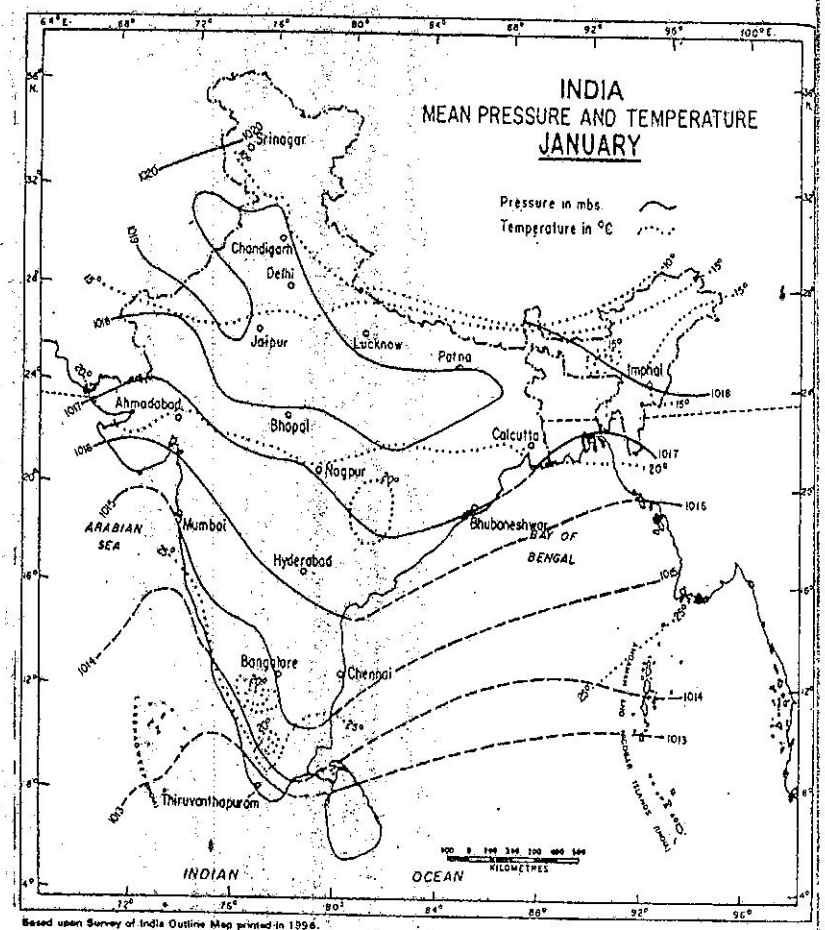


Fig. 2.2 India—Mean Pressure and Temperature (January)

In what parts do you see the highest and the lowest mean temperature? Note the high and low pressure areas. What do they indicate? Compare this map with Fig. 2.3.

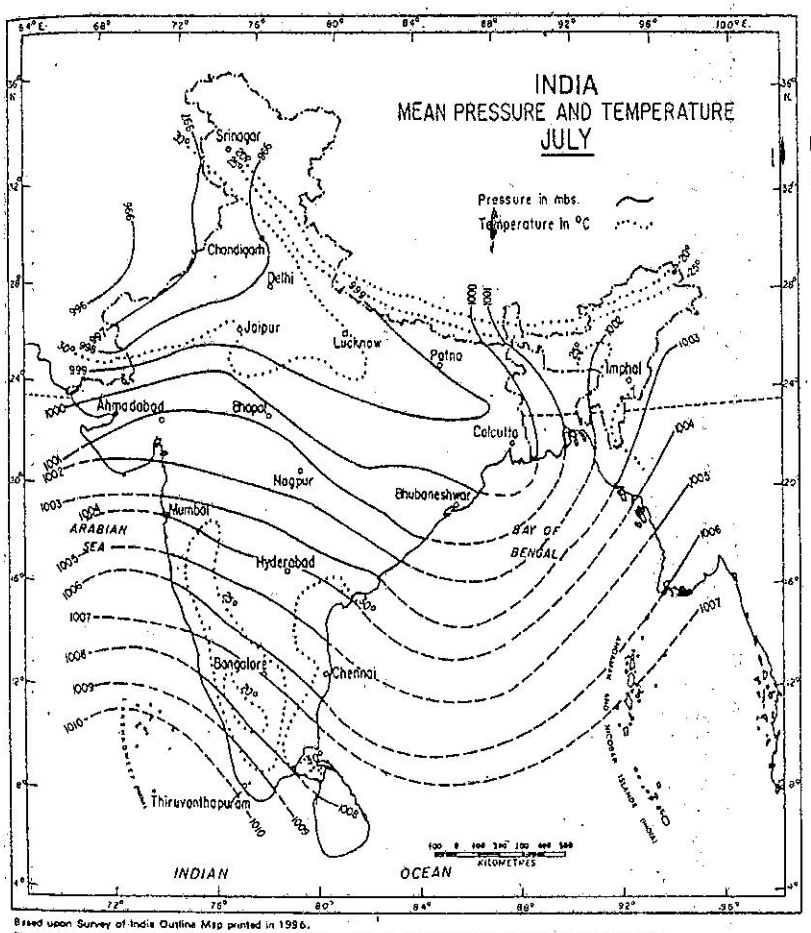


Fig. 2.3 India—Mean Pressure and Temperature (July)

Note the monsoon trough of low pressure extending from the Thar Desert to the head of the Bay of Bengal. Why is the climate of north-western India described as continental or of the extreme type?

nomenclature of *Kalbaisakhi*—Calamity of the month of *Baisakh*.

Advancing Monsoon

The four months namely June, July, August and September form the core of the rainy season almost all over the country. This duration of the rainy season, however, goes on decreasing from south to north and from east to west. In the extreme north-west it is barely two months. Between three-fourths and nine-tenths of the total rainfall is concentrated over this period. This may give us an idea of how unevenly it is distributed over the year.

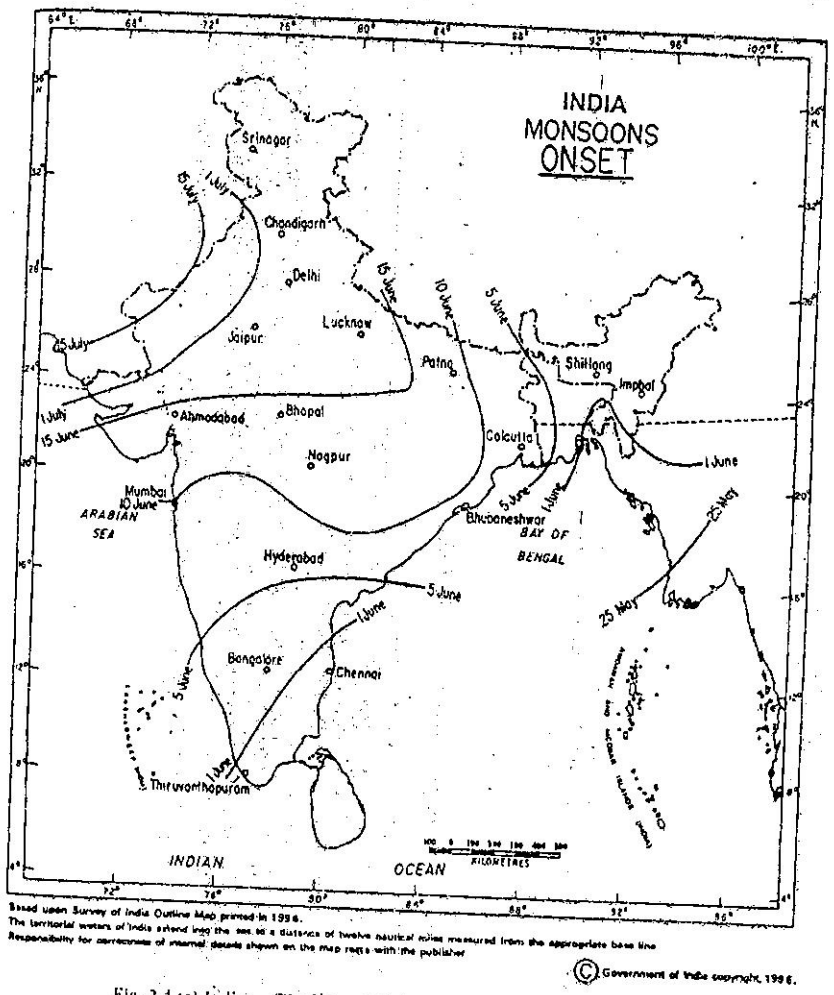
The low pressure conditions over the north-western plains get further intensified. By early June they are powerful enough to attract the trade winds of Southern Hemisphere. These south-east trade winds are of oceanic origin. Coming from the Indian Ocean they cross the equator and enter the Bay of Bengal and the Arabian Sea, only to be caught up in the air circulation over India. Passing over the equatorial warm currents they bring with them moisture in abundance. After crossing the equator they follow a south-westerly direction. This is why they are known as south-west monsoons. Thus the north-east trades of winter, originating on the land are replaced by diametrically opposite south-west monsoons laden with moisture. The monsoons unlike the trades are not steady winds. They are essentially pulsating in nature.

The rain-bearing winds are strong. They blow at an average speed of 30 km per hour. Barring the extreme north-west they overrun the country in a month's time. The sudden approach of the moisture-laden winds is associated with violent thunder the lightning. This is known as "break" or "burst" of the monsoons.

It is of interest to note that these monsoon winds follow a south-westerly direction. But as they approach the land their direction is modified by the relief and thermal low pressure over north-west India. To begin with, the Indian Peninsula divides the monsoons into two branches. They are the Arabian Sea branch and the Bay of Bengal branch.

The Arabian Sea branch of the monsoons is obstructed by the Western Ghats. The windward side of the Sahyadris receive very heavy rains. Crossing the Ghats they overrun the Deccan plateau and Madhya Pradesh causing fair amount of rainfall. Thereafter they enter the Ganga Plains and mingle with the Bay of Bengal branch. Another part of the Arabian Sea branch strikes the Saurashtra peninsula and the Kachchh. It then passes over west Rajasthan and along the Aravallis, causing only a scanty rainfall. In Punjab and Haryana, it too joins the Bay of Bengal branch. These two branches, reinforced by each other cause rains in the Western Himalayas.

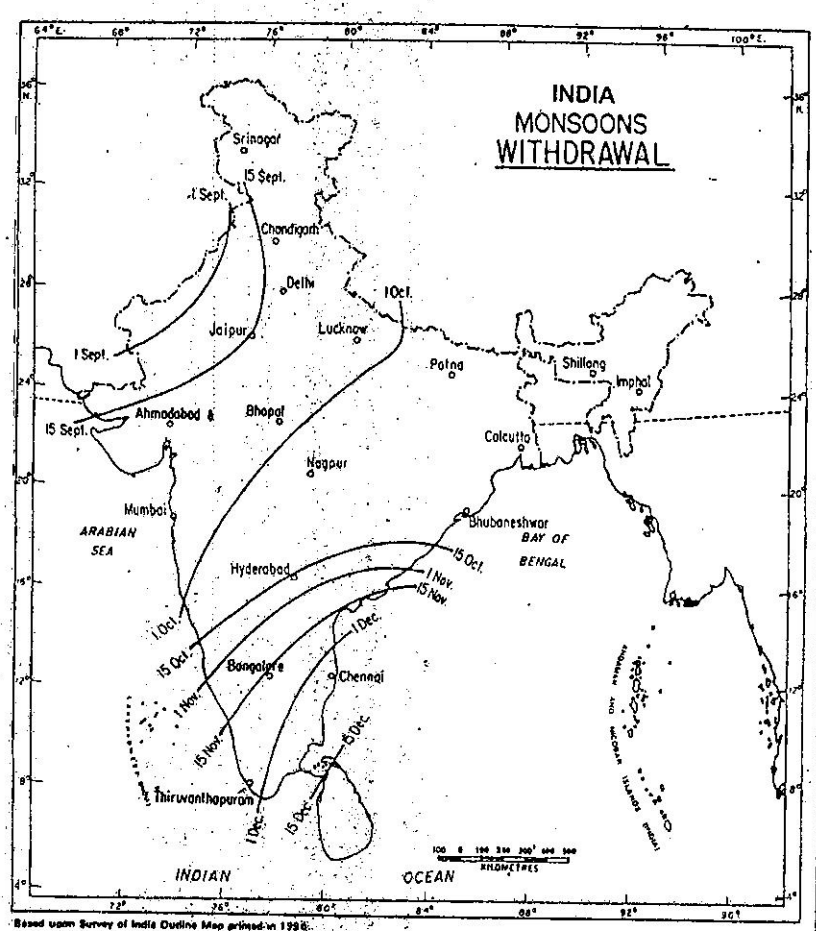
The Bay of Bengal branch is naturally directed towards the coast of Myanmar and part of the south-east Bangladesh. But the Arakan Hills along the coast of Myanmar are good enough to deflect a big chunk of this branch, enabling it to enter the Indian subcontinent. The monsoons, therefore, enter West Bengal and Bangladesh from south and south-east instead of the south westerly direction. Thereafter this branch splits into two under the influence of the mighty Himalayas and the thermal low in North



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
Responsibility for correctness of internal details shown on the map rests with the publisher

Fig. 2.4 (a) India — The Normal Dates for the Onset of the Monsoons

Note the dates when the monsoons enter Kerala and reach the western part of Rajasthan. You will notice that it takes about one and a half months to cover the whole country.



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
Responsibility for correctness of internal details shown on this map rests with the publisher.

Fig. 2.4 (b) India—The Normal Dates for the Withdrawal of the Monsoons

Compare the two maps 2.4 (a) and (b). Find out the duration of the south-west monsoon rainy season in Punjab, Assam, Kerala, Gujarat and the coastal areas of Tamil Nadu.

west India. One branch moves westward along the Ganga plains reaching as far as the Punjab plains. The other branch moves up the Brahmaputra valley in the north and northeast causing widespread rains in the Northeastern India. Its sub-branch strikes the Garo and Khasi Hills of Meghalaya. Mawsynram, located on the crest of the southern range of Khasi Hills, receives the highest average annual rainfall in the world. Cherrapunji, located 16 km east of Mawsynram holds some other rainfall records.

Distribution of rainfall received from south-west monsoons is very largely governed by the relief or orography. For instance, the windward side of the Western Ghats registers a rainfall of over 250 centimetres. On the other hand, the leeward side of these Ghats is hardly able to receive 50 centimetres. Again the heavy rainfall in the north-eastern states can be attributed to their hilly ranges and the Eastern Himalayas. The rainfall in the Northern Plains goes on decreasing from east to west. During this particular season Calcutta receives about 120 centimetres, Patna 102 cm, Allahabad 91 cm and Delhi 56 cm.

The monsoon rains occur in wet spells of few days duration at a time. The wet spells are interspersed with rainless intervals. This pulsating nature of the monsoon is attributed to the cyclonic depressions mainly formed at the head of the Bay of Bengal, and their crossing into the mainland. Besides the frequency and intensity of these depressions, the passage followed by them determines the spatial distribution of rainfall. The passage is always along the axis of the "monsoon trough of the low pressure". For various reasons the trough and its axis keep on moving northward or southward. For a fair amount of rainfall in the Northern Plains it is necessary that for the most part the axis of the monsoon trough should lie in the plains. On the other hand, whenever the axis shifts close to the Himalayas there are longer dry spells in the plains, and widespread rains in the mountainous catchment areas of the Himalayan rivers. These heavy rains bring in their wake devastating floods causing great damage to life and property in the plains.

The monsoons are known for their vagaries and uncertainties. The alternation of dry and wet spells keeps on varying in intensity, frequency and in duration. On the one hand if they cause heavy floods in one part, they may be responsible for droughts in the other. They are often found irregular and unpunctual in their arrival as well as retreat, dislocating the entire farming schedule of the millions and millions of farmers.

Retreating Monsoon

The months of October and November are known for the retreating monsoons. During this season, the monsoon trough of low pressure becomes weaker and is gradually replaced by high pressure. This results in the retreat of the monsoon. The out-reach of the monsoons begins to become unsustainable. Their sway over the Indian land-mass begins to shrink. By the beginning of October they withdraw from the Northern Plains.

The months of October-November form a period of transition from a hot rainy season to dry winter conditions. The retreat of the monsoons is marked by clear skies and

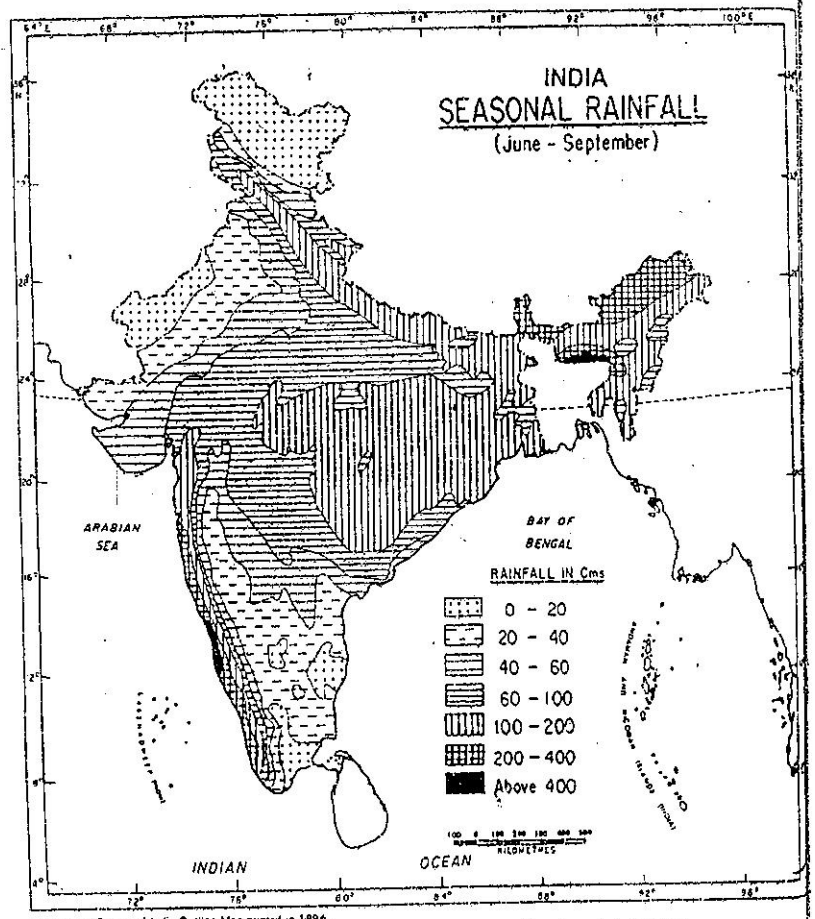


Fig. 2.5 India—Seasonal Rainfall (June to September)

Note the areas of high, medium and low rainfall. Which parts of India have low rainfall and why?

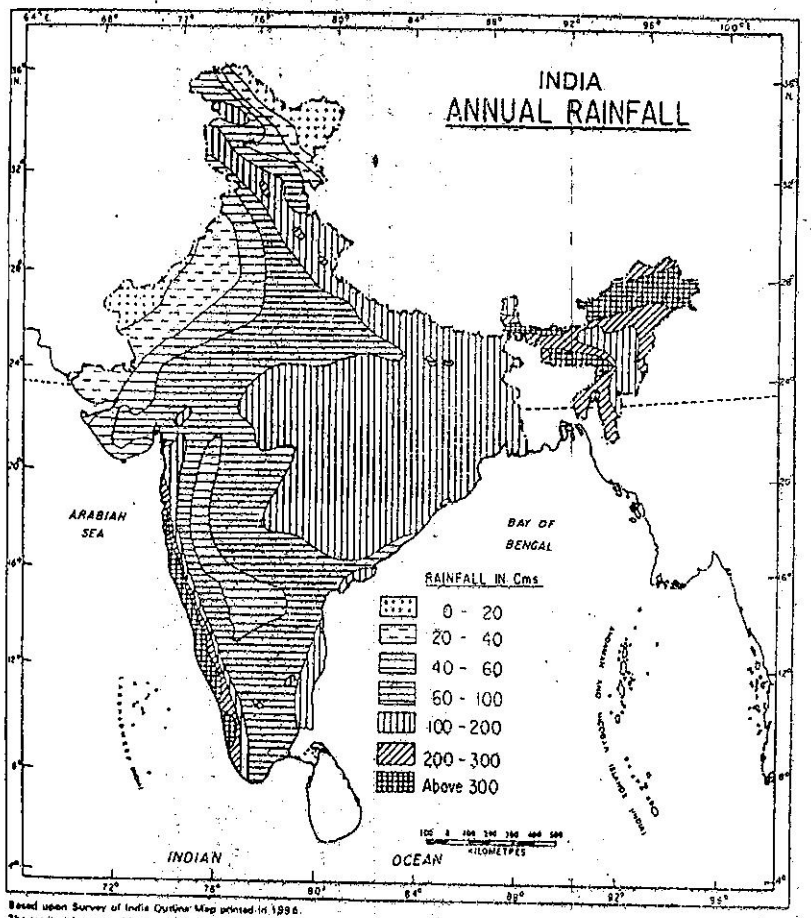


Fig. 2.6 India—Average Annual Rainfall

Compare Figs. 2.5 and 2.6 and note the monsoonal control over the annual rainfall in India. Name those parts where the bulk of the rainfall is not confined to the June-September period

rise in temperature. The land is still moist. Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive. This is commonly known as 'October heat'. In the second half of October the mercury begins to fall rapidly, particularly in northern India.

The low pressure conditions which once prevailed over north-western India get transferred to the centre of Bay of Bengal by early November. This shift of the low pressure area is far from smooth. The period is associated with occurrence of cyclonic depressions which originate over the Andaman Sea. Those that manage to cross the eastern coasts of southern peninsula cause heavy and widespread rains. These tropical cyclones are often very destructive. The thickly-populated deltas of the Godavari, Krishna and Kaveri are their preferred targets. No year is ever found disaster free. Occasionally, these tropical cyclones visit Sundarbans and Bangladesh too. Bulk of the rainfall of the Coromandel coast is derived from depressions and cyclones.

Distribution of Precipitation

Annual rainfall of over 300 cm is received over parts of western coast and northeastern India. Annual rainfall of less than 50 cm is experienced in western Rajasthan and adjoining parts of Gujarat, Haryana and Punjab. Rainfall is equally low in the interior of the Deccan plateau east of the Sahyadris. A third area of low precipitation is around Leh in Kashmir. Rest of the country receives moderate rainfall. Snowfall is restricted to the Himalayan region.

Owing to the vagaries of the monsoon, the annual rainfall is highly variable from year to year. Variability is high in the regions of low rainfall. Areas of high rainfall are liable to be affected by floods. Areas of moderate and low rainfall are drought prone.

Monsoons as a Unifying Bond

We have seen how the Himalayan chain of mountains protects the subcontinent from extremely cold polar winds. This enables even northern India to have uniformly high temperature for their latitudes. Despite climatic contrasts and variations from region to region, the monsoons provide a rhythmic cycle of seasons year after year. It is around this seasonal rhythm that the Indian landscape, its animal and plant life its entire agricultural calender and the total life its entire agricultural calender and the total life of the Indian people, not excluding their festivities, revolve. The monsoons are characterised by their most uneven distribution of rainfall in the country. However, it is interesting to note that they are responsible for fringing highly moist marine air to almost every part of the country at least for a few weeks no matter whether it results in rain or not.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) Which are the two characteristic features of the tropical climate?
   (ii) Which phenomena are responsible for the rise of south-west monsoon?
   (iii) What are jet streams?
   (iv) Name the four seasons of India.
   (v) Why do the north-east trade winds change their direction while blowing through the Ganga Valley?
   (vi) What is meant by 'breaking of the monsoon'?
   (vii) Why does Mawsynram receive the highest rainfall in the world?
   (viii) Name the states on the eastern coast which are frequently struck by tropical cyclones.
2. Distinguish between:
   (i) Equable and Extreme climates
   (ii) Rainfall and Precipitation
   (iii) North east monsoons and Retreating monsoon.
3. Give few examples of apparent climatic contrasts in India to cover the following points:
   (a) range of temperature (b) direction of rain-bearing winds (c) form of precipitation (d) amount of rainfall (e) rainfall regime i.e. seasonal distribution of rains.
4. Discuss the mechanism of the monsoons.
5. Give an account of the general weather conditions during the cold weather season in India.
6. Discuss how monsoons act as a unifying bond giving suitable examples.

Map Work

7. On an outline map of India show the following:
   (i) Area receiving winter rain
   (ii) Common paths of tropical cyclone
   (iii) Area with less than 20 cm of annual rainfall.

UNIT TWO

Our Natural Resource Base

Life flourishes only in a congenial environment. As such, life and environment are inseparably interlinked. Every kind of life together with the physical environment in a given area forms an ecosystem. Every plant and animal species interact with the environment. Human beings too are a part and parcel of the ecosystem like any other plant or animal species. However, they differ from all other species as they can learn from the environment and in the process husband it to their advantage. Many elements of the environment or ecosystem, are utilised by them for comfort and betterment. Some of the useful elements are the gifts of nature, which cannot be produced by them. These gifts of nature, found useful in making life of human beings comfortable and worth living, are known as natural resources. Other components of environment are potential resources.

The natural resources have an economic importance because of the value attached to them by human beings. Secondly, with their growing use the element of scarcity or the fear of their exhaustion also generally creeps in. Natural vegetation, animal life, soils, water and minerals constitute the natural resources of our country.

In this unit, therefore, three chapters have been included. The first deals with the flora, fauna and the soils. The next attempts to assess our water resources and their crucial role in agriculture and development of hydroelectricity. The last chapter is related to our mineral and power resources.

It is on this natural resource base that we have been struggling to impose a super structure of agriculture and industry backed by the network of transport, communications and trade.

CHAPTER 3

The Flora, the Fauna and the Soils

For millions of years our earth was merely a barren planet without any kind of life on it. Gradually life evolved in salty ocean waters. The first forms of life belonged to the plant kingdom. Plants of a particular region or period, listed by species are referred to as 'flora'. It was the plant kingdom that prepared stage for the appearance of another kind of life—the animal kingdom. Fauna refers to species of animals. The animals could survive only on the food or energy supplied by the plant kingdom. The basic importance of plant kingdom lies in the fact that it alone could convert energy derived from the sun into food energy. Therefore, this chapter begins with the flora of our country as the backbone of its natural resource base.

It is true that the fauna depends entirely on the plant kingdom for its very survival. But the fauna in turn has also been useful to the flora and its perpetuation in many ways as you must have studied in biology. They complement each other. This is why the chapter then moves on to the fauna.

Finally, the chapter deals with soils which are our prime resource. It is on the soil that the entire plant and animal lives ultimately depends for deriving its food directly or indirectly. Are human beings exceptions to it? No, not in the least. They also depend upon the plant kingdom to derive their food. Soils are as important to them as they are to plants and animals. With the long history of over 5,000 years of farming, all that human beings have been able to do is to select

FOR DOING IT YOURSELF

1. Study the map showing broad belts of natural vegetation in India. Compare it with relief and rainfall maps of India. See for yourself with what it is closely related.
2. Find out what governs the quick succession of natural vegetation belts in the Himalayan region. Is the succession horizontal or vertical?
3. Collect coloured pictures of the typical Indian fauna in their natural setting i.e. in national parks, animal/bird sanctuaries, zoological gardens and biosphere reserves.
4. Keep a watch on newspaper supplements, advertisements and other publicity materials issued by Central and State Departments of Tourism concerning our

country's flora and fauna: Hold a class/school exhibition of the materials so collected.

5. Study the map of major soil types of India and find out which of the following factors is most closely related to the soils: (a) distribution of rainfall, (b) natural vegetation, (c) major landforms.

plants, sow seeds, and help their growth, and store them for a rainy day. They themselves cannot manufacture food as the plants do.

Natural Ecosystem

All the plants and animals in a given area are so closely interlinked and interdependent that they cannot be thought of exclusively without the other. All these interdependent species of plants and animals in a given area form a single ecosystem. It has evolved over a period running into thousands and thousands of years. Any attempt to tamper with the ecosystem is frought with grave risks. Human beings themselves are a part of the ecosystem. In fact this fundamental fact has been realised by them only recently after having committed gross mistakes and blunders. They have, therefore, started correcting this dangerous situation lest it goes out of their hands.

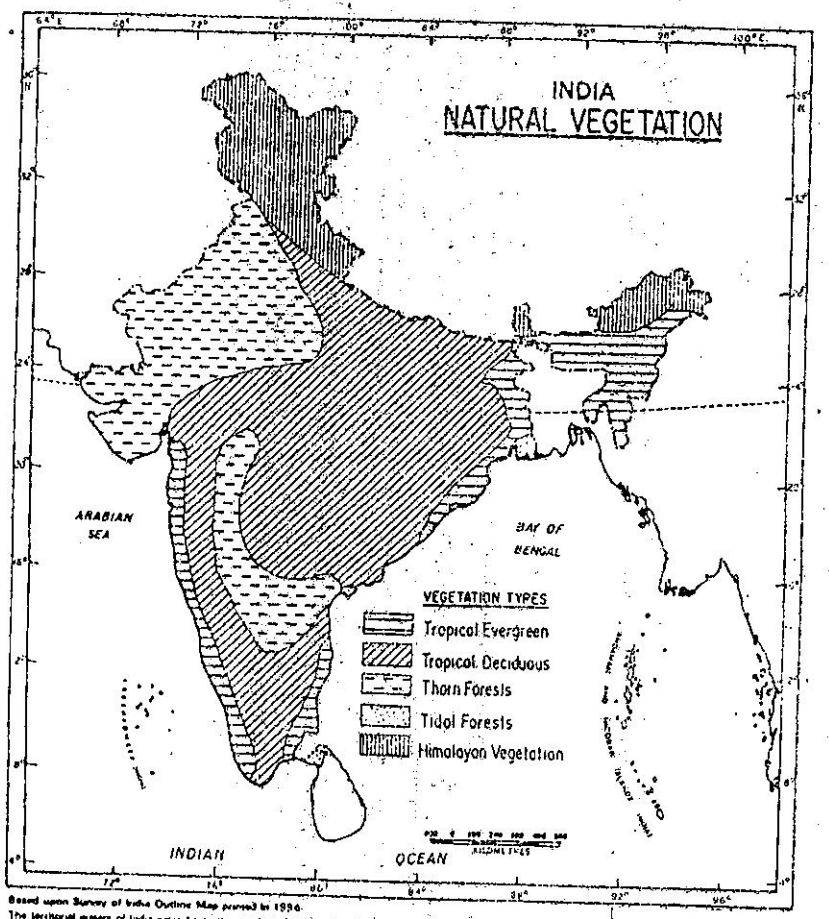
DIVERSE FLORA

Our country has already listed and carefully described 49,000 different species of plants. This represents the widest range for any country of the world of its size. Of these, nearly 5,000 species are found exclusively in India. The country is rich in both flowering and non-flowering plants. The ferns, algae and fungi belong to the latter category. The secret of such diverse flora lies in the country's varied relief, land forms, terrain, soil, range of daily and annual temperature and varying amount of rainfall and duration of its regime. In brief, our flora ranges from the one found in the tropical zone to that of the Arctic zone. It is because of the Himalayas. The assemblage of plant species living in association with each other in a given environmental framework is known as 'vegetation'. Climatic conditions, natural vegetation and soil are closely interrelated. The original vegetation cover of India consisted of forests, grasslands and scrub.

Vegetation Types

The natural vegetation of India, barring the Himalayan region is divided into four major vegetation regions, they are: (i) the tropical rain-forests: (ii) the tropical deciduous forests, (iii) the thorn forests and scrubs, and (iv) the tidal forests.

(i) TROPICAL RAIN-FORESTS : Trees in these forests do not have a distinct season of shedding leaves because the region is warm and wet throughout the year. As such these forests are evergreen. They are at their best where rainfall is in excess of 200 centimetres with a short dry season. They are thus typical rain-forests. Such areas are confined to rainy slopes of the Western Ghats, plains of West Bengal and Orissa and North-eastern India. In these forests, trees grow very vigorously, reach to



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
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Fig. 3.1 India—Natural Vegetation

Compare this map with that of the average annual rainfall and note the correlation between the two. Which type of natural vegetation is most predominant in India?

heights of 60 metres and above. The number of species is too large and too mixed to exploit each one of them commercially. Some of the commercially useful trees of these forests are ebony, mahogany and rosewood.

(ii) TROPICAL DECIDUOUS FORESTS : These are also called the monsoon forests *par excellence*. This is so because they form the natural cover almost all over India, particularly between regions of 200 and 75 centimetres of rainfall. Economically they are very important. They need a lot of care as they are less resistant to fire. They are divided into two groups: (i) moist, and (ii) dry deciduous. The former are found on the eastern slopes of the Western Ghats. Teak is an important species of this region. The moist deciduous are also found in the north-eastern part of the peninsula i.e. around Chhotanagpur plateau covering east Madhya Pradesh, south Bihar and west Orissa. They are also common along the Shiwaliks in the north. Sal is the most important tree of the dry deciduous type. It has been observed that moist deciduous forests are getting gradually replaced by dry deciduous forests. These are called deciduous (be it moist or dry) because they shed leaves for about six to eight weeks in summer. Every species has its own time of leaf shedding and as such at no particular time the forests are absolutely bare.

(iii) THE THORN AND SCRUB FORESTS: These are confined to areas with rainfall under 75 centimetres. They are spread over north-western part of the country from Saurashtra in the south to Punjab plains in the north. In the east they stretch to northern Madhya Pradesh (mainly Malwa Plateau) and south-west Uttar Pradesh covering Bundelkhand plateau. Kikar, babul, khair, date palms are some of the useful trees. Scattered trees with long roots spread in a radial pattern are common features. These forests gradually fade away into scrubs and thorny bushes, which constitute the typical desert vegetation.

(iv) TIDAL FORESTS : The tidal area along the coasts and rivers is covered by mangrove trees that can survive in both fresh and salt water—the major characteristic of the tidal areas. *Sundari* is a well known mangrove tree. It is after this tree that the name Sundarban has been given to the forested parts of the Ganga-Brahmaputra delta.

Altitudinal Zones of Vegetation in Mountainous Regions

Altitude is an important consideration in the distribution of vegetation in mountainous region because temperature decreases with increasing altitude. In mountainous regions, we notice a succession of natural vegetation belts from tropical to the tundra region. All of them are compressed into an altitude of six kilometres or so. However, even at the same altitude sunny areas differ in vegetation from those that are not so sunny.

The Shivaliks, the foothills of the Himalaya, are clothed with tropical moist deciduous forests. Sal is the most dominant and economically important species. Bamboo trees are also common in this belt.

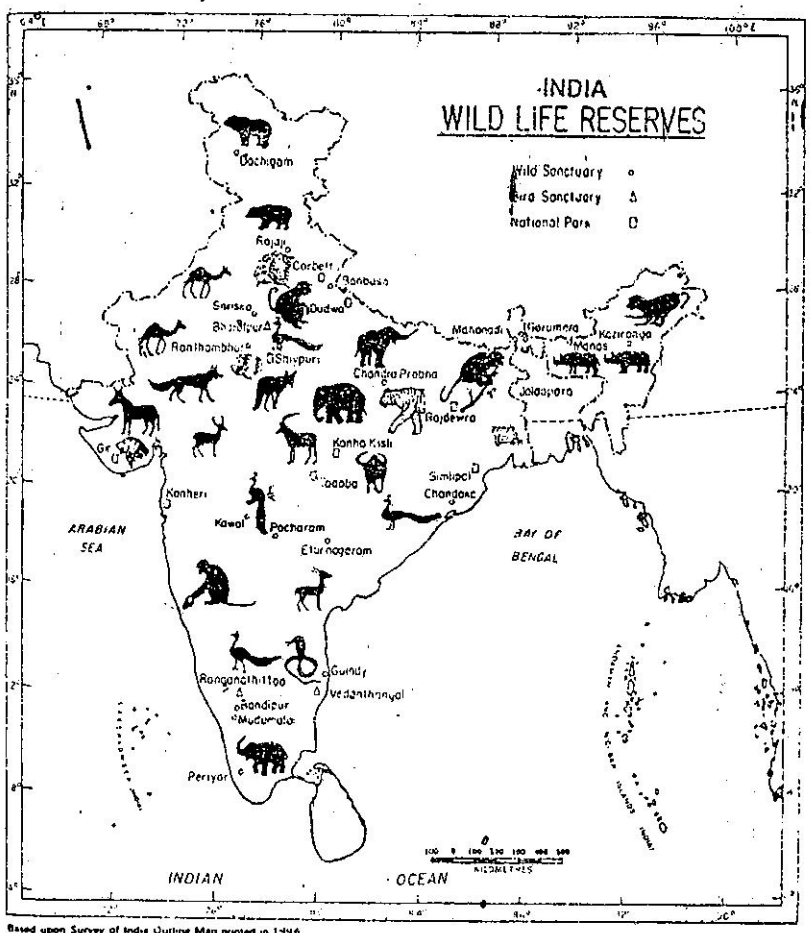

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Fig. 3.2 India—Major Wild Life Reserves
Note the location of some of the major wild life reserves in India

cover the eastern part of the peninsula comprising Chhotanagpur plateau, Orissa, eastern Madhya Pradesh, Telangana, the Nilgiris and Tamil Nadu plateau. They extend northwards in the west along the Konkan coast of Maharashtra. Soils are loamy in deep depressions and in uplands, they consist of loose gravel—a highly coarse material. They are deficient in phosphoric acid, organic matter and nitrogenous material. They do well with dose of fertilisers and irrigation waters.

LATERITE SOILS: The laterite soils is a result of intense leaching owing to heavy tropical rains. They are usually found capping the flat uplands, and are spread in western coastal region receiving very heavy rainfall. They are also found in patches along the edge of the plateau in the east covering small parts of Tamil Nadu, and Orissa and a small part of Chhotanagpur in the north and Meghalaya in the north-east. The soils are invariably poor and support only pastures and scrub forests.

Among the miscellaneous types of soils, two groups are more significant. They are the desert soils of west Rajasthan and the mountain soils of the Himalayas.

DESERT SOILS AND MOUNTAIN SOILS: The arid sandy soils include wind-borne loess as well. With irrigation facilities these soils are found to yield good harvests. The mountain soils include peat, meadow, forest and hill soils. The forest soils can be described as soils in the making.

Owing to the wide variety of rich soils, India is able to produce a variety of crops. It is important because this potential can make India not only self-sufficient in various agricultural produce but also a leading exporter of several agricultural products. This would, however, depend upon scientific management of our soils, their proper conservation, avoidance of their erosion and maintenance of their fertility through organic and bio-manures, rather than depending entirely on chemical fertilizers. This is self-evident from the fact that nearly nine million hectares of alluvial soils and seven million hectares of black soils are currently suffering from salinity and alkalinity. Much of it is due to water logging and excessive irrigation.

Realising the importance of soil as a valuable resource, steps have been taken to prevent soil erosion caused by running water and winds. Conservation of soil is necessary to ensure sustained productivity of land.

EXERCISES

Review Questions

1. Answer the following questions briefly :
   (i) What is an eco-system?
   (ii) What makes the maintenance of the eco-system indispensable for the survival of the human beings?

   (iii) Why does India possess a great variety of flora?
   (iv) Name the four major vegetation regions of India.
   (v) What is a bio-reserve? Name any two.
2. Distinguish between:
   (i) Flora and fauna
   (ii) Regur soils and laterite soils.
3. Describe the altitudinal zones of vegetation in the Himalayan regions.
4. What are the major natural vegetation zones in India? Give a detailed account of monsoon forests in India.
5. Give a brief account of the types of soils found in India.
6. Write short essays on:
   (i) Conservation of wild life
   (ii) Conservation of soil.

Map Work

7. On an outline map of India show the following:
   (i) Kaziranga National Park
   (ii) Valley of flowers
   (iii) Nilgiri Bio-reserve
   (iv) Area covered with black soil
   (v) Tidal Forests.

CHAPTER 4

Land Use and Water Resources

LAND USE

Our country has the total area of about 328 million hectares. The land utilization statistics are available to us for nearly 92.7 per cent of the total area. It is significant to note that our forefathers over the past 8,000 years or so have succeeded in bringing nearly 140 million hectares of land from the natural ecosystem to agriculture. Since Independence we added another 22 million hectares. As a result today 162 million hectares of land stands out as the net sown area. It forms a spectacular percentage of as high as 51 per cent. No other big country is so fortunate as we are in this regard.

FOR DOING IT YOURSELF

1. Study Table 4.1 carefully before you take up the suggested activities :

TABLE 4.1

Country	*Average density of population (per sq km)*	*Per capita arable land (in hectares)*
Canada	3	1.70
China	110	0.14
India	243	0.20
Japan	320	0.04
USA	26	0.73
Erstwhile USSR	12	0.81

   (i) Arrange the countries in order of:
   (a) Average density of population, and
   (b) Per capita of arable land
   (ii) Now compare, average density of population and per capita arable land. Find out which of the two is more significant and meaningful.
   (iii) Compare India with (a) China, (b) Japan, and (c) Canada to draw your own inferences.

2. Table 4.2 provides a comparative picture of land use of the same six countries included in Table 4.1

TABLE 4.2
Land Use (in Percentage)

Country	*Cultivated area*	*Pasture land*	*Forested land*	*Waste land*	*Total*
Canada	5	2	33	60	100
China	11	30	14	45	100
India	51	4	21	24	100
Japan	13	2	68	17	100
USA	20	26	28	26	100
Erstwhile USSR	10	17	42	31	100

   (i) Compare the position of India with other countries in regard to (a) cultivated area, (b) pasture land, (c) forest land, and (d) wasteland including built-up areas.
3. Compare average density of population and actual pressure on the cultivated land in India and China and see how you can account for China's great population and yet its ability to be self-sufficient in food.
4. Study carefully rainfall data provided in the chapter on climate.
   (i) Choose suitable criteria to classify months into three categories (a) rainy, (b) dry, and (c) moderate.
   (ii) Generalise the rainfall regime on this basis for each station.
   (iii) Draw your inference in regard to the need for irrigation.

Land Use Pattern of India

According to the available land use figures, there has been a slight increase in the net sown area. Nearly 28 million hectares have been added over a few decades. Another 1.3 per cent of the land is under fruit trees. Nearly 5 per cent of the land falls in the category of the fallow land which is cultivated not every year but once in two to three years. Thus nearly 51 per cent of the total area, on an average, is cultivated annually. The fallow lands are marginal lands and are kept so to restore their fertility. Its use depends upon good and timely rains too. However, it is notable that the fallow land has come down to 5% from the earlier figure of 7%. This shows perhaps greater use of manures and fertilisers and adoption of new techniques to conserve more moisture in such lands.

The area classified as cultivable waste has remained stationary at 6.4 per cent for several decades. The land under permanent pastures is miserably low and indicates tremendous population pressure on our land. Also, it must go to the credit of our farmers that with so little land under pastures they have the largest number of cattle. They are reared mainly on husk, grain chaff, farm waste and a few fodder crops. This is indeed the most economic way to have a larger number of drought animals and bovine

cattle. Some areas classified under forests are also used for cattle grazing.

The forested land in our country is far below the scientific norm. For a self-contained economy and proper ecological balance, at least a third of the total land area must be kept under forests and natural vegetation. In India it is as low as 19.27 per cent. The photographic evidence derived from the satellites has confirmed that only 46 million hectares are under real forests as against the 63 million hectares according to land use statistics. However, this figure shows a small rise from 40 million hectares.

We have to ensure that we increase the area under forests for reasons more than one. A larger area under forests is a must for maintaining the ecological balance and for absorption of carbon-dioxide, the accumulation of which is likely to accentuate green house effect. This in turn would raise atmospheric temperature at the global level. It may lead to melting of ice caps and corresponding rise in sea level endangering low lying thickly populated parts of the world. Forests provide habitat to wild life and help their preservation. They help in raising the level of precipitation, minimising the incidence of droughts. Forested lands also help in percolation of rain water in the subsoil and regulating the flow of river waters in both rainy and dry seasons. Forests conserve not only water but soil as well. They thus help in reducing the volume of flood waters and their fury.

A part of the land is not utilized at the moment. This is classified as wasteland. This includes the arid, rocky and sandy deserts. The high mountainous and uneven lands also belong to this category. At times human beings have also been responsible to add to such areas by deforestation and overgrazing.

The growing population and higher standards of living have created ever increasing demand for residential land both in villages and towns. Cities and towns are compelled to grow vertically rather than horizontally. Even then land is needed to expand industry, commerce, transport and recreational facilities. Their claims become irresistible.

We should remember that the total availability of land is a fixed asset. In view of the increasing pressure on land for various purposes, it is necessary to plan proper use of all the available land. This may be done by adopting suitable measures to check soil erosion, desertification etc. which turn arable land into wastelands. Besides, some of the wastelands may be brought back to other uses. Similarly, with the help of modern and scientific methods of farming, the productivity of the land may also be increased. All attempts should be made to strike the balance among various uses of land.

WATER RESOURCES

Water is an important resource like land. An important use of water in our country is for irrigation. Through irrigation we have been able to extend the gross area under cultivation and raise agricultural productivity. Besides, water is required in large amounts for industrial and domestic consumption.

Unlike land, the availability of water varies from place to place and time to time. Being a monsoon land, the bulk of rainfall is confined to a brief period of three to four months. As such, a large part of the country lacks surface water supply for a greater part of the year. Even regions like Meghalaya and Konkan receiving heavy rainfall have water scarcity during dry months. Due to unequal distribution of rainfall, the country faces the problems of flood and famine in some part of the country or the other every year.

Our ground water resources are abundant only in the northern and coastal plains. In other parts of the country, its supply is not adequate. In fact, at places the ground water is obtained from a depth of more than 15 metres. So far as safe drinking water is concerned, we have not yet been able to provide it to all the villages. In many parts people have to walk for more than a kilometre to fetch water. Thus in most parts of the country, the availability of water for agricultural and other purposes is inadequate and irregular. We, therefore, need to plan the use of available water. Let us have a look at our national water budget.

Our Water Budget

Suppose there is a level piece of land, one hectare in area i.e. 10,000 sq. metres. On this piece of land if one metre deep water is allowed to stand, it would be 10,000 cubic metres or simply one "hectare meter".

Taking into account the average annual rainfall of 50 cm for the entire country and its total area, it has been found that our total water resources are of the order of 167 million hectare-metres. Again, it has been further worked out that only 66 million hectare-metres of water can be utilized by us for irrigation. Keeping in view the limitations of our financial and technological resources we have planned to use it in a phased manner fully by 2010 A.D.

Before the commencement of the planning era i.e. in 1951 only 9.7 million hectare-metres of water was used for irrigation. By 1973, as much as 18.4 million hectare-metre of water was being used for irrigation.

If we take up the land area as a unit, the position could be stated a little differently. In 1951 only 22.6 million hectares of land was under irrigation. By 1984-85, the land under irrigation almost tripled to 67.5 million hectares. By 1990 another 13 million hectares were to be brought under irrigation, taking the total to 81 million hectares. This may be adjudged against the total potential of 113 million hectares by 2010 A.D. This is the gross sown area and not the net sown area as the former is bound to be larger than the latter. Currently 28 per cent of the net sown area is under irrigation i.e. 45 million hectares even though the gross irrigated area is about 80 million hectares. Not more than 50 per cent of the net sown area will ultimately be brought under irrigation. This estimated potential takes into account even the ground water resources that are recharged every year by the normal rains. These usable ground water resources are estimated to be around 40 million hectare-metres. Of this, only a fourth i.e. 10 million hectare-metres are now being utilized. The remaining 30 million hectare-metres are yet to be utilized. This is the overview of our potential and developed water resources.

Multi-purpose River Valley Projects

Since Independence, our country has been engaged in planned economic activities to achieve self-reliance and improve the

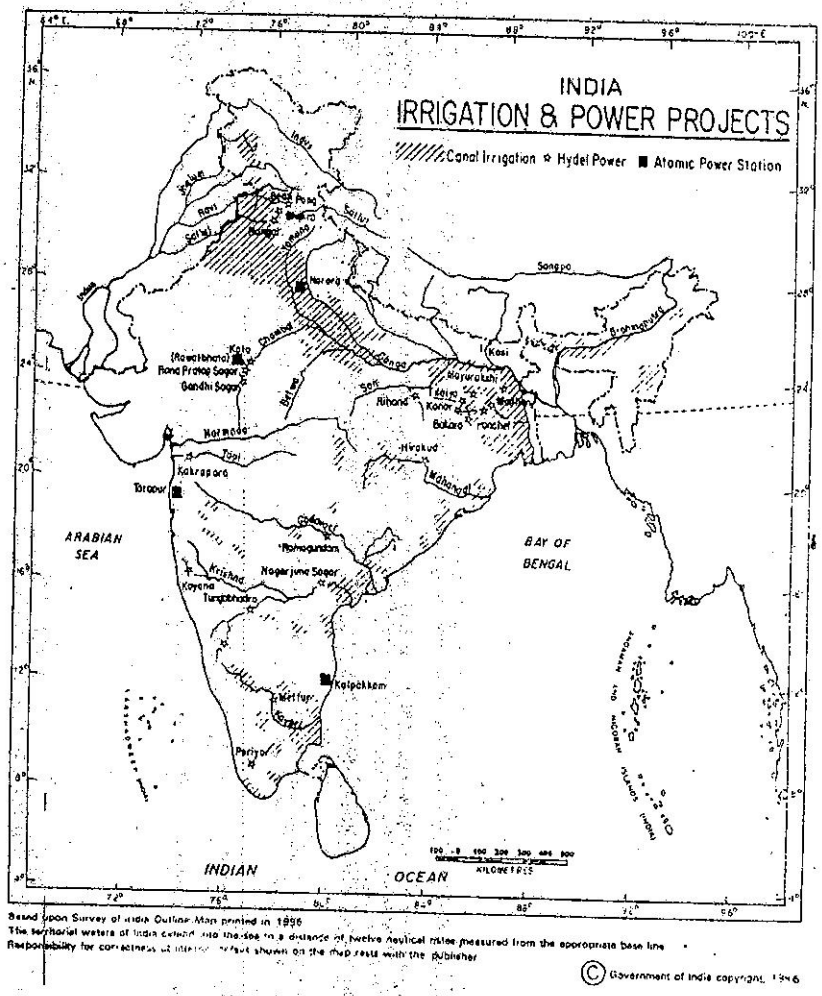

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Fig. 4.1 India—Irrigation and Hydel Power Projects

Note the major irrigation and hydel power projects in India. Name the states where canal irrigation is most important. Which parts of India do not have hydel power projects?

standard of living of its people. Among several measures adopted for this purpose, managing our water resources is one of them. The twin problems of floods and famines are nothing but two sides of the same problem. As such they are being increasingly tackled in an integrated fashion. The surface and ground water resources are viewed complementary to each other. Their source is one and they serve the same purpose. Out of these practical concerns and long experience, there evolved a common philosophy and technology. It is now being followed almost all over the world—specially in the water thirsty areas. Multi-purpose river valley project is a common label it has acquired over the years. Damodar River Valley project was the first of its kind taken up by free India.

In a multi-purpose river valley project quite a few objectives are realised simultaneously. A huge single dam or series of small dams are built on a river and its tributaries. In the first place these human-made lakes help in impounding huge amounts of rain water. To that extent they help in controlling floods and protecting soils. The same water comes very handy in irrigating farms in command areas during the dry season when water is in great demand.

The catchment areas of these dams are now systematically afforested. This helps to preserve "wild land" and natural ecosystem. It is high time that we now restore ecological balance in the hilly catchment areas of our life-giving rivers. The afforestation also helps in avoiding silting of dams, lakes, river channels and irrigation canals. It helps in extending their life and economic viability.

The wild land so purposefully developed helps in preserving wild life, the most precious heritage of the humankind. It is our bounden duty to preserve and pass on intact this inheritance to our future generations to whom it rightly belongs. We are only the trustees of this heritage.

The stored water in the hilly and mountainous tract generally provides high head. The stored water when made to fall from a high head helps in generating power even in dry seasons. Power derived from running or falling water is known as hydel power or hydro-electricity. It is one of the neatest, cleanest and pollution-free forms of energy. Equally important is the fact that hydro-electricity is derived from water which is a renewable resource. Thus in every respect it scores over fossil-fuels which are exhaustible and are the least free from pollution.

Multi-purpose river valley projects often provide for inland water navigation through main rivers and canals. It is the cheapest means of transport for heavy goods. Another economic benefit of these projects is the ideal conditions they provide for development of fisheries. Fish hatcheries and nurseries are developed to stock water bodies with chosen varieties of fish that are allowed to grow to their full. They are harvested only at regular intervals through controlled fishing. Such well-developed fish farms can be the cheapest source of protein for our people whose diet is otherwise extremely poor. Such well cared for and scientifically developed river valley projects become centres of tourist attraction. It is for all these reasons that the multi-purpose river valley projects are called the new temples of modern India.

Before Independence water management meant irrigation only. But now it includes generation of power, fisheries etc. Canal irrigation was practised in the south since antiquity—specially in the Kaveri delta. Tank irrigation was widespread, almost in every village in the south. Likewise well irrigation was common all over India. Animal power was harnessed to draw water from wells. In medieval times, several rulers promoted canal irrigation in northern India. During British period the huge arid tracts of north-west Indian subcontinent, particularly in the Indus basin, were brought under irrigation where retired army personnel were encouraged to settle on new lands. Land was extremely flat and fertile, and Indus and its tributaries had ample water to irrigate these virgin lands. Cotton was a major cash crop grown under irrigation. Over a period of time the world's one of the best canal irrigation networks was developed. Bulk of it went over to Pakistan.

Damodar Valley Project sets an example towards managing our water resources on scientific lines. Damodar, though a small river, was called the river of sorrow owing to devastating floods it caused. It flows from Chhotanagpur in south Bihar to West Bengal where it joins Hooghly. The valley has the largest deposit of black gold i.e. coal. Iron-ore deposits of India are also found in its vicinity. The project consists of a series of small dams on the tributaries of Damodar. There are a few hydel-power stations. A navigable canal has also been developed. The hydel power is fed into a common grid in which big thermal power stations provide the bulk of electricity for the growing industrial complexes spread over south-east Bihar and adjoining parts o West Bengal. The project irrigates half million hectares of land in West Bengal an parts of south-east Bihar.

The Bhakra Nangal Project is an ex ample of water management on scientifi lines on the largest scale. The Bhakra Dan has been built at a strategic point where tw hills on either side of the Satluj are ver close to each other. The dam, therefore, not very wide. It is the highest gravity dar in the world. Its height is 226 metres fro the river bed. It is located in the seismi zone, and the hills that act as huge natura walls for storing 7,80,000 hectare-metres water are made up of unconsolidated ma ter. Being very weak and brittle, the hil had to be strengthened by injecting the with big concrete blocks at regular interval The man-made lake Gobind Sagar is Himachal Pradesh and has been named a ter Guru Govind Singh, the tenth Guru the Sikhs. The canals taken out are 1,1 kilometres long. The distributaries are 3,4 kilometres, in length. It irrigates an area 1.4 million hectares. The Nangal pow plant on the Satluj produces 1204 mw electricity each year. The project serves t states of Himachal Pradesh, Punja Haryana, Rajasthan and the National Cap tal Territory of Delhi

Indira Gandhi Canal Project Rajasthan is an ambitious scheme to bri new areas under irrigation so that additio areas could be cultivated. The waters of t Beas and the Ravi had to be diverted to t Satluj. The Pong Dam on the Beas has be constructed. It impounds 6,90,000 hectar metres of water. It has helped to divert Be water into the Satluj in a regulated man

so that Indira Gandhi or Rajasthan Canal, the longest irrigation canal in the world, can irrigate Ganganagar, Bikaner and Jaisalmer districts of north-west Rajasthan. The main canal is 468 kilometres long. Waters of Satluj, Beas and Ravi are now being almost fully used by India to irrigate its water thirsty lands in the north-western parts of the country.

The Kosi Project in Bihar has been taken up in cooperation with Nepal. Its main aim has been to control floods brought by the river Kosi, known as the River of Sorrow for north Bihar. It has the capacity to irrigate 8.73,000 hectares of land in Bihar. The main canal is taken off from Hanumannagar barrage on the Kosi. Another important joint venture of India and Nepal is the Gandak Project.

The Hirakud dam in Orissa is the longest dam in the world. The 4.8 km long dam impounds 8,100 million cubic metres of water for irrigation, besides controlling the floods in the Mahanadi delta. It irrigates in all three quarters of a million hectares of land. The installed power capacity is 270 mw.

The Tungabhadra Project serves Karnataka and Andhra Pradesh. This 2.5 km long and 50 metres high masonary dam irrigates nearly 4,00,000 hectares in the two States.

The Nagarjunasagar Project is built on the river Krishna in Andhra Pradesh irrigates 8,67,000 hectares of land. The dam has been named after the Buddhist scholar Nagarjuna. Ancient temples of great architectural value would have been submerged in the man-made reservoir. They were dismantled stone by stone and have been reconstructed as before on a new site. This shows how we can preserve our cultural heritage while adopting modern technology.

The Chambal Project helps irrigate parts of Madhya Pradesh and Rajasthan. Its main purpose is soil conservation in the Chambal basin. The project consists of Gandhi Sagar Dam in Madhya Pradesh, and Kota Barrage and Jawahar Sagar Dam in Rajasthan. It has the total capacity to irrigate nearly half a million hectares of land.

There are many other projects on different rivers in the country. Find out which important project is located in your state and how useful it is for irrigation and power.

India stands fifth in the world after Zaire, Russia, Canada and the United States in potential water power resources. Her water power resources have been estimated at over 40 million kilowatts. The north-eastern India falling largely in the Brahmaputra basin accounts for nearly 30 per cent of our water power resources. The states of Arunachal Pradesh and Manipur are particularly rich. Yet another chunk of 30 per cent is widely spread over the rest of the Himalayas lying within the Indian territory. Half of it belongs to the Indus and her tributaries. The Ganga and her Himalayan tributaries together with the rivers like Tista and Manas lying further east, claim the remaining half. The remaining 40 per cent is claimed by the rivers of peninsular India. Half of it is attributed to the east flowing rivers rising in the Western Ghats and a quarter each is shared by those small rivers that rise in the Western Ghats and flow into the Arabian Sea, and the rivers of central India.

The advantages of hydro-electricity are beyond any dispute. It is a renewable resource and is totally pollution free. It has little maintenance or recurring costs. Its only unfavourable point is that its initial costs are high and gestation period is somewhat long. In 1950-51 the installed hydel power capacity was just 600 megawatt (mg). By 1997-98 it stood at 22,000 megawatt. It accounted for a quarter of the total installed capacity to generate electricity.

In terms of actual generation of water power it was 2.5 million kwh — nearly 38% of the total power in 1950-51. By 1997-98 the hydroelectricity generated in India was as much as 74.5 billion kwh. However, its actual share had come down to more 16%.

Major Water Projects

By the turn of the twentieth century, a new era of developing hydel power in this country started on a modest note. In the year 1902 the first water power house was set up on the river Kaveri at Sivasamudram in Karnataka. It was then followed by the Tata Hydroelectric Scheme in the Western Ghats of Maharashtra to supply power to the city of Mumbai. In Tamil Nadu, Pykara was the first water power station. In the north, Mandi power house was the first to be developed in the Himalayan region. The next one to be taken up was the Upper Ganga Canal Hydroelectric Grid System.

After Independence there has been a sudden spurt in developing hydroelectricity in different parts of the country. We have already discussed various hydel power schemes under the multipurpose river valley projects like Bhakra-Nangal, Damodar Valley, Hirakud, Chambal etc. In addition, there have been a few exclusive hydel power projects.

The *Rihand Project* is the largest manmade lake in India on the borders of Madhya Pradesh and Uttar Pradesh. Its capacity is 300 mw every year.

The *Koyna Project* in Maharashtra is on an east flowing tributary of the Krishna. A dam on the Koyna has been built only to take waters through a tunnel to the western slopes of the Ghats. Its capacity is 880 mw. It feeds power to Mumbai-Pune industrial region.

The *Sharavathy Project* in Karnataka is located at the Jog Falls, the highest in India. Its total capacity is 891 mw. It feeds Bangalore industrial region and is also taken to the states of Goa and Tamil Nadu. Kalinadi Project in Karnataka has 270 mw capacity.

The *Kundoh Project* in Tamil Nadu had initially 425 mw capacity which has been expanded lately to 535 mw.

The *Sabarigiri Project* in Kerala has an installed capacity of 300 mw while the Idukki Project has a capacity of 390 mw.

The *Balimela Project* in Orissa has an installed capacity of 360 mw and in Gujarat Ukai Project has a capacity of 300 mw.

In Jammu and Kashmir *Salal Hydel Power Project* has been completed and the new ones are being taken up. They together would provide over a thousand mw of power.

Besides these power projects, India constructed a very big hydel power project in Bhutan at Chukha. It was financed by India. The surplus energy is brought by India for its use in the north-eastern parts of the country including West Bengal.

The National Hydroelectric Power Corporation Ltd. (NHPC) was set up in 1975. It has added 2133 mw of hydel power since then. These cover Chamera Stage I (M.P.); Uri (J&K); Salal Stage I (J&K); Baira-Siul (H.P.); Loktok (Manipur); Tanakpur (U.P.).

Tehri Hydel Power Project has now been in news for quite a few years. It is a joint project of the Govt of India and Uttar Pradesh for the implementation of which Tehri Hydro Development Corporation was set up in 1988. The goal of the project is to generate 2400 mw of power annually and provide irrigation to 27000 hectares. The project has failed to make any headway and has been incurring huge financial losses as the Govt and environmentalists are not able to see eye to eye on the goal and methodology to be adopted in implementing this project.

Narmada Valley Development

Narmada is one of the major rivers of India flowing through the two major States of Madhya Pradesh and Gujarat. A small quantity of water from Maharashtra and Rajasthan also follows into this main river. The Govt. of India has set up Narmada Control Authority and a Review Committee in 1980. It has also set up Sardar Sarovar Construction Advisory Committee to tackle and sort out problems of this main dam and its ultimate height.

As the large number of villages, particularly of the tribal people and large forest tracts are likely to be submerged, the entire project has turned into a controversy. One of the humanitarian issues thrown up by this project is the rehabilitation of the villages, mostly tribals, in a satisfactory manner. The issues involved merit careful and sympathetic considerations and the opinion of the experts at the highest possible level.

It is really strange that the issue of distribution of water of the Indus and its tributaries could be resolved amicably between India and Pakistan to the satisfaction of both; but the same cannot be said about Narmada where no foreign interest is involved at all. Since Independence the water of Narmada is being allowed to go back to the sea without any advantage to us. No one knows how long this state of affairs would continue !

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) How is per capita availability of arable land more significant than average density of population?
   (ii) Why is it necessary to know the land use pattern of a country?
   (iii) What is the most satisfying feature of land use pattern in India?

(iv) What are the disturbing features of land use pattern in India?
(v) Why is the availability of water inadequate for human use in India?
(vi) Whey does hydel power score over other conventional sources of energy?

2. What is a multi-purpose project? How does it excel over traditional irrigation projects? Give examples from various parts of India.
3. What is our national water budget like? Why is it as important as our food budget?
4. Distinguish between:
   (i) A cubic metre and a hectare-metre
   (ii) Net sown area and gross sown area
   (iii) Surface water and ground water resources
   (iv) Himalayan rivers and those of peninsular India.
5. Hold a class discussion on (i) Water—the Saviour of Life or (ii) Our lopsided land use pattern.

Map Work

On an outline map of India show the following :
(i) Three states of northern India where the proportion of irrigation area is very high
(ii) Two similar states from the south
(iii) Show the four deltas where irrigation is very common
(iv) Show the following hydel power projects on the respective rivers:
   (a) Salal, (b) Nangal, (c) Koyana, (d) Rihand, (e) Sharavati, (f) Periyar.

CHAPTER 5

Mineral and Power Resources

Not all the natural resources are located on or above the earth's surface. Many of the resources are hidden deep below the earth on which we live. They are buried deep even under the sea-bed. In the modern industrial era these underground resources are of great importance. Much of the country's industrial growth depends upon these mineral resources. Early human civilization started with tools and weapons made out of stone. Copper was the first metal to be widely used. However, iron being stronger and more abundant, revolutionised the life of man. It helped to clear forest and accelerate the spread of farming. It was agriculture that laid the foundation for cultural progress of man.

MINERAL RESOURCES

India is bestowed with a fairly rich mineral resource base, and has the potential to become an industrial power on its own.

We are particularly rich in iron resources. Iron, together with coal, forms the basis of the machine age. As per one estimate, India has nearly the world's one-fourth of iron ore resources. Its reserves are rich not only quantitatively but also qualitatively. Another important mineral required for ferrous industries is manganese, and India is very rich even in this. It is used in manufacturing steel alloys. Our coal reserves are considerable. But unfortunately the quality coal required for producing coke as an essential input in steel industry is rather deficient. However, the proximity of coal and iron deposits have compensated to some extent this disadvantage. Limestone, another input in steel industry, is also ample and widespread.

India is rich in bauxite, the ore for aluminium, and mica used for electrical industries.

India on the other hand is poor in non-ferrous minerals like zinc, lead, copper and gold. It also lacks sulphur which forms the base of modern chemical industry.

At one point of time, India was poor in the production of mineral oil and natural gas. However, our tenacious efforts, backed by modern technology, have helped us to locate sizeable reserves that may last for at least another thirty to forty years. Our water power resources and atomic minerals, however, can be relied upon. Solar energy, which the bountiful nature has bestowed on us generously, will be our ultimate saviour when proper technology can be developed to harness the same.

Iron

India is exceptionally rich both in quantity and quality of its iron ore deposits. The ores mainly consist of hematite and magnetite.

FOR DOING IT YOURSELF

1. Pay a visit to a village nearby and collect the following figures:
   (a) Number of houses/households.
   (b) Number of electricity connections provided.
   (c) Number of hours each day when electricity is made available by the authorities.
   (d) The average number of hours and days when electricity is not available because of fault/break down in transmission line or pumping set etc.
   (e) The rate charged per unit of electricity consumed.
   (f) Possible ways of avoiding wastage of power.
2. Study Table 5.1 and answer the questions given below.

TABLE 5.1

Production of Coal and Lignite
(1950-51 to 1997-98) (in Million Tonnes)

	Coal	Lignite	Total
1950-51	32.3		32.3
1960-61	55.23		55.23
1970-71	72.95	3.39	76.34
1980-81	114.32	5.11	119.02
1990-91	211.75	13.77	225.50
1997-98	295.93	23.05	318.98

   (i) If coal is an index of industrial activity name the two decades when the industrial activity had really picked up.
   (ii) What does trend in lignite production suggest?
3. Study Table 5.2 and work out the rate of growth in percentage in the production of iron-ore, bauxite, coal, petroleum and natural gas.

TABLE 5.2

Trends in Minerals and Mineral Fuels Production
(1950-51 to 1997-98)

	1950-51	1997-98
Iron-ore (Million Tonnes)	3.0	71.5
Bauxite (Million Tonnes)	0.06	5.8
Coal (Million Tonnes)	32.3	319.0
Petroleum (Million Tonnes)	0.3	33.0
Natural Gas (Billion Cubic metres)	-	25.0

4. There has been an international debate on merits and demerits of big dams. Hence, an International Commission on Big Dams was set up. According to this commission the big dams are on the rise again. Study Table 5.3, which provides the relevant data. All these dams are more than 10 metres high. Answer the questions that follow.

TABLE 5.3

Country	Big Dams	
	New Status	Under Constructions
China	85	311
Japan	11	140
Korea	2	129
India	48	76
U.S.A.	30	55
Italy	0	37
Tunisia	16	28
Algeria	6	27
Iran	1	76
France	8	12
Brazil	4	12

   (i) Name the countries having more big dams than India.
   (ii) Which countries are smaller in area than India have more dams?
   (iii) Find out arguments against as well as in favour of big dams.
5. Study Table 5.4 and answer the questions that follow:

TABLE 5.4

Changing Consumption Pattern of Electricity (1950-1997)

Year	Consumption in per cent				
	Domestic	Commercial	Industry	Agriculture	Others
1950-51	12.6	7.5	62.6	3.9	13.4
1996-97	19.8	6.2	37.6	29.6	6.8

By March 1998, the number of villages having access to electricity had crossed half a million mark. The total number of tubewells/irrigation water pumps energised was over 11 million.

   (i) Which sector had increased its demand considerably over the past 47 years? What does it indicate?

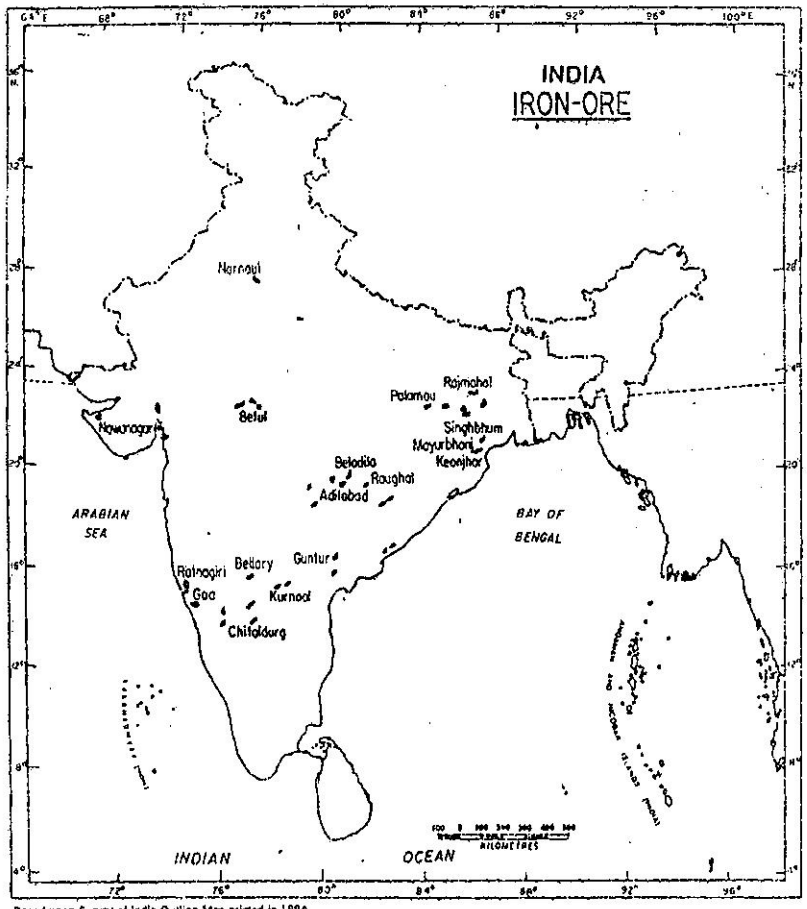

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Fig. 5.1 India — Iron Ore

Note the major iron ore mining states in India. Which states are devoid of iron ore deposits?

Haematite contains upto 68 percent metal content whereas magnetite claims upto 60 percent. The comes limotitic, a low quality iron ore. The latest official estimates about the iron ore reserves are a little over 13000 million tonnes. The major quality reserves of iron-ore are in Singhbhum in Bihar and Koenjhar, Bonai and Mayurbhanj in Orissa. Then comes Madhya Pradesh with Raipur, Durg and Bastar districts. The Bailadila mines in Bastar have been developed with Japanese collaboration. Ores are mechanically transported to Visakhapatnam for quick shipment on their way to Japan.

The other iron-ore deposits are found in several districts of Andhra Pradesh, Salem and Tiruchirapalli districts of Tamil Nadu, and Chikmaglur and Bellari districts of Karnataka. Goa also has iron-ore deposits which are regularly shipped to Japan since Portuguese times.

The production of iron-ore was 3 million tonnes in 1950-51. By 1997-98 it has crossed 70 million tonne mark. The ports specialising in export of iron-ore are Visakhapatnam, Marma Goa, Paradip and Calcutta. Kudremukh makes iron pallets and are expected to be exported from Mangalore port. Indian iron-ore has a great demand in international market because of its high iron contents.

Manganese

Ferro-alloys are mixed metals with iron as the base. These are prized for their strength, and as such they have become very important in the age of powerful giant machines. Manganese is used for this purpose and hence its growing importance.

The total recoverable reserves of manganese ore are 167 million tonnes. The main reserves are in Karnataka state followed by Orissa, Madhya Pradesh, Maharashtra and Goa. In 1997-98 the production of manganese ore was 1.6 million tonnes.

Bauxite

Bauxite ore has gained in importance because aluminium—a very light but highly useful metal, is produced from it. It is a must for an aircraft industry. It is also now being increasingly used in everyday life. But the manufacture of alumina and aluminium depends largely on the availability of cheap and abundant supply of electricity.

Bauxite deposits in India are widely distributed. Orissa, Andhra Pradesh, Madhya Pradesh, Gujarat, Maharashtra and Bihar are the principal states where bauxite reserves are largely located. The total reserves are estimated to be more than 2462 million tonnes. Major reserves are concentrated in East Coast Bauxite deposits of Orissa and northern Andhra Pradesh. In 1997-98 the production of bauxite was 5.8 million tonnes.

Recently deposits in Orissa have been developed and the largest plant of its kind in Asia has been set up to produce alumina and aluminium. Its annual capacity is 800,000 tonnes of alumina and 225,000 tonnes of aluminium. It uses the latest French technology which economises on the use of electricity. Ore is exported to Japan and European countries.

Mica

India produces nearly 90 per cent of the world's mica. It is a basic ingredient of the

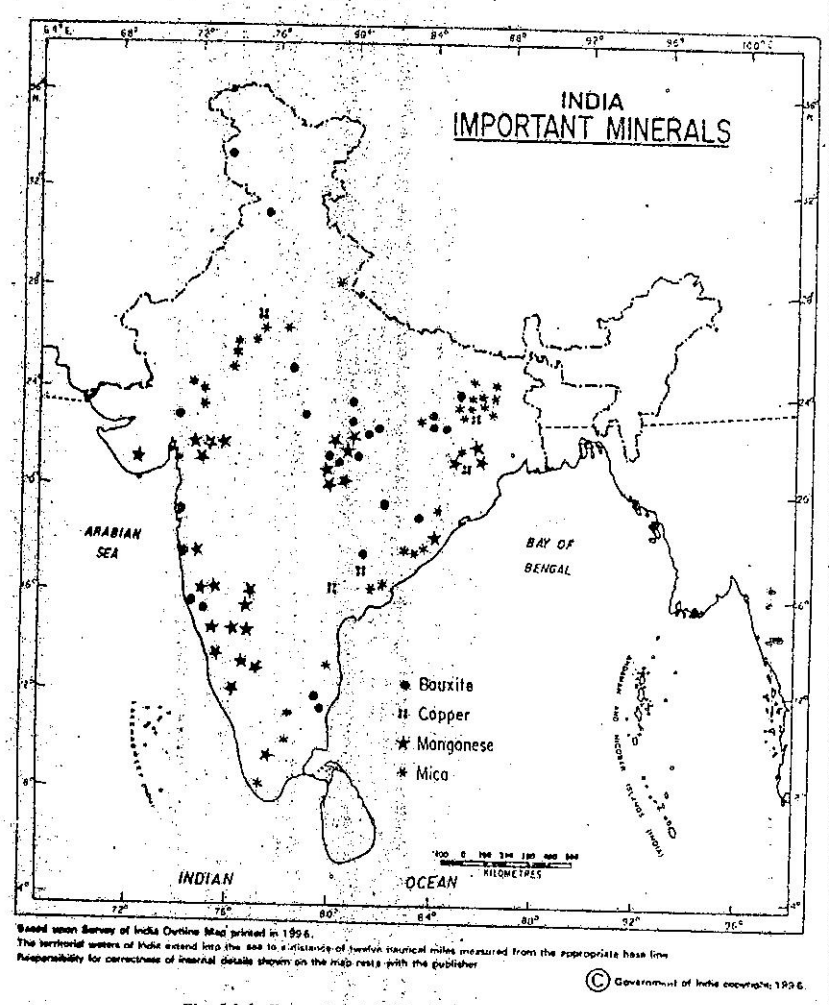

Fig. 5.2 India — Bauxite, Manganese, Mica and Copper

Note the distribution of bauxite, manganese, mica and copper in India. Name two states each where bauxite, copper, manganese and mica are found.

electrical industry. India accounts for 60% of the mica entering into international trade. Annual production is about 2650 tonnes. Half of it comes from Hazaribagh, Gaya and Munger districts of Bihar. These districts lie on the northern edge of Chhotanagpur plateau. The remaining half is equally shared by Nellore district in Andhra Pradesh and Bhilwara District in Rajasthan. India faces competition from Brazil. Our reserves are 93,000 tonnes in Andhra Pradesh, 13,000 tonnes in Bihar, 16,000 tonnes in Rajasthan. Production has been declining because of synthetic substitutes.

Copper

Copper was widely used for making household utensils. In fact before the discovery of iron, copper held its sway symbolising march of civilization. But today it is valued as the best conductor of electricity. Currently, most of the ore is mined in the districts of Singhbhum (Bihar), Balaghat (M.P.) and Jhunjhunu and Alwar (Rajasthan). The minor producers are Khamman district of Andhra Pradesh, Chitradurga and Hassan district of Karnataka and also Sikkim. The total recoverable reserves are 416.8 million tonnes. Its metal convent is estimated at 4.37 million tonnes. The annual production of ore was 4.5 million tonnes in 1997-98.

Gold

India is very poorly placed in regard to the reserves of gold ore. Currently, gold is mined at Kolar mines, the world's deepest, and Hutti mines (Raichur District)–both in Karnataka. The other mine is in Anantpur district of Andhra Pradesh. It has started functioning of late. The known reserves are placed at only 66700 kg of gold content. The annual production of gold has been dwindling. It has come down from 7,000 Kg. in 1951 to 2600 kg in 1997-98.

POWER RESOURCES

With the dawn of industrial era, the sources of energy to run giant machines suddenly came into prominence. Wood fuel was confined only to domestic use and that too in the rural area. Coal which was already in use became a highly priced commodity. It was then supplemented by natural oil. Likewise, the use of hydroelectricity gained currency in the areas where running water and needed technology was readily available. After the World War II yet another source of energy was added. It was the nuclear energy. It called for a very sophisticated level of technology. All these sources of energy are known as conventional sources of energy.

These sources of energy, like minerals are exhaustible. Hence they need to be used judiciously and conserved for future use. Among the conventional sources, the coal still occupies a prominent position.

Coal

Coal, besides being prime source of industrial energy, it is also a raw material. It is an indispensable input in steel and chemical industries. Coal, inclusive of lignite, even today accounts for 67 per cent of the country's commercial power requirements.

The coal deposits in India, to the tune of 98 per cent belong to the Gondwana age. Nearly three-fourths of the coal deposits are located in the Damodar River Valley. The

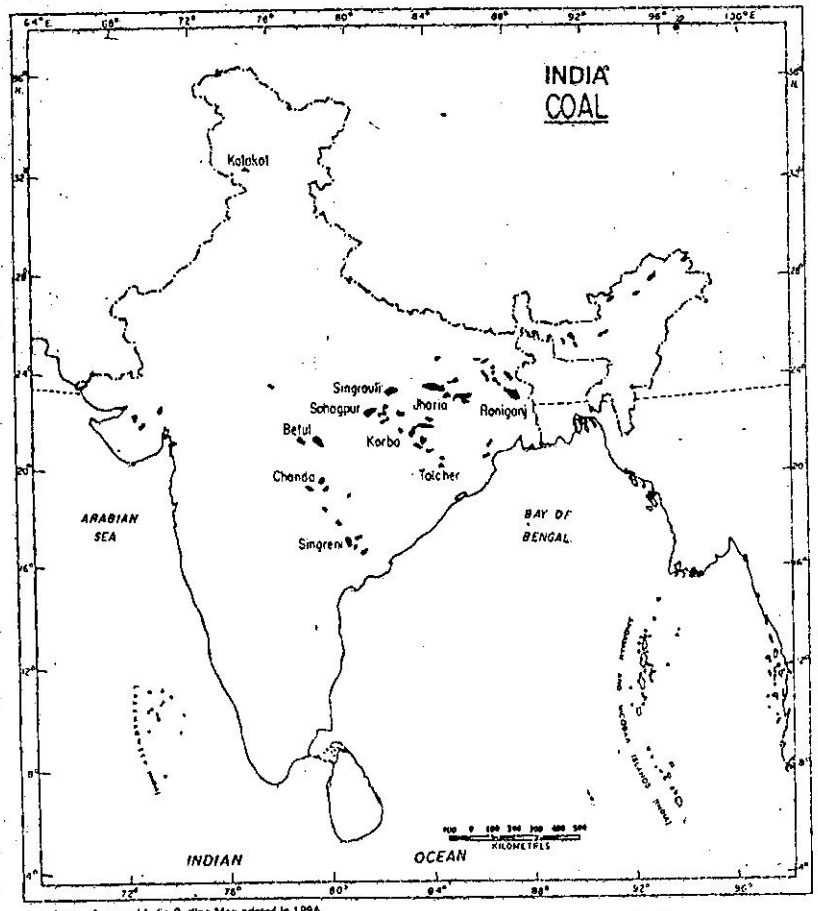

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Fig. 5.3 India — Coal

List the states where coal is found. Why is Damodar valley called the 'Ruhr of India'?

places well associated with these deposits are Raniganj, Jharia, Giridih, Bokaro and Karanpura.

Minerals are exhaustible sources and hence need to be conserved. The efficient utilisation, recycling and application of improved technology for extraction and purification will help in conserving minerals. The other river valleys associated with coal deposits are the Godavari, Mahanadi, Son and Wardha. Other coal mining areas are in the Satpura range and in Chattisgarh plains of Madhya Pradesh. The coal fields of Singreni in Andhra Pradesh, Talcher in Orissa and Chanda in Maharashtra are also very large.

Coal mining in India started at Raniganj in West Bengal in 1774. After Independence the entire coal mining was taken over by the State from private hands to avoid exploitation of labour. The major coal fields after their regrouping are (1) Raniganj, (2) Jharia, (3) East Bokaro and West Bokaro, (4) Panch-Kanhan, Tawa Valley, (5) Singrauli, (6) Talchar, (7) Chanda-Wardha, and (8) Godavari Valley.

Reserves and Production

The Geological Survey of India, according to its surveys till 1998, have put the country's proven coal reserves at nearly 206,239.5 million tonnes. These are based on the seams of 0.5 metre and above in thickness and only to a depth of 1200 metres below the ground surface. The major states known for coal reserves are Bihar, Orissa, West Bengal, Madhya Pradesh, Andhra Pradesh and Maharashtra. By and large, the quality of Indian coal is rather poor in terms of their capacity to give heat. However, the poor quality coal can be converted into electricity and gas. This is the reason why many of our thermal and super thermal power stations are located on the coal fields and the electricity produced is fed into large regional grids. This cuts down time and expenditure involved in transportation of coal to its consumption points.

The coal production in India which was just 32.30 million tonnes in 1951 has now jumped to over 318.98 million tonnes. Thus the per capita consumption of coal has increased from 135 kg to nearly 400 kg.

Lignite, also called brown coal, is generally a low quality coal. But the Indian lignite has less ash content than coal, and is consistent in quality. The deposits at Neyveli in Tamil Nadu are of the order of 3,300 million tonnes. Total reserves have been estimated at 27,500 million tonnes. The mines, however, suffer from the artesian structure and constant pumping of water is a formidable task. But the location of these deposits is a boon for Tamil Nadu. It produces 600 mw of thermal power. The industrialization of the State depends considerably on the thermal power generated at Neyveli lignite field. In 1997-98 the total production of lignite in the country was 18 million tonnes.

Oil and Natural Gas

India has a very large proportion of tertiary rocks and alluvial deposits particularly in the extra-peninsular India. These sedimentary rocks which were once under the shallow seas hold the possibility of harbouring oil and gas deposits. Such potential oil bearing area in India is estimated to be over a million square

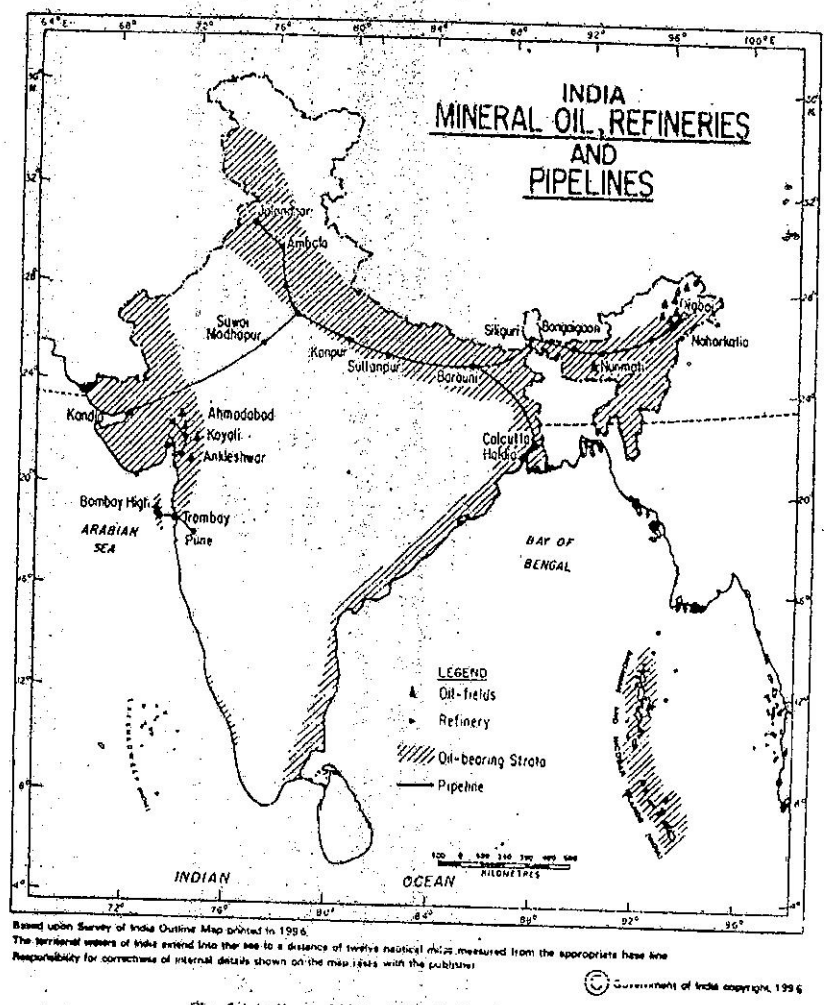


Fig. 5.4 India — Mineral Oil, Refineries and Pipelines

Note the major oilfields in India. Name the states where oil refineries are located. Note the places connected with pipelines.

kilometres, a third of the total area. It covers the Northern Plains in the Ganga-Brahmaputra Valley, the coastal strips together with their off-shore continental shelf, the plains of Gujarat, the Thar desert and the area around Andaman and Nicobar Islands.

Till Independence Assam was the only state where mineral oil was drilled and refined in the refinery at Digboi. Although small in size this is the only oilfield in the world that has lasted for 100 years continuously. After Independence Gujarat Plains and the Cambay off-shore area showed evidence of hydro-carbon deposits. But the major reserves were unexpectedly found off the Mumbai coast, 115 km from the shore. So far this has been the richest oilfield of India. This oilfield is known as "Bombay High". Sagar Samrat, bought from Japan, was the first mobile off-shore drilling platform. The deposits of oil were located deep under the sea bed. The depth of the sea water was high enough to call for high technology. But India took up the challenge and developed the oilfield in almost a record time. Now India manufactures oil drills and mobile platforms for drilling in deep coastal waters. The latest oil deposit discoveries have also come from off-shore areas off the deltaic coasts of Godavari, Krishna, Kaveri and Mahanadi. New reserves have been located in Assam.

The gas reserves are generally found in association with oilfields. As such gas reserves are found in almost in all the off-shore oilfields of Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh and Orissa. But exclusive natural gas reserves have been located in Tripura, Rajasthan.

Our Growing Oil Budget

In 1950-51 our mineral oil production was 2,69,000 tonnes, all from Assam. During that year we consumed 3.1 million tonnes. The gap between production and consumption was rather small and easily manageable. By 1997-98 we had a handsome production of mineral oil of the order of 33.8 million tonnes. Work out how many times our production had registered its increase. It is interesting to note that out of 33.8 million tonnes of indigenous production while the on-shore production was 11.5 million tonnes from Assam and Gujarat, the rest i.e. 22.4 million tonnes came from off-shore oilfields of Bombay High and Khambat Gulf off Gujarat coast. On the other hand our consumption had increased to 84.5 million tonnes forcing us to import 50.7 million tonnes at the cost of 8217 million U.S. Dollars worth of foreign exchange. This points out how important it is for us to increase our exports of value-added manufactures.

Natural Gas: In 1977-78, 24.6 billion cubic metres of gas was produced, out of which 23.0 billion cubic metres was utilised. The reserves were 675 billion cubic metres as on 1 April 1998. In a power deficient country like India, natural gas is a precious gift. It can be used both as a source of energy and also as an industrial raw material in petro-chemical industry. It takes less time to build a power plant based on natural gas. For Indian agriculture it has a capacity to boost its production through the building of fertilizer plants based on natural gas. The utility of gas is further heightened because of its easy transportability through gas pipe lines. Now gas from Bombay High and

Gujarat gas fields is taken to states like Madhya Pradesh, Rajasthan and Uttar Pradesh. Hazira-Bijaipur-Jagadishpur (HBJ) gas pipe line is 1,730 km long and carries 18 million cubic metres of gas every day. It would feed six fertilizer plants and 3 power plants to begin with.

Oil Refineries in India

There are in all 14 refineries functioning in India. Their locations are based on three different considerations. Half of them are shore based as they can be easily fed by imported crude oil. Two of them are in Trombay (Mumbai), and one each at Mangalore, Kochi, Chennai, Visakhapatnam and Haldia near Calcutta. There are four inland refineries close to the oilfields. There are three plants in Assam-Digboi Guwahati and Bongaigaon. The fourth plant is in Gujarat at Koyali, which is fed by inland oilfields. The remaining three plants are near the market. They are located at Barauni in Bihar, Mathura in U.P. and Panipat in Haryana. Their total the capacity is 61 million tonnes. It is expected that in three to four years time, the capacity will increase to the 112 million tonnes. It may ensure self sufficiency in meeting our growing needs.

Thermal Power

We have already learnt about hydro-electricity. It is derived from a source which is plentiful and above all renewable. Thermal power plants, on the other hand, use coal, petroleum and natural gas to produce thermal electricity. These sources are of mineral origin. They are also called fossil fuels. Their greatest demerit is that they are exhaustible resources and cannot be replenished by human. Moreover, they are not pollution free as hydro-electricity is. However, electricity, whether thermal, nuclear or hydro, is the most convenient and versatile form of energy. It is in great demand by industry, agriculture, transport and domestic sectors. Its use is closely related to productivity and standard of living of the people.

The total installed capacity to produce electricity in India in 1947 was hardly 1400 mw. By 1997-98, it rose to nearly 90,000 mw, of this capacity, the share of thermal power plants was a little over 64,000 mw. The total power generated in 1997-98 was 420 billion units, of which 336 billion units came from thermal power plants.

Nuclear Power

India is deficient in quality coal and natural oil, nuclear power is expected to play a complementary role. Such power stations would be found handy where other power resources are either non-existent or in short supply. India has been a leader in making peaceful use of atomic energy in fields like medicine and agriculture.

India is rich in certain atomic or nuclear minerals. Uranium mines are located in Singhbhum in Bihar and parts of Rajasthan. More abundant source is monazite sands of the shores of Kerala. Thorium is derived from these sands. Placer deposits of Bihar have further enlarged our nuclear mineral reserves. Cheralite and zircomium deposits in India are among the world's largest reserves. Likewise graphite is another atomic mineral and is also known to exist in the Eastern Hills.

India has four atomic power plants

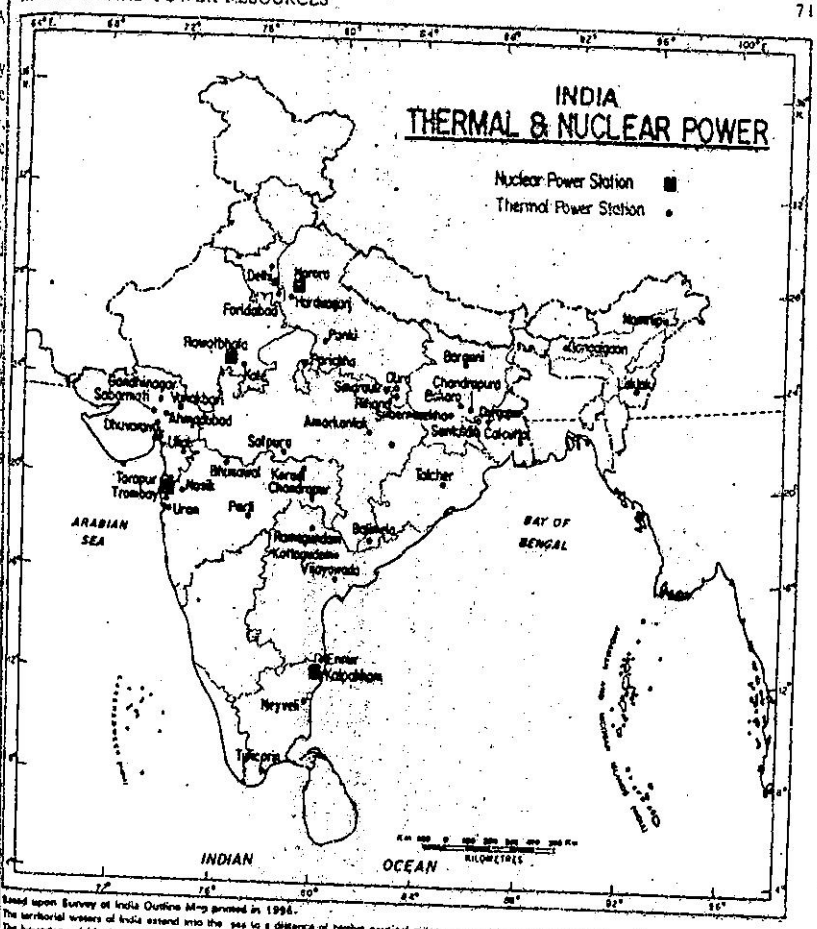


Fig. 5.5 India — Major Thermal and Nuclear Power Projects

Note the location of thermal and nuclear power stations in India. Which states do not have any major thermal and nuclear power projects? Find out the reasons for concentration of several thermal power projects in a few areas.

They are located at Tarapur on Maharashtra-Gujarat border on the Arabian Sea Coast, Rawatbhat near Kota in Rajasthan, Kalpakkam in Tamil Nadu and Narora on the banks of Ganga in western Uttar Pradesh. Together they have an installed capacity of nearly 1.5 million kw.

Power Grids

The power generated from every possible source is fed into five regional grids. All the regional grids are expected to be connected into a single national grid to serve all the regions better even in adverse conditions.

Centralised distribution system, however, has its demerits, too. It calls for huge expenditure on setting up infrastructure and problems of management. The system works well where service and efficiency are the watchwords. There is now a trend to move towards decentralisation. It would provide greater initiative to local people who can assess their needs and resources and plan a strategy that suits them best. Cost effectiveness becomes an immediate concern and hence wastages can be kept to the minimum in the interest of consumers themselves. The most important advantage of this system, however, has been the use of renewable and inexhaustible sources of energy.

Non-Conventional Sources of Energy

Wind and running water as sources of energy, were in use long before the conventional sources of energy like coal, mineral oil and natural gas came to be used widely. Wind mills were used for pumping water and for grinding grains, respectively. Wind and running water were also used for navigation.

Today non-conventional sources o energy include wind, tides, solar geo-therm heat, biomass including farm and anima waste as well as human excreta. All thes sources are renewable or inexhaustible. The are inexpensive in nature.

Wind Energy

It can be used for pumping water, a prim need in irrigating farms in the countryside Also, it can be used for generatin electricity. It is estimated that wind alon can provide 20,000 mw of electricity. Til March 1998 wind power projects of a tota capacity of 970 mw had been installed an linked to the grid. The states of Gujarat Tamil Nadu, Maharashtra and Orissa are better placed in regard to this energy. Areas with constant and high speed winds are suitable for the purpose. Besides wind mills there are also wind farms.

Tidal Energy

This is another inexhaustible and inexpensive source of energy. The Gulfs of Kachchh and Cambay are ideally suited to develop electricity from the energy produced by high tides entering into narrow creeks.

Solar Energy

The most abundant and inexhaustible source of energy is the sun. It is a universal source and has huge potential. A notable achievement has been the solar cookers. They help in cooking food almost without any cost. Small and medium size solar power stations are being planned for rural areas. The successful applications of the solar energy so far have been for cooking, water heating, water desalination, space

heating, crop drying. It is going to be the energy of future when fossil fuels, namely coal and oil, are totally exhausted.

Geo-Thermal Energy

India is not rich in this source. However, efforts are on to utilize natural energy of the hot springs at Manikaran in Himachal Pradesh. Energy so produced can be used for running cold storage plants.

Biomass

The efforts are being made in India to make use of biomass in an efficient and more scientific manner. The two main components of the biomass programme are production and utilisation of biomass.

(i) Energy Plantation

Waste and denuded lands are being used for plantation of fast growing shrubs and trees with high calorific value. They in turn provide fuel wood, charcoal, fodder, power and also scope for rural employment. Through the gasification system these energy plantations over 8,000 hectares were producing nearly 1.5 mw power, annually.

(ii) Energy from Urban Waste

A pilot plant for demonstration purposes has already been set up in Delhi to treat solid municipal waste for conversion into energy. It produces nearly 4 mw energy every year. Sewage in cities is used for generating gas and electricity.

(iii) Bagasse Based Power Plants

It is estimated that sugar mills in India can generate 2,000 mw surplus electricity during crushing season. Out of 10 mw energy produced by a mill of a given size, 4 mw would meet its own power requirements and the rest of 6 mw energy can be utilized in irrigating fields by feeding it into the local grid.

Like bagasse several other farm wastes such as rice husk are also being used to produce electricity.

(iv) Farm, Animal and Human Wastes

By using farm and animal wastes as well as human excreta, "gobar gas" plants are being set up in villages to make them self sufficient in their power requirements. The power so produced is used for cooking, lighting homes and streets and meeting irrigation needs of the village. The plants are being set up both at individual and community or village levels. Sewage from large cities can be used for generating biogas.

(v) Smokeless Chulhas

The largest share of energy is used in the country in millions of our kitchens. Wood and cowdung have been the universal sources of energy. Unfortunately the traditional chulhas are wasteful means of cooking food. There were nearly 28.5 million improved varieties of efficient and smokeless chulhas in operation till 1998. They help in saving fire wood to the tune of 20 to 35 percent. Nearly 11 million tonnes of fire wood is saved annually through these chulhas. They help in avoiding health hazards like sour eyes.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) What role does power play in the industrialization of our country?
   (ii) Name the mineral sources of energy.
   (iii) Why are coal, mineral oil and gas called the fossil fuels? What are the two major demerits of the power produced from these sources?
   (iv) Why do you think that nuclear energy is bound to play an increasingly important role in India?
   (v) In what minerals India is (a) very rich and (b) very poor respectively?
2. Make correct pairs from the two columns:

(i) mica	-	steel alloys
(ii) bauxite	-	electrical industry
(iii) lignite	-	production of electricity
(iv) coking coal	-	nuclear energy
(v) manganese	-	fertilizer industry
(vi) natural gas	-	aluminium industry
(vii) uranium	-	iron and steel industry

3. Tick mark one of the following alternatives which is incorrect.
   A big hydro-electric power plant
   (a) is easy and quick to set-up.
   (b) uses renewable sources of energy.
   (c) produces pollution free energy.
   (d) has low recurring costs.
4. Compare and contrast conventional and non-conventional sources of energy.
5. Give an account of distribution of iron-ore and coal deposits in India.
6. Write a brief note on our mineral oil and gas deposits covering the following points:
   (a) potential areas of deposits
   (b) production trend
   (c) growth in demand and consumption
   (d) refining industry.
7. Hold a class discussion on:
   (a) The role of non-conventional sources of energy

   or

   (b) Pros and cons of nuclear energy prospects in India.

Map Work

8. On an outline map of India show the following:
   (i) Oil refineries in India
   (ii) Three major mica producing areas
   (iii) Bailadila iron-ore mines and transport line connecting to Visakhapatnam
   (iv) Lignite deposits in Tamil Nadu
   (v) Coal reserves of the Damodar Valley.

UNIT THREE

Agriculture and Industry

We surveyed our physical setting and took stock of the resources provided to us by nature. Now we turn to a fascinating area to see for ourselves how far we have been able to make use of them and at what pace.

India has a long and proud tradition of agriculture, starting with the end of nomadic life and leading to a highly developed self-contained village economy based on the then principle of the static division of labour. Now, the pendulum has started swinging once again in the opposite direction. The motive force behind this swing is the new universal value system. It encompasses social mobility based on social justice and territorial division of labour where village and even a country becomes an obsolete unit in this fast shrinking world. The watchword of our times is application of knowledge and skills made available to us by the ever widening horizons of science and technology.

The Indian agriculture has now been shedding its subsistence character and is poised to enter into an entirely different phase of commercial agriculture. Our ever increasing population is compelling us to give up the old time-tested ways of maintaining soil fertility. Manures are being replaced by chemical fertilizers. Even marginal lands are being ploughed. Irrigation is being extended even to the most arid areas changing the age-old eco-system. The results of all these are yet to be known. Small and marginal farmers have started leaving the rural areas for their inability to compete with their better off fellow farmers. The agricultural produce has more than tripled but it will have to be further tripled before the population can be hopefully expected to stabilise in the next four or five decades.

Based on the broad foundations of expanding agriculture, we are now busy building a super structure of industry. It has been providing livelihood to a large number of people in the countryside who can no longer be absorbed in farming activities. Industry has been helping in "value addition" to our agricultural and mineral resources. Compared to agriculture, industry has the capacity to increase national wealth somewhat faster. The quickening of the process of industrialization has led to a new hunger for energy, particularly coal, mineral oil and natural

gas. These are fossil fuels of exhaustible or non-renewable nature. Rapid industrialization has also led to rapid urbanization. It is partially accentuated by the rapid growth of our population. Industrialization, together with urbanization, has led to a growing degradation of environment and to ecological imbalance.

Thus the twin challenges of industrialization and urbanization need to be met with well thought out policies which would ensure proper upkeep of environment, avoiding wastage and destruction of the natural resource base. Greater emphasis will have to be laid on the use of renewable and inexhaustible sources of energy. Pollution of soil, water, air and even noise will have to be arrested and stopped at any cost.

CHAPTER 6

Diversifying Our Agriculture

India is essentially an agricultural land. Indian society is an agrarian society. Agriculture has been the mainstay of its economy. Nearly 64% of its population still lives by agriculture, even though the share of agriculture in the gross national product has been progressively declining. During 1951 to 1956 its share stood at 60.5 per cent. Statistics for 1998-1999 show that it has slided down to 27.4 per cent only. Nonetheless, the importance of agriculture cannot be minimised for years to come. It feeds our ever increasing population. It has the distinction of sustaining two-thirds of our population entirely on its own. It provides the raw material to agro-based industries, contributing substantially to our national income and a base for huge employment potential in agro-based industries. It is on the broad foundations of Indian agriculture that the industrial structure is being built.

In 1950-51, the area under foodgrains was as high as 76.7 per cent. By 1994-95 it came down considerably to 66.9 per cent only—a clear indication of our resolve to diversify agriculture to meet the changing needs of our society committed to rapid industrialization.

Agriculture includes farming, animal rearing, fishing and forestry. Indian agriculture has made rapid strides since Independence. It tripled its food production. Production of jute and cotton which suffered heavily due to Partition has also improved. It has been possible because of hard-working nature of our farmers and favourable soil and climatic conditions. Against the world's average of 11 per cent of net cultivated area, our country is fortunate enough to have as high as 51 per cent of our area under cultivation. While most of the world's countries raise only one crop, India has the potential to raise two. The area that can be brought under irrigation is almost equal to the total net cultivated area of China.

Even so, Indian agriculture suffers from certain basic problems. For understanding the strengths and weaknesses of Indian agriculture, do the activities as suggested below:

FOR DOING IT YOURSELF

1. Study Table 6.1 and answer the following questions:

TABLE 6.1

Yields of Cereals in kg per Hectare in Some Asian Countries in 1985

1.	Japan	5848	4.	Bangladesh	2098
2.	China	3821	5.	Pakistan	1570
3.	Malaysia	2781	6.	India	1560

(i) Which of the following reasons may be attributed for India's dismal performance in 1985?
(a) uncertain distribution of rains
(b) high population pressure forcing her to use marginal lands
(c) a combination of several medium and low output cereals like coarse and small grains etc.
(d) inadequate irrigation facilities
(ii) Find out the average yield of cereals in India now. What does it indicate?

2. Study Table 6.2 and answer the following questions:

TABLE 6.2

Progress of Selected Agricultural Development Programme (1971-1997)

Programme	*Area in Million Hectares*	*1970-71*	*1990-91*	*1996-97*
Total high-yielding varieties		15.4	65.0	76.4
Irrigated Area Total		38.0	70.8	80.7
(a) Major & Medium		17.3	26.0	28.4
(b) Minor		20.7	44.8	52.3
Soil Conservation		13.4	34.9	39.3
Fertiliser Consumption	(Million Tonnes)	2.2	12.5	14.3

(i) Compare the contribution of
(a) Major and Medium Irrigation and
(b) Minor irrigation (which includes utilisation of ground water also) over the last 27 years. Which of the two had a predominant role? Give reason.
(ii) Explain how use of high-yielding varieties of seed and fertilisers have been contributing to rapid growth of yields per hectare.

3. Study Table 6.3 and answer the following questions:

TABLE 6.3

Growth of yield per Ha/in Kg. 1960-61 to 1996-97

	1960-61	*1980-81*	*1996-97*
1. Cereals	753	1142	1831
(a) Rice	1013	1336	1882
(b) Wheat	851	1630	2679
(c) Jowar	533	660	956
(d) Bajra	286	458	788
(e) Maize	926	1159	1720
2. Pulses	539	473	635
3. Foodgrains	710	1023	1614
4. Oil Seeds	507	532	926
5. Cotton Lint	125	152	265
6. Jute & Mesta	1049	1130	1818

(a) Name a single cereal crop whose yield per hectare has grown most spectacularly.
(b) What change did it bring in the recent history of Indian agriculture?
(c) Which two groups of crops have not increased their productivity compared to the cereal crops? Find out its cause.
(d) Of the two fibre crops whose productivity has improved more than that of the other?
(e) List cereals in the order of their growth in yield.
(f) Draw your inferences about the pulses and the oil seeds.

4. Study Table 6.4 and Answer the following questions:

TABLE 6.4

Average Size of Agricultural Holdings in Some Countries

Country	*Year*	*Hectare*
Australia	1970	1992.58
Egypt	1960	1.59
France	1970	23.07
India	1970	2.30
Japan	1970	1.01
U.S.A.	1969	137.61
Zaire (Congo)	1970	1.06

(i) List the top four countries in the order of their average land holding.
(ii) Identify the countries where the average size of the land holdings was smaller than that of India.
(iii) Compare and contrast merits and demerits of a very large and very small land holding. Take the following points into consideration.
(a) economic viability
(b) intensive and extensive farming
(c) commercial and subsistence farming
(d) mechanization
(e) labour saving and labour intensive techniques of farming
(f) related socio-economic system

5. Study Table 6.5 and answer the following questions.

TABLE 6.5

Total Number and Area of Operational Holdings according to Size (1970-71 Agricultural Census)

	Size class (ha)	No. (in million)	Percentage	Area (in million hectares)	Percentage of the arable land
(1)	Below 0.5	23.28	32.9	7.44	5.9
(2)	0.5 - 1.0	12.18	17.7	9.10	5.6
(3)	1.0 - 2.0	13.43	19.1	19.30	12.0
(4)	2.0 - 3.0	6.72	9.6	16.35	10.0
(5)	3.0 - 4.0	3.96	5.6	13.64	8.4
(6)	4.0 - 5.0	2.68	3.8	11.93	7.4
(7)	5.0 - 10.0	5.25	7.4	36.30	22.4
(8)	10.0 - 20.0	2.13	3.0	28.52	17.7
(9)	20.0 - 30.0	0.40	0.6	9.34	5.9
(10)	30.0 - 40.0	0.12	0.2	4.18	2.6
(11)	40.0 - 50.0	0.04	0.1	2.05	1.3
(12)	50.0 - and above	0.06	0.1	5.97	3.8
	All India Total	70.25	100.0	162.12	10.0

(i) Note the number and the percentage of the smallest sized holdings in India. Find out the percentage of the total arable land these smallest holdings account for. Draw your inferences in regard to
   (a) economic viability
   (b) population pressure on land
   (c) push factor in rapid urbanization
   (d) rural poverty
   (e) disguised unemployment and under-employment
   (f) credit, investment and use of new technology
   (g) cooperative movement
   (h) type of feasible farming.

(ii) Do a similar exercise for operational holdings between 20 hectares and 50 or more (Row Nos. 9 to 12)

(iii) Prepare a note on uneven distribution of land in our country and its socio-economic implications.

6. Study Table 6.6 and answer the following questions.

TABLE 6.6

Phase-I

Some Facts about Green Revolution in India (1970-71 - 1985-86)

(A) *Per capita Income* (1985-86) at 1970-71 prices
   India — Rs. 770
   Punjab — Rs. 1600

(B) *Commercial Nature of Agriculture*
   (a) Paddy (rice) procured by State agencies
   85.7% of the production
   (b) Wheat procured by State agencies
   57.3% of the production

(C) *Mechanisation of Agriculture*
   (a) One-third of the country's tractors were in Punjab alone
   (b) Ploughing, sowing, harvesting almost mechanised
   (c) Animal power replaced by mechanical power

(D) *Irrigation*
   (a) Mechanically operated tubewells provide assured irrigation
   (b) Irrigation Index
   1970-71 — 71% of the net sown area
   75% of the gross sown area
   1985-86 — 88% of the net sown area
   91% of the gross sown area
   (c) National irrigation index 28 per cent (1988)

(E) *Area under Heavy Yielding Varieties of Seeds*
   Wheat 100 per cent
   Rice 95 per cent

(F) *Consumption of Fertilizers*
   1970-71 — 213,000 nutrient tonnes
   1985-86 — 1,098,000 nutrient tonnes

(G) *Crop Intensity Index*
   1.87 (Almost two crops a year)

(H) *Wheat yield per hectare — 1985-86*
   India — 2032 kg.
   Punjab — 3531 kg.

(I) *Change in Size of Operational Land Holdings*
   (a) holdings above 10 hectares each — 7.3%
   the total area they account for — 29.2%

(b) marginal cultivators 38.6%
of the total area they account for only 10%

(J) *Agricultural labourers*
1971 : 32.06 per cent
1981 : 38.19 per cent

The rise ascribed to
(a) occupational shifts from rural artisans
(b) [illegible]
(c) influx of migrant labour from Bihar and east UP

(K) *Farmers below Poverty line (1979-80)*
24 per cent of the small farmers
31 per cent of the marginal farmers

(L) Marginal holdings declined by 61.9%
Small holdings declined by 23.3%
No. of operational holdings declined by 384,000 in a single decade
(i) List the characteristics of Green Revolution
(ii) Find out why Green Revolution is mainly confined to north-western part of India and largely to the wheat crop only
(iii) Write a critical note on socio-economic implications of Green Revolution

(M) Write a critical note on socio-Green Revolution in India based on the above Table.

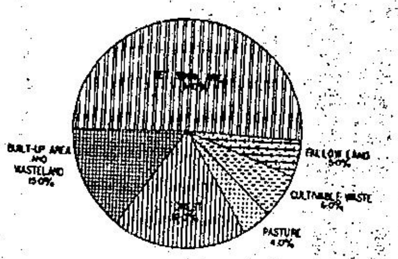


Fig. 6.1 Land Use Pattern
Note the different uses of the land. On the basis of the percentage, arrange them in an ascending order.

Problems Confronting Indian Agriculture

Perhaps the greatest problem of Indian agriculture is the tremendous population pressure it has to groan under. With nearly 300 persons per square kilometre, the hunger for land has remained unsatiable. Every possible marginal and even far from fertile pieces of land have been brought under the plough. In the hills, terraced farms rise in stairs up to the top. Forests have been mercilessly cut. The per capita availability of cultivated land has come down to only a fifth of a hectare. And when our population doubles, which it does almost every 35 years, the share of an individual would further slide down to one-tenth of a hectare. Under these conditions, the bulk

of land holdings are small. What is worse is their most uneven distribution, causing social tensions, violence and discontent. One-third of the land holdings are less than half a hectare in size. These holdings account for 3.9 percent of the arable land. On the other hand land holdings between 10 and 50 hectares and above are only 4 per cent in number. They, however, claim 31 per cent of the cultivated area.

Thus bulk of the land-owners have most uneconomic land holdings. Being too small in size, these holdings have lent to our agriculture, the dominant characteristic of subsistence farming. Here poor farmers have to struggle day in and day out on farms, which are too small to support them and their families. Indian agriculture has, therefore, stagnated for decades.

In the absence of adequate forest and pasture lands, the sources of maintaining natural fertility of the soil have been drying out. The lack of material resources and ignorance of scientific knowledge have only further depleted the soils of the natural fertility. There was a time when animal waste was enough to maintain soil fertility. But now that the population has been making increasingly greater demands on the soils, the subsistence farming techniques are no more relevant. We have been passing through this critical transition from subsistence agriculture to commercial farming based on varied scientific and material inputs. This calls for change at every step of farming.

In the first place the size of the holdings needs to be economically viable. The measures like chakbandi are a step in that direction. Further fragmentation of land holdings should be stopped. Small farmers should cooperatively plough their lands with more powerful ploughs or tractors of varying size and strength at least periodically. Even the ploughing techniques need to be scientific. For instance, bunding and contour ploughing are highly beneficial in dry farming to retain the maximum amount of moisture, and to avoid soil erosion.

Chemically treated seeds and high yielding varieties made all the difference between a poor and a bumper crop. The government has come forward with the improved seeds on a commercial scale. But behind them lie the marathon efforts of our agricultural scientists in developing such seeds through years of experimentation under differing soil and climatic conditions. Now insecticides, pesticides, fungicides and weedicides are available that save crops from insects, pests, fungi and weeds.

Now that the natural fertility is on decline because of hundreds of years of farming, green or bio-manures including animal dung also need to be supplemented with chemical fertilizers with suitable and optimum doses. The facilities for soil testing are available for the purpose.

Multiple cropping, intercropping, strip cropping and scientific rotation of crops is a must. This ensures better crop yields, besides maintaining the fertility of the soil. Further impoverishment of soil could be a fatal blow to our civilization which is at least 5000 years old.

Agricultural tools and implements play an important role in maximising agricultural output and cutting down the time required for different farm operations such as ploughing, sowing, weeding, spraying, irrigating, water sprinkling, harvesting, threshing, trans-

porting and storing. Today tractors, harvestors, combines, tractor trolleys, water pumping sets and water sprinklers are being increasingly used on our farms. Many of them have been developed to suit the requirements of our medium sized farm holdings. The saving of time has become critical in some agricultural pockets where three crops in close succession are raised in a year. For instance in Tanjaur district of the Kaveri Delta the first kharif crop of rice has to be quickly harvested and dried before the second crop could be sown or transplanted in time so that it could ripen prior to a fixed climatic deadline. Likewise, storage of foodgrains is a big challenge. Nearly 10 per cent of our harvest is allowed to be wasted every year! Hence scientific warehousing facilities are a must. The government has been active on this front to provide these facilities.

All the above mentioned inputs in Indian agriculture are very largely based on timely and adequate irrigation facilities. High yielding varieties of seeds and application of chemical fertilizers have no meaning if assured water supply is not available. India has been successful in increasing its food production nearly four times in the last fifty years. Area under irrigation has also increased considerably. Nearly half of the total area under food crops has been brought under irrigation. Crops like wheat and sugarcane are being grown mostly with the help of irrigation (over 80% land irrigated).

The government on its part has undertaken several steps to lift agriculture from subsistence level to a more vibrant, self sustaining level. It has taken legislative measures to abolish zamindari system helping peasants to be land-owners. It has been promoting consolidation of scattered land holding through *chakbandi*. Efforts are being made to popularise cooperative movement among the farmers to collectively tackle their problems of credit and marketing. There are district lead banks to promote agricultural development. Nationalised banks are also required to provide loans to farmers on relatively easy terms. National Seeds Corporation, National Warehousing Corporation, National Food Corporation, Indian Council of Agricultural Research, Agricultural Universities, National Dairy Board and several other institutions have been working to improve agriculture. National demonstration farms play an important role at grass-root level. Agricultural Prices Commission recommends remunerative prices for the crops. The government ensures minimum support prices for various crops to avoid distress selling on the part of the farmers. Considerable progress has been made in extending irrigation and electricity facilities for farm activities.

Wherever the prices of agricultural crops were raised to make their remunerative the farmers responded by raising their production and productivity. The fact that two-thirds of the manpower is able to account for only a third of the national income, needs to be carefully and sympathetically looked into. No corrective measures should be too dear to a country which still boasts of being an agricultural land and an agrarian society committed to the collective goods of one and all.

Agricultural Seasons

Agricultural activity by and large comes to a standstill during the peak summer season. With premonsoon showers the farm activities again pick up their tempo. Farmers plough land, prepare nurseries and await the break of the monsoon. With its onset they sow their *kharif* crops in June or early July. By the end of the monsoons these are ready for harvest. These *kharif* crops include rice, millets, maize, groundnuts, jute and cotton. Pulses are also grown during this season. Pulses like *arhar* take longer to mature, as they contain protein.

The next cropping season is called *rabi*. It largely depends upon subsoil moisture. The sowing is done in November and crops are harvested in April-May. The major crops are wheat, gram and oil seeds like mustard and rape seed.

Besides these two dominant crop seasons, a brief cropping season has been lately introduced mainly in irrigated areas where early-maturing crops are grown. *Moong* and *urad* are popular crops of this season. It would help in improving the protein content of our diet. Watermelons and cucumber are also grown in this season.

It has been rightly observed that India produces every cereal, pulse, vegetable and fruit, not excluding fibre crop, under the sun. Let us begin with food crops which include cereals and pulses. We may have a look at the national food budget before we study other crops like oilseeds, sugarcane, potatoes, spices, fruits, etc. Beverages and fibres are the other important crops of the Indian agriculture.

FOOD CROPS

Rice

Rice is the staple food crop of India. Being a tropical plant it thrives well in hot and humid climate. That is why it is essentially a *kharif* crop in India. It requires temperature of 25°C and above and flourishes in a rainfall of 100 centimetres and above. Note this *isohyet* on the map. It demarcates very clearly (i) the western coastal strip, (ii) the eastern coastal strip, covering all the major deltas, (iii) Assam plains and surrounding low hills, (iv) foothills and terai region along the Himalayas, and (v) West Bengal, Bihar, eastern Uttar Pradesh, eastern Madhya Pradesh, northern Andhra Pradesh and the whole of Orissa.

India has the largest area under rice cultivation in the world. Its output of rice, however, is next only to that of China. In 1950-51, area under rice cultivation was 30 million hectares. By 1997-98 it had risen to 43.4 million hectares. The production too rose from 25 million tonnes to 82.3 million tonnes. Thereby its yield per hectare also shot up to 1895 kg per hectare from 668 kg—i.e. by well over two and a half times. West Bengal led the country in rice production with a share of 13.2 million tonnes closely followed by Uttar Pradesh with 12.5 million tonnes. Then stood Andhra Pradesh, Punjab and Tamil Nadu in that order. In rice production and yield China stands far ahead of us.

Our country being a land of unending growing season, and the deltas of Kaveri, Krishna, Godavari and Mahanadi with a dense network of canal irrigation, allows farmers to raise two, and in some pockets, even three crops a year. Irrigation has made even three crops a year. Irrigation has made it possible even for Punjab and Haryana, known for their arid climate, to grow rice. They even export their surplus to other states. Punjab and Haryana raise quality rice for

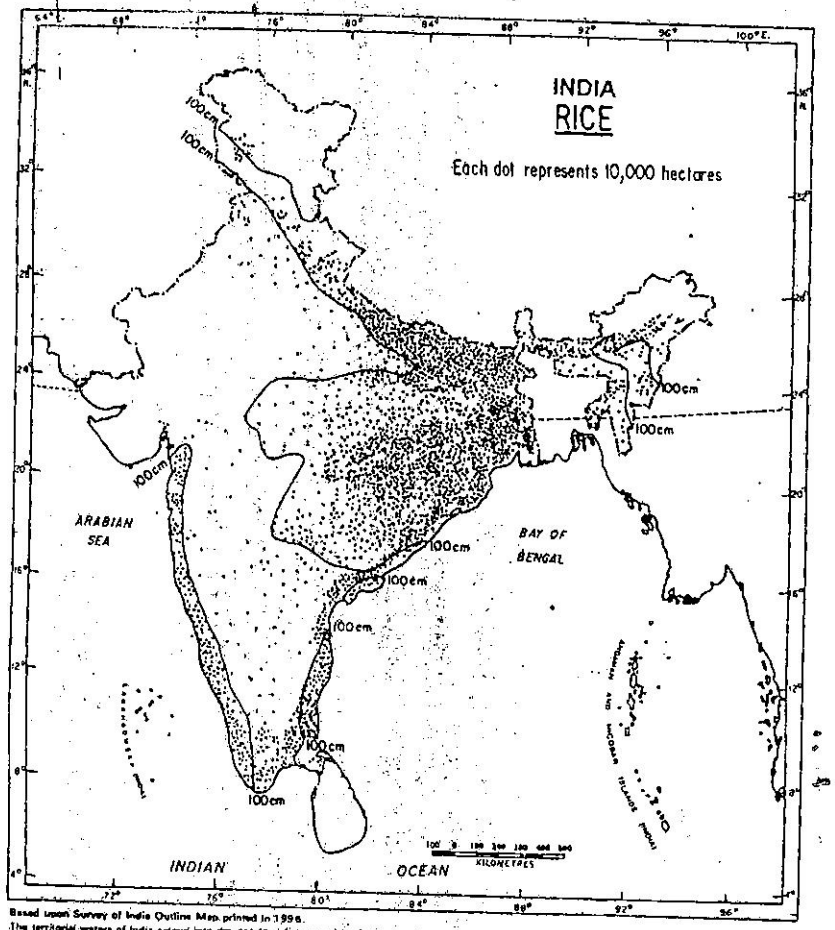


Fig. 6.2 India—Distribution of Rice

Note that the cultivation of rice is confined mainly to coastal strips, specially the deltas and areas having a rainfall of more than 100 centimetres, unless it is well irrigated.

export purposes. The hilly terraced fields from Kashmir to Assam are ideally suited for rice farming with age old hill irrigation facilities. High yielding varieties improved planting techniques, assured irrigation water supply and growing use of fertilizers have together led to good and quick results. It is the rainfed area that brings down average yields per hectare.

Wheat

The story of wheat is even more fascinating than that of rice. It is one of the oldest crops introduced in India at least four thousand years ago from the Middle East, i.e. mainly East Mediterranean and West Asia. It does well on the loamy soils of the Northern plains covering Punjab, Haryana and western Uttar Pradesh, in that order. It also grows well in the black soils of Madhya Pradesh. The minor areas extend to the rest of Uttar Pradesh, Bihar, Rajasthan, Gujarat and Maharashtra. It is, however, essentially a crop of north India.

It requires a cool and moist climate during growing season and a dry warm climate at the time of ripening. Annual rainfall of 50 to 75 centimetres is generally suitable. All these requirements make it an ideal rabi crop. A few light winter showers or assured irrigation ensure a bumper harvest. Unlike the rice crop, it is not so much at the mercy of the elements of nature.

In the year 1950-51 area under wheat was 9.7 million hectares with a total production of 6.4 million tonnes. However by 1997-98 the area under wheat had risen to 26.7 million hectares, touching even a more impressive production figure of 65.9 million tonnes. As a result during the same period the yield per hectare rose from 660 kg to 2470 kg—i.e. more than three and a half times.

Among the states Uttar Pradesh led the country in wheat production with 18.6 million tonnes in 1997-98. It was followed by Punjab (12.7 million tonnes), Haryana, Madhya Pradesh and Rajasthan in that order.

The breakthrough that we achieved in increasing agricultural productivity is popularly described as the Green Revolution. The credit goes to our scientists in the Indian Council of Agricultural Research who developed several high yielding varieties through dedicated experimentation. Assistance received from Mr. Baurlog, an eminent agronomist from America, is worth mentioning.

Millets

Millets like *jowar* (sorghum), *bajra* (pearl millets) and *ragi* (finger millets) are also called coarse grains. They are *kharif* crops and are mainly rainfed crops needing hardly any irrigation facilities. Unlike rice, they grow in less rainly areas in the following order—ragi, (damp areas), jowar (moist areas), and bajra (dry areas). Ragi which requires relatively more rains is grown more commonly in Karnataka and Tamil Nadu; jowar in Karnataka, Andhra Pradesh, Maharashtra and Madhya Pradesh, and Bajra in the drier parts of Maharashtra, Gujarat, Rajasthan and south-west Uttar Pradesh. India leads the world in the production of millets. The area under these crops has not increased. But the production of jowar and bajra has increased from 7 million tonnes to 19 million tonnes by 1996-97. Millets have a protein content higher than both wheat and rice individually.

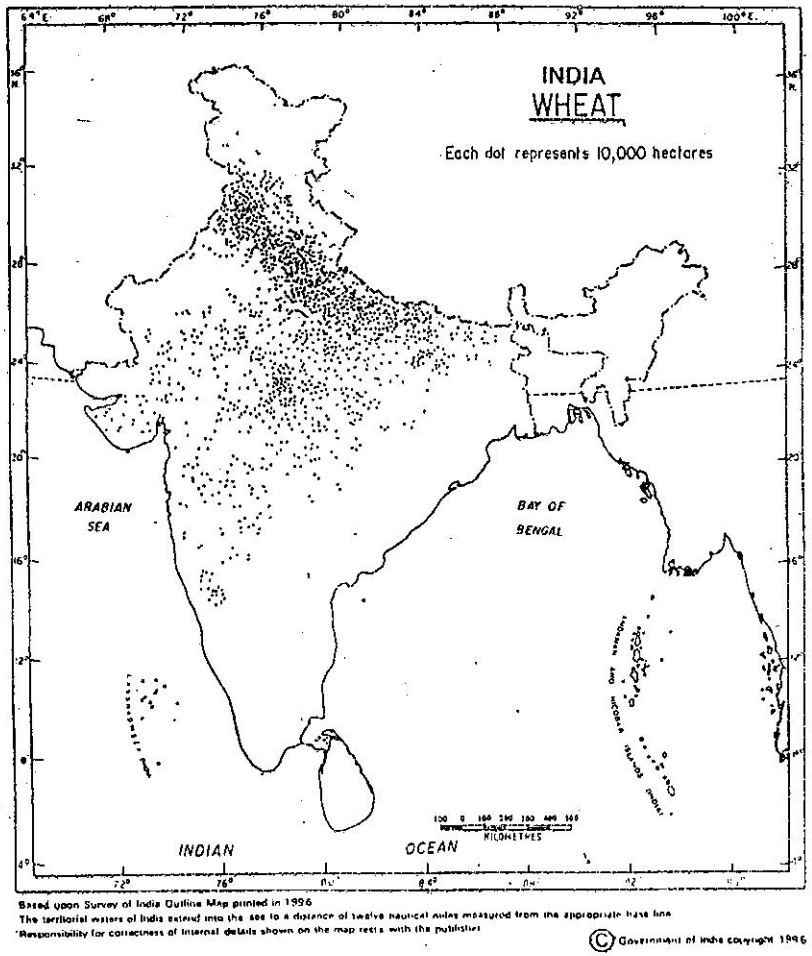


Fig. 6.3 India—Distribution of Wheat

Wheat being a crop of the temperate zone is important in northern India where there is a relatively long cool winter season with occasional showers. Wheat is also grown in the plateau region of central and western India What factors favour the cultivation of wheat in these areas?

Maize

Maize, being an American crop, is relatively a new enterant. However, it is gaining popularity because of its high yields, and its easy adaptability to various soils and climatic conditions. Uttar Pradesh, Rajasthan, Bihar and Punjab are the major producers.

In 1950-51 the area under this crop was 3.2 million hectares. It has risen to nearly 6.2 million hectares by 1996-97. The production has also jumped from less than 2 million tonnes to 10.6 million tonnes. Thus, the productivity has tripled during this period.

Pulses

India is the largest producer as well as the consumer of pulses. So far they have been the major source of protein for our people, as meat is out of reach for most of the people. The pulses include grams *(chana)*, *arhar* or *tur*, *moong*, black gram *(urad)*, lentil *(masur)* and peas *(matar)*. They are grown all over the country except in areas with a heavy rainfall. These are again mostly rainfed crops. Being leguminous, these plants help in restoring the fertility of the soil and are, therefore, grown in rotation with other crops. Interculture is another common practice.

In 1950-51 the land under pulses was nearly 19 million hectares. It has risen to 23 million hectares, the highest in the world. The production has increased to 14.4 million tonnes with a marginal increase in yield from 4.4 quintals to 6.2 quintals per hectares by 1996-97.

One thing is clear from the facts mentioned above that the prospects of bringing more pulses within the reach of the common man are bleak. The limitations of the so called Green Revolution are obvious. For heavy yielding varieties, assured irrigation and higher inputs of chemical fertilizers are the pre-requisites. Similarly the support prices should be equally attractive. Nevertheless, the only positive change is introduction of a short duration third crop of moong and urd, which can be grown as post rabi crop. Situation can be improved if we develop new varieties of seeds increasing their yield.

Our Food Requirements of Tomorrow

The food requirement of a country is determined by the size of its population and its living standards. Population of our country has now been doubling itself every 35 years. Despite the substantial success achieved in reducing the growth rate of population, it is feared that population will not stabilise below 1500 million, by the middle of next century. More reasonable estimates put this limit between 1600 and 1700 million in the latter half of the 21st century.

We will require 400 million tonnes of foodgrains alone to meet the food requirements of 1600 million people. Even by 2010 A.D. the need would be between 230 and 240 million tonnes. Although this is not impossible, it would put tremendous strain on our limited financial resources, affecting the developmental inputs in other crucial sectors including health and education. By 2025 we would reach a saturation point in our irrigation potential by utilizing the maximum of 105 million hectare metres.

Oilseeds

Vegetable oil being the common medium of cooking, oilseeds are as important as the pulses. The principal oilseeds are groundnuts, rapeseeds and mustard seeds. While the former is a kharif crop depending entirely

upon moderate but timely rainfall, the latter is a rabi crop essentially confined only to non-irrigated areas. As such their production as well as productivity is subject to climatic fluctuations and market speculations. The other oilseeds are sesame, linseed, caster seed, safflower seed, soyabeans, sunflower seeds, cotton seeds and copra. Rapeseeds and mustard seeds belong to the wheat belt of north and central India. Groundnut, on the other hand, is grown in west and south India. Gujarat is the dominant producer of groundnut. While the population has been increasing at 2 per cent per annum the demand for oil has been rising at 5 per cent a year. Why should it be so?

In the year 1950-51 the area under groundnut was 4.5 million hectares. By 1996-97 it rose to 7.8 million hectares. And production too rose to 9 million tonnes from 3.4 million tonnes. The same is true of yield per hectare which stood at 1155 kg per hectare against the figure of 775. The story of rabi oilseeds namely rapeseed and mustard is equally encouraging. The area in this period rose to 6.8 million hectares from mere 2 million hectares; and production from 0.7 million tonnes to nearly 7 million tonnes—a ten times rise! The yield also increased from 368 kg to 1013 kg per hectare. The overall production of nine oilseeds rose to about 25 million tonnes by 1996-97.

In order to cut down imports of palm oil, plantation of oil palm trees has now been undertaken on a large scale.

Sugarcane and Potato

Over the years sugar has become an important ingredient of our daily food intake. For our daily sugar needs, we depend exclusively on *sugarcane*. Incidentally India is claimed to be its original home. India has the largest area under sugarcane and its production is also the highest in the world. Uttar Pradesh is a leading producer, followed by Maharashtra, Punjab, Andhra Pradesh, Bihar, Tamil Nadu and Karnataka.

Sugarcane requires well drained fertile soil, and plenty of manure and fertilizers. It needs hot and moist climate and a rainfall of about 100 centimetres. It really does well in irrigated lands with abundant sunshine.

Sugarcane is the most irrigated crop in India, as 88% area under this crop has irrigation facilities. In 1950-51 the area under sugarcane was 1.7 million hectares. By 1997-98 it rose to 4 million hectares. Production also jumped from 57 million tonnes to over 275 million tonnes and correspondingly the yield per hectare also rose from 33 tonnes to 70 tonnes. It is still far behind the yield of sugarcane in Hawai Islands.

Introduced by the Portuguese in our country in the 16th century, potatoes are used as a stock vegetable. Its major producers are Uttar Pradesh, West Bengal and Bihar. In 1996-97 the area under potato was 1.2 million hectares and production of 24 million tonnes compared to mere 2.7 million tonnes in 1960-61. The yield per hectare also rose from 7 tonnes per hectare to 19 tonnes per hectare during this period. In countries like Russia, Poland and Ireland it is one of the staple foods. Himachal Pradesh in our country specialises in potato seed production.

Spices and Fruits

What refrigeration can do today was being done by the spices for centuries—preserving meat etc. in European countries. Hence

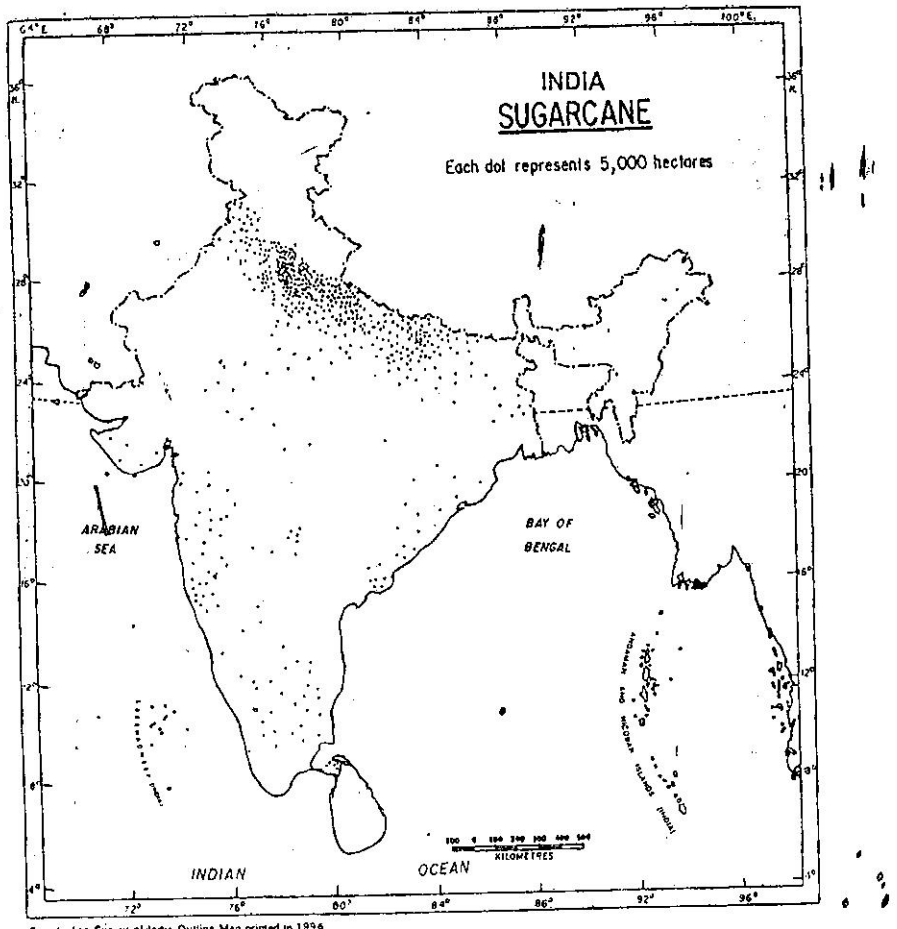


Fig. 6.4 India—Distribution of Sugarcane

Note that the Northern Plains produced the bulk of the sugarcane in India, although it is a tropical crop. How would you account for this?

their demand in Europe raised a special interest in trade with India. Pepper, cardamom, cloves, mace, cinnamon, ginger, nutmeg and cassia etc. are together known as spices. They are mainly grown in the Malabar coast of Kerala and Karnataka.

In 1960-61, 47,000 tonnes of spices were exported bringing in 36 million U.S. dollars. By 1997-98 these figures had changed to 241,000 tonnes, and 379 million U.S. dollars. Indeed a very good performance!

Fruits

Intensive cultivation of vegetables, flowers and fruits is called horticulture. Indian mangoes and bananas are now in greater demand outside the country. India is a producer of tropical fruits like coconuts, jackfruits, cashewnuts, pineapples, bananas and oranges. Of the temperate fruit, apples, plums, peaches, almonds, apricots, grapes are grown in plenty. While Jammu and Kashmir and Himachal Pradesh lead in the fruit production of the temperate region, others are grown in various parts of peninsular India and the Northern Plains. India earns foreign exchange by exporting cashewnuts. Part of the raw cashewnuts is imported and processed here before they are re-exported.

In 1960-61 about 4,300 tonnes of cashew-kernels were exported fetching 40 million U.S. dollars. By 1997-98 the quantity of exports rose to 76,000 tonnes and foreign exchange earnings touched a high of 372 million U.S. dollars.

India now tops the world in fruit production and ranks second in production of vegetables. In 1995-96 the total production of fruits was 41 million tonnes and that of vegetable over 70 million tonnes.

BEVERAGES

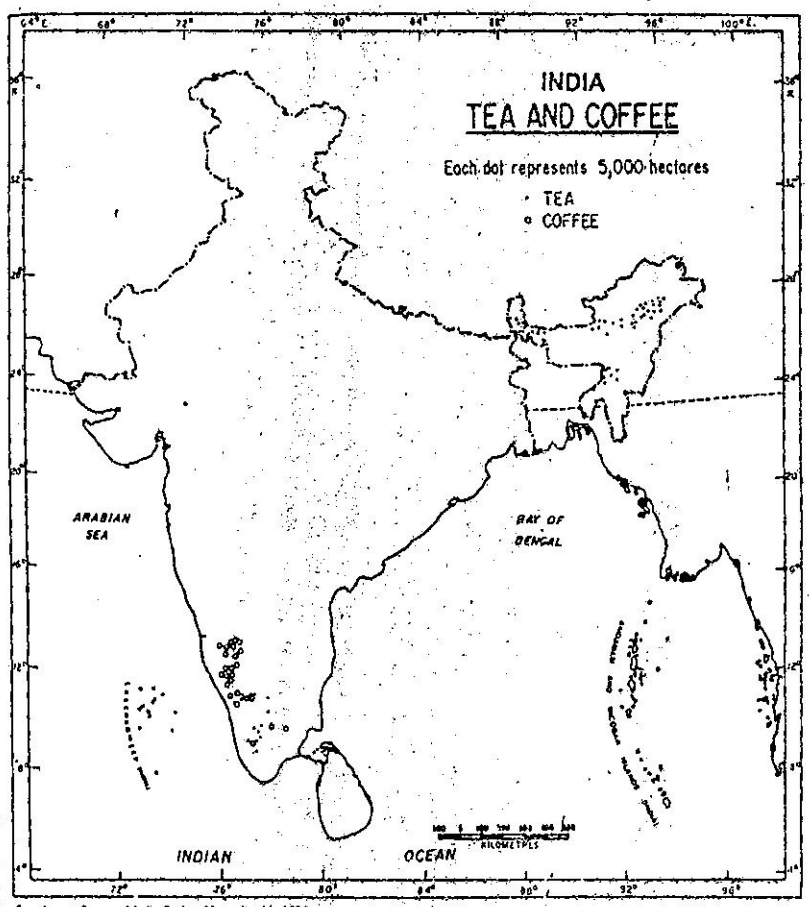
Tea, coffee and cocoa are the beverage crops of India. India has been the leading producer of tea. It represents a spectacular success in plantation agriculture run on the most scientific and commercial lines. Though introduced by the British in their own interest, the industry is now in Indian hands. It employs a million persons directly and another equal number indirectly. Thus it is a labour intensive industry. Plantation agriculture is a part of horticulture.

Tea grows well in deep and fertile well-drained soils. It requires warm and moist climate all through the year. Frequent showers well distributed over the year ensure continuous growth of tender leaves. Undulating plains of the Brahmaputra valley extending into low hills of Assam is the home of Indian Tea. Hills of Darjeeling and Jalpaiguri in northern West Bengal and the hills of the Nilgiris are other tea producing areas. They are also known for their quality tea.

In 1950-51 over 300,000 hectares area was under tea plantations. By 1997-98 it stood at 400,000 hectares. In this period production also rose to 800,000 tonnes. More importantly the yield per hectare which was 971 kg per hectare in 1960-61, had risen to 1875 by 1996-97. The per capita availability of tea in India has risen to 636 grammes per year from 362 gm in 1955-56. Sri Lanka very closely competes with India. Kenya has also emerged as a new exporter of tea. India's domestic tea market has been growing much faster and hence its inability to export enough.

Coffee

It stands next only to tea as a popular bever-



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
Responsibility for correctness of internal details shown on the map rests with the publisher.
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Fig. 6.5 India—Distribution of Tea and Coffee

Note the areas producing tea and coffee. Name the states known for tea and coffee cultivations.

age in the world as well as in India. If tea belongs to the north-eastern part, coffee is confined to the south-western part of the world. Unlike tea, coffee holdings are of less than 10 hectares each.

Coffee grows in tropical highlands at altitudes varying between 900 and 1800 metres above sea level. In India they grow well on laterite soils of Karnataka. In 1950-51 the area under coffee was 91,000 hectares with a production of 25,000 tonnes. By 1997-98 the area under coffee was 400,000 hectares and production was 200,000 tonnes. The yield also increased to 818 kg per hectare. In 1997-98, the coffee exports were 147,000 tonnes fetching 436 million U.S. dollars, even more than tea.

FIBRES

Cotton, jute, wool and natural silk are the four major fibres. While the first two are derived directly from the soil, the latter are obtained indirectly.

Cotton

The original home of the cotton plant is India. The ruins of our past civilizations revealed that in those days India was producing cotton. It used to spin yarn and weave cotton fabrics and export them to the Middle-East countries. Babylonians called cotton by the name Sindhu and Greeks named it Sindon.

Cotton grows very well in drier parts of the "black cotton soil" of the Deccan Plateau. Traditionally, the major producers are Gujarat and Maharashtra. The other producers include Punjab, Karnataka, Tamil Nadu and Madhya Pradesh. In 1988-89 the production scenario was considerably changed. Punjab led other states with 21 lakh bales followed by Gujarat, 17.5 lakh bales, Maharashtra, 16.5 lakh bales, and Andhra Pradesh, 13.2 lakh bales. The others were Rajasthan, Madhya Pradesh, Karnataka and Tamil Nadu.

In 1950-51 area under cotton was a little less than 6 million hectares. By 1997-98 the area rose to nearly 9 million hectares. Production also boosted from 3 million bales (170 kg) to over 11 million bales by 1997-98. The yield also grew from 88 kg per hectare to 213 kg of lint. India was the first to develop hybrid cotton variety leading to increased production.

Jute and Mesta

Jute was called the golden fibre of the Indian sub-continent. After partition while the jute mills remained in India around Calcutta, the bulk of the jute supplying area went over to the then East Pakistan i.e. Bangladesh of today. Over the years the great loss has been made good. Jute grows well on well-drained fertile soils in the flood plains where soils are renewed almost every year. High temperature is also a must during the growing season. West Bengal, Assam and Orissa are the states the produce jute and its another variety mesta.

In 1950-51 area under jute cultivation was 0.57 million hectares. Production was 3.3 million bales (180 kg each) and yield per hectare was just one quintal. By 1997-98, the area rose to 1.1 million hectares, production crossed 11 million tonnes mark. The yield also, shot up to about 1800 kg per hectare.

Silk

The silk tradition is one of the oldest in In-

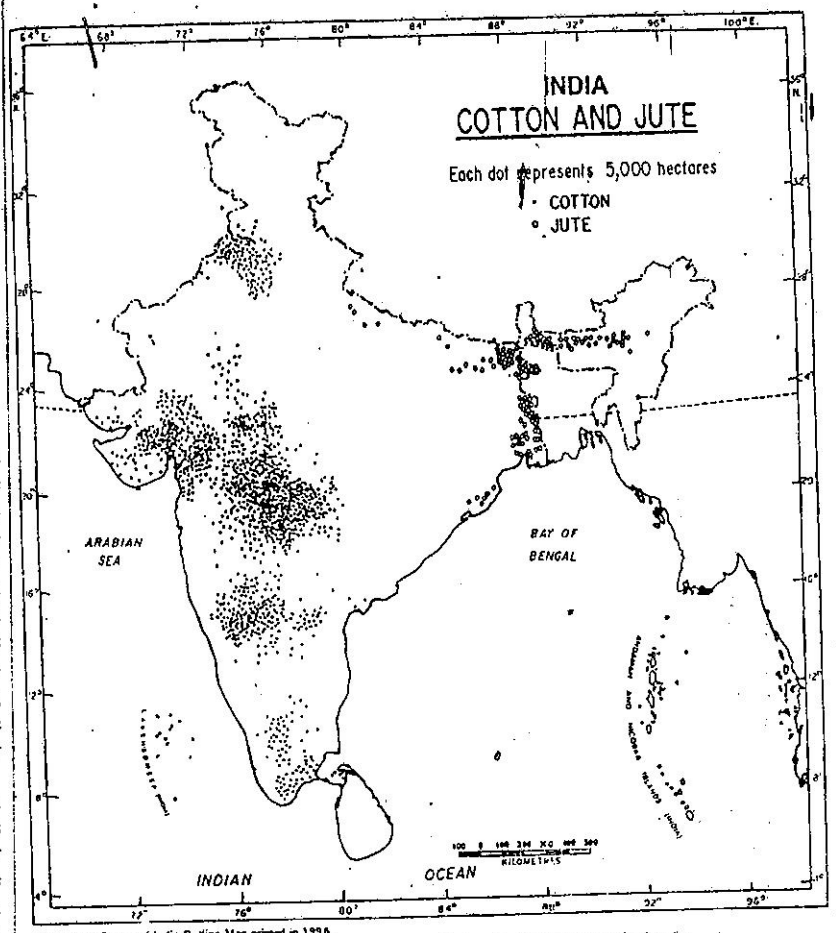


Fig. 6.6 India—Distribution of Cotton and Jute

Note the areas producing cotton and jute. While cotton is grown mainly in the western states of Gujarat and Maharashtra, Jute is grown in the Ganga delta. Why?

dia. Sericulture is a labour intensive industry. It involves rearing of silkworms, which are highly voracious. A pound of worms may consume a tonne of mulberry leaves in a year, Karnataka, Tamil Nadu, Andhra Pradesh, Assam, West Bengal, Bihar, Uttar Pradesh and Madhya Pradesh produce raw silk. In 1980-81 the production of silk was 5,000 tonnes. As Japan has withdrawn, from this industry, India has very good chance to fill in the gap. Our country would need 30,000 tonnes in near future. India earned nearly 250 crores rupees worth of foreign exchange through export of silk items. China continues to be the world leader in production of silk and its exports.

OTHER CASH CROPS

Rubber

Rubber is an important industrial raw material. It is mainly grown in Kerala.

In 1947-48, area under rubber was about 60,000 hectares. By 1997-98 it rose to 400,000 hectares. Production also grew from 14000 tonnes to half a million tonnes. Now the yield per hectare also stands at 1565 kg per hectare. The land under rubber belongs to small land holders.

Tobacco

India is the third largest producer of tobacco and ranks fifth in exports. The crop requires freedom from frost. But the soil should be rich as the crop depletes its potash content very heavily. It is a short season crop. Although widely distributed, its leading producers are Andhra Pradesh and Gujarat. About a hundred thousand tonnes of quality Virginia tobacco is exported. Production of tobacco is regulated by the Tobacco Board. Nearly 70,000 growers were registered with the Board.

ANIMAL HUSBANDRY

Farms, farm animals, and farmers together make a farming eco-system in India. To farmers farm animals are not mere animals. They often treat them as their partners. This is particularly true of cattle and buffaloes. Ox, he-buffaloes and camels are used as draught animal on the farm. They help in ploughing, sowing, thrashing and transporting farm products. Cows and she-buffaloes provide milk. Animal wastes are used as farm manures. Animal husbandry and dairy development play key role in rural development.

Cattle

Cattle are an asset to small and marginal farmers who supplement their farm income through the milk they yield. The Indian cattle species are known for their hardiness and resistance to tropical diseases. They, therefore, have a great international demand. Special efforts are being made to improve cattle breed mainly for yielding more milk. Embryo transfer technology is now being applied in a big way. Artificial insemination centres have been set up all over the country. With 205 million cattle India alone accounts for one-sixth of the world's total cattle population. And 84 million buffaloes in India constituted 55% of the world's total number of buffaloes, as per 1992 animal census. In 1951 their number was 155 million cattle and 43 million buffaloes. The milk production was 17 million tonnes in 1950. It has now risen to 71 million tonnes by 1997. India stands second in the world, next only to the U.S.A. Very shortly it will overtake U.S.A. in milk production.

Uttar Pradesh leads in cattle rearing and is followed closely by Madhya Pradesh. The states of Bihar, Maharashtra, Rajasthan and Andhra Pradesh follow suit in that order. But the quality bulls and buffaloes are from Punjab, Haryana, Gujarat, Rajasthan and Uttar Pradesh. Of its breeds, Surti and Murrah buffaloes from Gujarat and Punjab respectively are well known. The kankrej breed of cattle goes back to the Mohanjodaro and Harappa days. The other breeds are Sahiwal and Nagora from Haryana and Rajasthan and Halliker and Khillar from the south.

Sheep

The 1982 livestock census puts their total number at over 48 million. Our share in the world is among the lowest—only 4 per cent! Indian sheep yields rather low quality wool and their yield is also low. It comes to less than one kilogram per head. The total production of wool was 44,000 tonnes. Over 20,000 quality merino sheep for fine wool have been imported to improve the breeds of Indian sheep. Sheep of coarse quality wool are reared in Andhra Pradesh and Tamil Nadu. But sheep with fine quality wool are reared in western Himalayas i.e. in the states of Jammu and Kashmir and Himachal Pradesh.

Goats

Known as poor man's cow, goats are more numerous in India, particularly in Bihar, Rajasthan and Madhya Pradesh. They account for one-sixth of the world's total.

India's share of horses, ponies and mules is very low—just 2 per cent of the world's aggregate. Camels and yaks are the other domestic animals in India.

Poultry

Although an old pursuit, the poultry has of late acquired considerable importance both in farmer's economy and in the Indian diet, both of which have remained poor for long. The annual production of eggs was less than two billion in 1950-51. It rose to 28 billion by 1996-97. Broiler production, almost unknown till 1961, had risen to 80 million birds during 1986-87. Duck are also now bred on a large scale. The annual production of meat of different species has crossed one million tonne mark. Its export earned Rs. 1925 crores of rupees in 1996-97. Pork is derived from 10 million pigs reared in the country.

For taking due care of the health of livestock, sizeable number of veterinary hospitals and dispensaries have been set up.

Dairying and Operation Flood

After the Green Revolution there is a talk about White Revolution. It is also known as "operation flood". Dairy development is one of the successful planks of integrated rural development. It can supplement the meagre income of the small and marginal farmers and can also augment farm manure and biogas in the interest of rural economy. It can help many families to rise above the poverty line. The dairy cooperatives have given a fillip to rural development. They collect and market milk. The ideal dairy co-operative in India is in the Kaira district of Gujarat. It markets its milk even in far off places like Delhi, and supplies butter and cheese to a large urban population in the country. National Milk Grid is the major achievement of the operation flood. It helps

in offsetting regional and seasonal imbalances in milk collection and distribution.

FISHERIES

A country, which has a limited scope to further exploit its land harvests, must turn to the sea. India is endowed with a huge potential to derive its food from the exclusive economic zone of nearly two million square kilometers. With a vast continental shelf, active sea currents and large rivers dumping fish food into the sea, India has rich marine fisheries to develop and exploit. The marine fish catch was half a million tonnes in 1950-51. By 1997-98 it had risen to 3 million tonnes. The inland fish catch was 2.4 million tonnes. The mechanised fishing has adversely affected the traditional fishermen. For increasing its marine fish catch, it needs big mechanised fishing craft and vessels. It must also add to its landing and berthing facilities in big and small fishing harbours. Cold storage and processing facilities of marine products is another requirement. Considerable progress has been made in this direction. The fishing vessels for our fishermen are under construction both in Indian and foreign shipyards.

Likewise inland fishing is to be further developed for which there is ample scope in rivers and several huge water reservoirs developed over the past 40 years.

The country has vast scope to increase employment opportunities in this promising field. In 1997-98, exports of fish and fish products fetched 1160 million U.S. dollars.

FORESTRY

Forests play a very important role in maintaining the ecological balance and natural eco-systems. But they are also an economic asset. They provide timber and fuel wood. The quality timber comes from teak forests typical of the monsoon lands. These deciduous forests extend between the Western Ghats in the south and the sub-Himalayan region in the north. Sal is yet another dominant and useful tree more dominant in the eastern half of the country. Sal area is relatively larger than the teak area.

The other trees in more rainy areas are the bamboos, mahogany and rosewood. They are more common in Assam and Kerala. Sundari trees of mangrove family from Sundarbans are used for boat construction and manufacture of boxes.

The soft wood from coniferous forests of the Himalayas is used for furniture, packing boxes and also as timber in building houses. Pulp is made from soft wood and has great demand. Unfortunately a time has come to use our forest resources as sparingly as possible and only on a continuing basis, unlike the present practice of their reckless destruction.

Forests provide us not only timber but also lac, cane, resin, wood pulp, charcoal, firewood and gums, medicinal herbs, fodder and grass. It is high time that we do not look to the forest department as a revenue earning department as was the case during British rule.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) Why is agriculture called the mainstay of Indian economy?
   (ii) What is the most significant characteristic of Green Revolution?
   (iii) Why is a breakthrough in dry farming most essential in Indian agriculture?
   (iv) Which are the two staple food crops of India? Compare and contrast the climatic and soil requirements of the two.
   (v) Why is the production of pulses and oil seeds still lagging behind?
2. Distinguish between:
   (a) marine and inland fishing
   (b) kharif and rabi
   (c) fertilizers and manures
   (d) dairy animals and drought animals.
3. Give a technical term of each one of the following:
   (i) The art and science of cultivating soils, raising crops and rearing livestock, not excluding fishing and forestry.
   (ii) A large scale one-crop farming, resembling factory production, based on capital investment and application of modern science and technology in cultivating, processing and marketing the final product.
   (iii) Rearing of silk worms and producing raw silk.
   (iv) Intensive cultivation of vegetable, fruits and flower crops, not excluding plantation crops.
4. Given below are the requirements of : (a) Wheat, (b) Rice, (c) Tea, and (d) Sugarcane. Make the correct pairs accordingly:
   (i) Plentiful and cooperative labour, temperature of 25°C, and 100 cm of rain.
   (ii) Cool and moist climate during growing season and dry sunny warm climate at the time of ripening.
   (iii) Well-drained fertile soil, hot and moist climate and rainfall of about 100 cm or irrigation facilities.
   (iv) Deep and fertile well-drained soils, warm and moist climate with frequent showers all through the year.
5. Give a brief account of progress made by Indian agriculture since Independence in the production and productivity of leading crops.
6. What suggests to you that Indian agriculture has been transforming from subsistence to commercial farming?
7. Write a critical note on Green Revolution and its socio-economic impact on the Indian society.

8. Write a critical essay on implications of the growing population on Indian farming.

Topic for Class Discussion

(a) Indian agriculture deserves a still better deal.
(b) Mechanization is a curse to Indian farming.

Map Work

9. On different outline maps of India, showing state boundaries, show the following:
   (i) Rice growing areas
   (ii) Wheat growing areas
   (iii) Sugarcane growing areas
   (iv) Coffee and Tea plantations
   (v) Cotton and Jute growing areas.

CHAPTER 7

Progress of Industries

If our past rightly belonged to agriculture, our future is going to depend increasingly on industries. Evolution of agriculture freed us from the constant worry of hunger and survival. Industry alone can take us to a better quality of life. In other words, our living standards will improve more or less to the extent our country becomes industrialized.

This is not to suggest that agriculture and industry are exclusive of each other. They will have to move hand in hand. Think for a while the place of agro-industries in India. If agriculture has enabled us to lay a strong foundation of industry, the latter in turn will contribute substantially in raising the productivity of the former. Increased use of fertilizers, pesticides plastics, electricity and diesel in agriculture is bound to depend upon the growth and competitiveness of our industry. In fact several branches of agriculture have been increasingly claiming themselves industries, for instance plantation industry, dairying industry, and high-yielding seed industry. With the rapid emergence of bio technology, it is difficult to draw a clear cut line between agriculture and industry. The application of science has led us to see a hen as some kind of an egg-laying machine and cattle and pigs as meat producing machines.

There was a time when self-sufficiency in the industrial sector was the need of the hour. But today it is not enough. In the present day world of globalisation our industry needs to be more efficient and competitive. Our goods must be at par in the international market. Then alone we will be able to compete with others and fetch foreign exchange and increase our national wealth. It is a precondition for its equitable distribution to eradicate poverty from our land. The following activities would prepare you to appreciate the problems and compulsions of industrialization in our country.

FOR DOING IT YOURSELF

1. Given below are lists of four different types of natural resources in India:
   a) fish, poultry, meat, hides and skins, raw wool, silk and milk
   b) grasses wood, tree bark, cane, bamboo, leaves, flowers, lac, gums, resins and medicinal herbs
   c) cereals, pulses, vegetables, oilseeds, beverages like tea, coffee and cocoa, sugarcane, tobacco, spices, plant fibres such as jute,

d) iron-ore, bauxite, coal, mineral oil, manganese, natural gas, limestone, mica uranium etc.

(i) Give a proper label to each of the four lists given above.

(ii) List different kinds of occupations associated with each of the above four categories.

2. There are two countries A and B. Both of them have reserves of mineral oil and natural gas. They utilize these resources as stated below:

Country A exports all its crude oil and gains handsome foreign exchange immediately.

Country B refines its crude oil to produce and market following products in the home and world market.

(a) lubricating oil
(b) furnace oil
(c) diesel
(d) kerosene
(e) white oil
(f) petrol
(g) L.P.G. or cooking gas
(h) naphtha
(i) chemical additives
(j) grease
(k) menthol
(l) nylon and
(m) polyester

(i) Reason out the economic implications of the two different approaches around the following points;

(a) industry
(b) creation of jobs
(c) national wealth
(d) value added to the natural gift
(e) standard of living and
(f) earnings in foreign exchange

3. Jamshedpur Steel Plant is:

(a) Located at a distance of 250 km from Calcutta, a metropolitan city and a big river port of international importance.
(b) situated on trunk railway route connecting Calcutta with Mumbai.
(c) placed at the confluence of the rivers Subarnarekha and Kharkai.
(d) now backed by township of Tatanagar.
(e) sustained by iron-ore from (i) Mayurbhanj and Bonai districts of Orissa and (ii) Singhbhum district of Bihar.
(f) powered by captive coal mines of Jharia in Bihar, yielding coking and other coal.
(g) supported by limestone from Gangpur in Orissa.
(h) facilitated by manganese ore from Mayurbhanj and Keonjhar in Orissa.

(i) List all the factors on which location of steel industry at Jamshedpur depends.

(ii) See what part transport and communication played in the rapid growth of steel industry at Jamshedpur.

4. Industries are classified in ways more than one according to various dimensions.

(A) *Ownership Basis*
(a) Mineral oil (from drilling, refining to marketing)
(b) Vegetable oil industry
(c) Cement industry
(d) Sugar mills set up recently in the States like Maharashtra and Gujarat
Put the labels — mixed sector, public sector, private sector and cooperative sector — correctly against each of the above examples.

(B) According to their main *role or function*
(a) Basic or key industry
(b) Consumer industry
Classify the following into the two categories as stated above
(i) Television and radio receiving sets
(ii) Iron and Steel
(iii) Machines and tools
(iv) Basic bulk drugs
(v) Paper
(vi) Soap and cosmetics
Find out and name five assembly line industries in India.

(C) According to the *size of the industry* classify the following industries under the headings:
(a) Large scale, (b) Small scale, (C) Village and cottage industries
(i) Khadi (ii) Handicrafts (iii) Commercial Vehicles (iv) Cycle (v) Modern Synthetic and Mixed Textiles.

(D) According to *bulk and weight of raw materials* and *finished products*
They are called (a) Heavy Industry and (b) Light Industry
Classify the following into the two.
(i) Ship building (ii) Electric bulbs (iii) Consumer Electronics (iv) Iron and steel (v) Watches (vi) Mineral oil.

AGRO-BASED INDUSTRIES

Textiles, sugar, vegetable oil and plantation industries derive their raw materials from agriculture. These are, therefore, called agro-based industries.

Textiles

Cotton jute, silk and wool are the basic raw materials of the textile industry. While cotton and jute are derived directly from the soil, silk and wool come indirectly. They are animal products.

Cotton Textiles

Cotton textiles are among the oldest industries in India. One can trace it back to the day of Indus civilization when cotton fabrics of India had a great demand even in the countries of Europe and West Asia. It was a cottage or a village industry at that time. The spinning wheel constituted its sole machine, simple but highly imaginative. The modern textile industry in India began first at Fort Gloster near Calcutta in early nineteenth century. But it really made a start in Mumbai when a cotton textile mill was set up there exclusively out of Indian capital in the year 1854.

There are several aspects of the Indian textile industry worth noting. It is based on indigenous raw materials particularly cotton. In the year 1995-96 the textile industry provided employment to over 64 million persons, next only to agriculture. Thus it is highly significant for a country like India, as it is a labour intensive industry. It alone accounts for 4% of gross domestic product. More importantly, it is responsible for 20% of the manufacturing value addition. Of late it has been fetching one-third of our total export earnings. In 1996-97 we earned nearly 12 billion U.S. dollars.

The industry provides living to farmers, cotton ball pluckers, and workers engaged in ginning, spinning, weaving, dying, designing and packaging not excluding sewing and tailoring. It is India's most traditional and prestigious industry. More importantly the industry strikes a judicious balance between tradition and modernity. While the spinning activity is fairly centralised, weaving is highly decentralised providing scope for traditional skills of weavers in cotton, silk, zari, embroidery and so on. The hand spun and hand woven *khadi* retains our hoary tradition of providing large scale employment in one's home and cottages. The textile industry in India has all along flourished on its own capital. On the other hand, we have the most modern capital intensive and high speed mill produced cloth with a big market both at home and abroad.

The fabrics, i.e. cloth is largely produced in three sectors — (i) mills, (ii) powerlooms and (iii) handlooms. Together they account for 98.5 percent of the fabrics produced in the country. It is interesting to note the share of each. The mill sector accounts for only 5.2% of the total fabrics produced in the country, whereas powerlooms and handlooms are responsible for 73 percent and 20.3 percent respectively. For instance the entire sari sector is reserved for handloom and powerloom sectors. The later also produces hosiery on large scale mostly for export. We also export quality yarn to Japan and European Economic community.

In 1997-98 the country produced 37.4 billion metres of fabrics. The per capita availability of fabrics rose to 30.92 metres in the same year. It was less than 15 metres in 1955-56. At that time it was only cotton fabric. Now the proportion between natural and human-made fibre is 50:50.

The total spindles rose by the three times since 1950-51: The spinning mills rose from 378 to 1719 by 1997. The states of Maharashtra, Tamil Nadu and Gujarat lead the country in textiles in a descending order.

The important centres of cotton textiles industry are Mumbai, Ahmedabad, Coimbatore, Maduri, Indore, Nagpur, Sholapur, Calcutta, Kanpur, Delhi, Bangalore and Hyderabad.

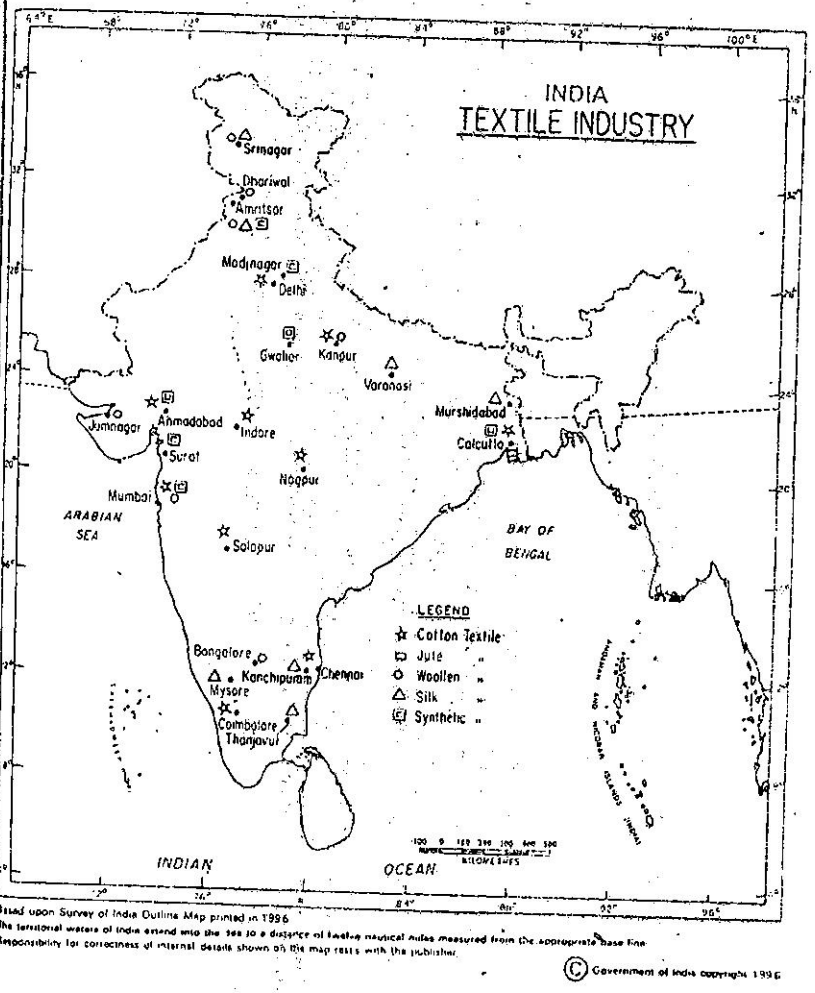


Fig. 7.1 India—Textile Industry

Note the major centres of textile industry in India. Which type of textile industry is most widespread?

Of late, readymade cotton garments industry has been developing fast to cater to the foreign markets. They are thus earning precious foreign exchange. One of the problems faced by cotton textile industry in India was the out dated technology of old mills and their industrial sickness. Gradually old technology is being replaced by the new one. We have yet to exploit our huge potential to manufacture quality cotton fabrics for which there is a great demand in the upper social strata of the industrialised countries of the world.

Jute Textiles

The first jute mill came to be set up near Calcutta as early as 1859. Being an export oriented industry, it grew very rapidly. After partition of the country most of the mills remained in India, but three-fourth of the jute producing area went to Bangladesh (erstwhile East Pakistan). In 1950-51 the production of jute was 3.3 million bales (or 180 kg each) by 1996-97 it rose to 9.75 million bales. India is the second largest exporter of jute goods. The jute industry sustained 250,000 labour and 4 million jute farmers.

The industry once fetched sizeable foreign exchange. Today it is confronted with numerous challenges. One is the decline in demand for jute carpets and packing materials. High costs and stiff international competition in export market are the other problems. Above all synthetic substitutes both in home and export markets are posing the biggest ever challenge. Its export earnings are included under textile industry.

Woolen Textiles

There are over 50 mills in the country. Many of them are in Punjab with Amritsar, Dhariwal and Ludhiana as major centres. The other centres of the industry are Mumbai, Bangalore, Jamnagar, Kanpur and Srinagar. The domestic wool production was 44,000 tonnes in 1997-98. 16 to 18 thousand of tonnes of wool imported from abroad may be added to this amount.

Silk Textiles

Indian silk is well known all over the world. Silk worms are reared mostly on mulberry leaves. 90 per cent of the silk produced in India belongs to this category. It is mainly produced in the three southern states of India — Karnataka, Tamil Nadu and Andhra Pradesh. Less than half percent of the cultivated land is under mulberry trees. It can be increased to 1 percent of the cultivated area. Japan was one of the major producers of raw silk in the world. It is now withdrawing from this field. But China has raised its production from 4000 tonnes to 35,000 tonnes. India produces less than 10,000 tonnes. The major silk weaving centres are — Mysore and Kanchipuram, Varanasi, Srinagar, Murshidabad and Amritsar.

Synthetic Textiles

Rayon, nylon, terene and dacron are the human made synthetic fibres produced in India. They are developed from wood pulp, coal and petroleum through chemical processes. The synthetic fibres are also used along with natural fibres like cotton, silk and wool with better results. Besides having better finish, these fibres are more durable and easy to maintain. Mumbai, Ahmedabad, Delhi, Surat, Calcutta, Amritsar and Gwalior are the centres of this industry. The per capita availability of synthetic fibres over the past two decades has now reached to 15 sq. metres or so.

Coir Industry

The coconut husk provides fibres to coir industry particularly in Kerala. It has a good deal of employment potential in rural areas particularly for women. The country also earns foreign exchange out of export of coir goods. Well over half a million people live by this industry. Coir ropes and mats are the major products. In 1997-98 coir exports were of the order of 68 million dollars.

Sugar Industry

India is the largest producer of sugarcane. Putting sugar khandsari and gur or jaggery together, India stands first in the world production. In 1950-51 there were 138 sugar mills in the country. Their number has now increased to 460. Since it deals with a perishable raw material it is widely scattered and is essentially a rural based industry. The production of sugar has also steadily risen, although not without wide fluctuations, from 1.13 million tonnes to 12.8 million tonnes by 1997-98. In 1998-99 the sugar production may touch 15 million tonne mark. In 1996 it was 13 million tonnes. But simultaneously its off take in the domestic market has risen further.

The industry still follows duel pricing system and compulsory levy to the public distribution system. However, the margin between the two sets of prices is now very low.

The industry started in private sector and was largely confined to Uttar Pradesh and Bihar. Now it is fairly widespread. As many as 256 mills are in the cooperative sector. The pockets of sugar industry are well irrigated and have also become pockets of rural prosperity to some extent. It is a seasonal industry and as such better suited to cooperative sector. The sugar content in the cane is higher i.e. about 10.5 per cent in Maharashtra and other southern states. The industry, therefore, has been expanding rapidly in these parts.

Vegetable Oil Industry

Extracting oil from oilseeds is an age old village industry in India. Ours is the largest oilseeds and vegetable oil producing country in the world. It is also the biggest consumer of vegetable oil, as it is the most popular cooking medium. Even with a bumper crop of oilseeds India imports edible oil. The most common sources of oil are groundnut, mustard and rape seed, sunflower seed, soyabean and coconut. To supplement all these sources, of late palm oil had to be imported on a big scale. In 1950-51 the production of edible oil was 170,000 tonnes. By 1995-96 it had risen to 6.42 million tonnes. During this period demand grew to 7.2 million tonnes and hence there was the need for imports.

The ordinary oil was replaced in a big way by hydrogenated oils giving semblance to *ghee*. In fact hydrogenated ghee is less wholesome than the natural vegetable oil. Now it is likely to be replaced by refined vegetable oils available in sealed packs. Gujarat leads all other states in vegetable oil, particularly the groundnut oil. The industry is widely spread owing to the universal nature of market, and availability of various kinds of oilseeds in different parts of the country. Like sugar the consumption of vegetable oil has been increasing very rapidly

notwithstanding its prohibitive prices during the last few years. This explains the need for setting up the oilseeds technology mission. Within a short span it has started showing results.

Paper Industry

Machine-made paper was first manufactured in India in 1812. There were 15 mills with a total production of one lakh tonnes before Independence. With growing population and spread of education, the demand for paper has been increasing. Owing to very limited forest resources, wood pulp is in short supply. Therefore, bamboo, sabai grass and sugarcane bagasse are being increasingly used. Waste paper and rags are also recycled as raw materials. By 1997-98 there were 380 mills. Of these 28 were big ones and the rest were small units of 33,000 tonnes each. In 1997-98 the production of paper and paper board had crossed 4 million tonne mark. We have to meet 10% of our demand through imports.

The paper required for newspapers is called newsprint. Its demand is bound to grow considerably. The Nepanagar Newsprint plant in Madhya Pradesh was the first to be set up. Its capacity has been raised to 75,000 tonnes a year. West Bengal and Maharashtra are the leading states in this industry. But new plants have come up in other parts of the country also. The total newsprint production has now reached well over 400,000 tonnes although imports of about 500,000 tonnes are still unavoidable.

MINERAL BASED INDUSTRIES

The use of metals had been quite widespread in India. It was the village smithy that took care of the needs of the farmers and householders. The rust free huge iron pillar of the fourth century A.D. near Qutab Minar in Delhi stands in testimony of highly developed metallurgical skills of our forefathers. The modern metallurgical industry is essentially large scale in nature and tends to be concentrated at a favourable point. Iron and steel industry is one example.

Iron and Steel Industry

A modest beginning of the modern steel industry was made in India at Kulti in West Bengal in 1870. But the concept of large scale production materialised with the setting up of a steel plant at Jamshedpur in Bihar in 1907. It started production in 1912. The new township was named after Jamshedji Tata. Then came up Burnpur and Bhadrawati Steel plants in 1919 and 1923 respectively. It was, however, only after Independence that the steel industry has been able to find its feet. Barring the Jamshedpur plant of the Tatas all are in public sector and looked after by Steel Authority of India Ltd. (SAIL).

Bhilai and Bokaro plants were set up with the soviet collaboration. Durgapur and Rourkela came up with British and West German technical knowhow respectively. (Table 7.1)

Iron and steel industry by nature is a heavy industry. All its raw materials are heavy and bulky. They include iron-ore, coking coal and limestone. The location of this industry is therefore, governed by its close proximity to raw materials particularly coking coal. The finished products in turn are also heavy and need good transport system for their distribution. The Chhotanagpur plateau bordering West Bengal, Bihar,

TABLE 7.1

Production of Saleable Steel in Public Sector Steel Plants (SAIL) (1996-97)

Plant	*Production Million Tonnes*
Bhilai	3.4
Durgapur	1.1
Rourkela	1.2
Bokaro	3.0
Alloy Steel Plant	0.2
Salem	0.1
Total (SAIL)	9.1
India Iron & Steel Co.	0.3
Total	9.4

Orissa, and Madhya Pradesh, therefore has been the natural core of this industry. Iron and Steel industry is also a basic or key industry. It precedes heavy machines and tools industry. On it depends several light, medium, small and cottage industries. As a result, the production of iron and steel is an index of modernization and industrialization of a country. The industry also calls for huge investment, basic infrastructure, particularly efficient means of modern transport and communication not excluding abundant fuel or power supply. However it does not create directly enough jobs commensurating with the huge investment. It calls for continual updating of technology, "R and D" (Research and Development) support, and above all a long waiting time before it begins to yield dividends. All these considerations made the government to enter into this key industry in a big way on its own, despite its natural drawbacks or limitations. Visakhapatnam Steel Plant is the first shore based integrated steel plant in the country. It has the advantage of importing quality coking coal from abroad and has ease in exporting its products directly to the world market. In 1997-98 it produced 2.2 million tonnes of saleable steel and half a million tonnes of pig-iron. The plant has been able to maintain international standards of efficiency. In the same year it exported nearly 0.8 million tonnes of steel and pig-iron earning foreign exchange of Rs. 600 crore.

Mini Steel Plant : As per their name these plants are of relatively small size. They produce steel in electric arc furnaces using scrap and sponge iron. They produce both mild steel and alloy steel of given specifications. In 1997-98 they produced 8.5 million tonnes of crude steel. Nearly 200 miniplants have been working in the country.

Compared to China, we in India had a good head start, with India producing 1.7 million tonnes of pig iron and 1.5 million tonnes of steel in 1950-51. By now China has overtaken us several times. Its steel production was 59 million tonnes in 1988.

TABLE 7.2

The Total Finished Steel Production (in Million Tonnes) (1950-51 - 1997-98)

1950-51	*1960-61*	*1970-71*	*1980-81*	*1990-91*	*1997-98*
1.04	2.39	4.64	6.82	13.53	23.4

As given in the table 7.2 the progress of iron steel Industry has been rather slow. It is only in the last decade that the production has really picked up. It was over 23 million tonnes in 1997-98.

ENGINEERING INDUSTRY

There was a time when we were totally dependent on other countries for every kind of

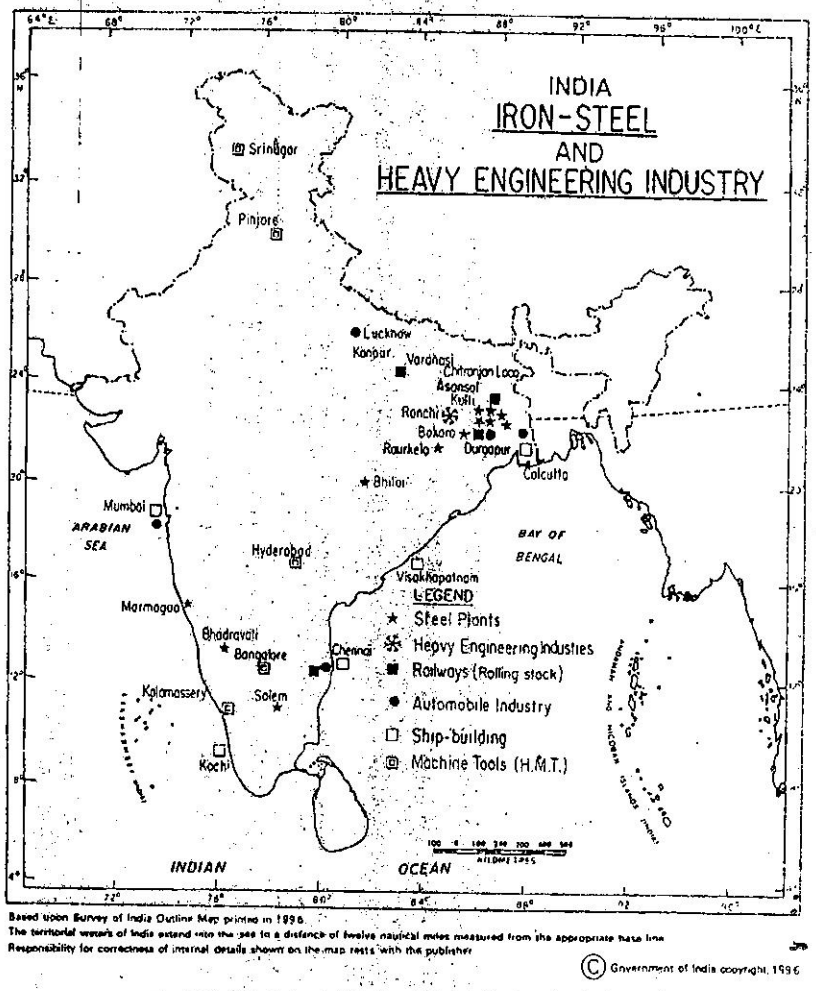


Fig. 7.2 India—Iron and Steel and Heavy Engineering Industries

Note the centres of the iron and steel, heavy engineering and transport industries. Where do you notice the highest concentration of all these industries taken together?

finished goods. Then we started making many articles in our own land. Even for this we had to import entire machinery from abroad. But today the situation has changed a lot. We now manufacture complete machinery for textile, sugar, paper, tea, cement, mining and petro chemical plants. We have completed several "turnkey" projects in many other countries of the world. The heavy engineering plant at Ranchi has been designing and fabricating huge machines required for iron and steel industry. A very large range of engineering goods are produced not only for domestic but for international market also. The industry brings home hard needed foreign exchange.

Hindustan Machine Tools produces a wide variety of machines and precision tools maintaining very high international standards. It has several production centres in the country.

In light engineering the country leads the developing world. It has set up "Industrial Estates" in several Afro-Asian countries.

TRANSPORT EQUIPMENT INDUSTRY

Railways

Indian Railways not only cater to the goods and passenger traffic in India but also undertake production of their rolling stock requirements, such as railway engines, wagons and coaches. They also undertake research and development activities on their own. For the masses the railways represent the growing level of technology being developed in the country.

Railway engines are of three types — steam, diesel and electronic. Of these the coal or steam engines are on their way out as they are being replaced by diesel and electric engines. These engines posses more traction power and are more fuel efficient.

The country produces diesel engines at Varanasi and electric engines at Chittaranjan Locomotive Works. The metre gauge railway engines are manufactured by TELCO at Jamshedpur. The integrated coaches are manufactured at Perambur near Chennai in Tamil Nadu. The new rail coach factory has been set up at Kapurthala in Punjab. Goods wagons are produced at a number of places in India. In 1996-97 Chittaranjan Loco Works (CLW) produced 155 broad gauge electric engines. Varanasi (DLW) manufactured 157 and 14 diesel engines for broad metre gauge respectively. BHEL, Bhopal has also developed Research and Development capacity in this field. Perambur and Kapurthala added 1010 and 920 passenger coaches respectively. A wheel axel factory is located at Bangalore.

Railways have become self-sufficient and have also secured contracts to manufacture railway equipment for other countries, and render consultancy services to them.

Roadways

Road transport is far more widespread than the railways. Commercial vehicles like lorries, trucks and passenger buses had hardly begun to be produced in India at the time of Independence. In 1950-51 the country produced only 8600 auto commercial vehicles and 7900 passenger cars. In 1997-98 it manufactured 219,000 commercial vehicles and 3,203,400 motor-cycles, scooters, mopeds etc. India is the second largest producer of three wheelers. In 1997-98 it produced 2,34,000 three wheelers. The industry is

widely distributed around Delhi, Mumbai, Pune, Chennai, Calcutta, Lucknow, Indore, Hyderabad and Bangalore.

In 1997-98 nearly 280,000 tractors were manufactured. Nearly 20 production units are in the field. The annual production of bicycles is around 10 million with a good deal of foreign market at Command.

Ship Building

Mumbai, Calcutta, Kochi, Visakhapatnam and Marmagao are the major ship building centres in India. They are all in public sector. The private sector shipyards look after the local needs. Kochi shipyard, the latest and the largest in India has been developed with Japanese expertise. It can build a ship of 86,000 tonnes dead weight. Two such ships have been delivered so far. Visakhapatnam yard can go in for ships up to 45,000 DWT. The Visakhapatnam shipyard has built by now 89 ships since 1947.

Dry docks are meant for repairing big ships. Generally they accommodate ships up to 10,000 DWT. But one dock at Mumbai can admit a ship up to 20,000 DWT. The other at Visakhapatnam can allow a ship up to 70,000 DWT and at Kochi up to 1 lakh DWT. Kochi shipyard has build 3 bulk carriers of 75,000 DWT each. It now manufactures battleships for the Indian Navy. There are plans under way to manufacture aircraft carriers in India. Such a ship will take a few years to complete, after the work is commenced. 62 fishing crafts have been built indigeneously and 26 more are under construction.

Aircraft

India has not entered into civil aircraft industry. But owing to the need for self-sufficiency in defence requirements, it has developed aircraft industry at Bangalore, Koraput, Nasik, Hyderabad, Korwa, Kanpur and Lucknow. Each place specialises in a certain task. India has developed a jet trainer place Kiran MK II. We now manufacture this plane. The country also manufactures Chetak and Cheetah helicopters. It produces Jaguar, Mig. 21, Mig. 27 including their engines.

ELECTRICAL GOODS, CHEMICAL AND HEAVY EQUIPMENT

India produces a wide range of electrical goods and appliances. But more importantly, it now manufactures heavy equipment like electrical motors, transformers, water turbines, and electrical traction motors. Bhopal, Hardwar, Trichi, Hyderabad, Ranipet, Bangalore and Jagdishpur are the important centres engaged in heavy electricals. Several units manufacture transmission line towers, both for home and world markets.

Electronics Industry

From the manufacture of radio receiving sets in private sector, in late forties, the electronics industry has made very rapid progress. In 1983 its total production was worth 1,360 crores of rupees. By 1988 it rose to 6,500 crores. This represents nearly a five times growth. In a single year 1987-88 the growth was 37.7%. The industry has very wide range of production like consumer electronics mainly radio and television sets, control instruments and industrial electronics, computer systems, communication and broadcasting equipment, aerospace and defence equipment, and electronic components. India has emerged as one of the exporters of electronic goods. Besides the hardware, India has earned high reputation in the development of software and has good international market. Electronics is the fastest growing sector of Indian economy. In 1997-98 its production was worth Rs. 32,070 crores in — 920% increase over previous year. Exports in the same year touched 9,500 crores of rupees. By the end of Ninth Five Year Plan it is expected to reach 49,000 crores of rupees. Like industrial estates Electronic Technology parks are being developed at various centres.

Chemical Industry

It is fourth in size, next only to (i) iron and steel, (ii) engineering, and (iii) textiles. There has been rapid growth in the fields of organic and inorganic chemicals. These heavy chemicals facilitate down-stream products like drugs, dyestuffs, pesticides, plastics, paints etc.

Pesticides which include insecticides, weedicides, fungicides, rodenticides, have become very important for agriculture and for public health purposes. DDT plant came up in 1954 in Delhi. In 1996-97 the turn-over of the industry was Rs. 900 billion and accounted for 10% of exports, 20% of customs and excise earnings.

Pharmaceuticals are yet another area in which India has given a lead to the third world. It is highly diversified and at the same time vertically integrated. The country is almost self-sufficient in basic and bulk drugs. Some imports are still necessary. But these are compensated for by exports to a certain extent. In 1996-97 the total turn out of the industry was 12,680 crores of rupees.

Petro-chemicals

Owing to their superior properties, petro-chemicals have started substituting traditional raw materials like wood, glass and metal. They have application in domestic, industrial and agricultural fields. For instance, plastics have brought about revolutionary changes. You have already seen a long list of by-products derived from crude petroleum. The industry is located near Mumbai and Vadodara. Now it is spreading to other parts of the country.

The consumption of major petro-chemicals was 3 million tonnes in 1995-96 and by 2002 it is expected to rise to 6.8 million tonnes. Now there are as many as 14 mineral oil refineries in India — 3 in Assam, 2 in Maharashtra and one each in Gujarat, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, West Bengal, Bihar, Uttar Pradesh and Haryana. Locate them in the map.

TABLE 7.3

Production of Fertilizers (1950-51—1997-98)
(in million tonnes)

	1950-51	*1970-71*	*1990-91*	*1997-98*
Nitrogenous	0.009	0.830	6.99	10.5
Phosphetic	0.009	0.229	2.05	3.2
Total	0.018	1.059	9.04	13.7

Fertilizer Industry

In 1950-51, the per hectare consumption of fertilizer in India was not even one-fourth of the world average. Today, however, India ranks third in the production of nitrogenous fertilizers in the world. In 1998-99 the country produced 10 million tonnes of nitrogenous fertilizers and 3 million tonnes of phosphates. However, the total consumption was 16.5 million tonnes. Thus we had to import about three and a half million tonnes to meet our growing requirements.

The production is largely in the hands of

public sector and cooperative sector. Prices of fertilizers have been partially decontrolled. However, the government has been paying heavy subsidy to farmers as it is a crucial input in meeting our growing food requirements. There are now 63 fertilizers units in the country. So far fertilizer plants tended to be located near the reserves of raw materials. Now natural gas is being increasingly used as suitable raw material. As it can be taken any where through pipelines the fertilizer plants are now being located close to the potential markets. Fertilizer plants are in public, private, joint, and cooperative sectors. Some fertilizer plants are also set up jointly by Indian and local collaborators in some west Asian countries. Assured proportion of the production would be available for India in a way with somewhat reduced transport costs. India is deficient in potassium and has to import it from abroad.

Cement Industry

In view of its key role in building and constructional activities it is now called an infrastructural core industry. The housing industry is bound to gain in momentum every year as a tremendous backlog needs to be cleared up both in urban and rural areas. The first cement factory was set up at Chennai in the south in 1904. Today there are 115 large and 310 mini cement plants with an installed capacity of above 110 million tonnes. In 1997-98 the total production was of the order of 83 million tonnes of which 4.25 million tonnes were exported to south and Southeast Asia, Middle-east of Africa.

Defence Production

Constant vigilance is the price of freedom. Our priority, therefore, is an indigenous production of defence equipment for our army, navy and airforce. We produce heavy tanks, battleships and supersonic war planes. We are developing missiles and a large variety of electronics defence equipment. What is important is "R and D" in this technology which costs a lot.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) Explain how agriculture and industry go hand in hand.
   (ii) What is our latest priority in industry—self-sufficiency or a higher degree of efficiency and competitiveness?
   (iii) In what different ways are the industries classified?
   (iv) What is the significance of "value addition" in increasing national wealth?
   (v) Which are agro-based industries in India? What is their significance in Indian economy?
   (vi) Why is iron and steel industry called a basic industry?

2. Compare and contrast textile and steel industry in India.
3. Match the items in the two columns correctly :

(i) Bangalore	-	Electrical rail engines
(ii) Calcutta	-	Electrical turbines
(iii) Chittaranjan	-	Railway coaches
(iv) Kochi	-	Big oil refinery
(v) Gurgaon	-	Aircraft
(vi) Hardwar	-	Stainless steel
(vii) Kapurthala	-	Fertilizer
(viii) Mathura	-	Gem cutting
(ix) Salem		Shore based steel plant
(x) Sindri	-	Small car
(xi) Surat	-	Ship building
(xii) Visakhapatnam	-	Jute textiles

4. Give one word for
   (i) An industry concerned with heavy and bulky raw materials and finished products and their consequent transport costs.
   (ii) An industry for which the state or its agency undertakes economic activities and controls the means of production and distribution.
5. Write short notes on:
   (i) Petro-chemical industry
   (ii) Ship building industry
   (iii) Fertilizer industry
   (iv) Sugar industry.

Hold class discussion on any one of the following:
   (i) The role of public sector in rapid industrialization
   (ii) The role of industries in value addition
   (iii) Can industrialization by itself eradicate poverty?

Map Work

6. Show two major centres of each of the following industries:
   (i) Cotton textiles, (ii) Jute and wool (one each) textiles, (iii) Iron and steel (one inland and another on-shore), (iv) Ship building, and (v) Petrochemical.

2.	India	Cotton textiles, tea, jute, iron-ore, leather goods	Foodgrains	Mineral oil, Petro-chemicals and weaponry
3.	Russia	Mineral oil and Petro-chemicals, weaponry	Foodgrains, timber, paper	Cotton wares, leather goods, tea, consumer goods
4.	Japan	Automobiles, electronic goods, ships	Timber, paper fish	Mineral ores, coal, wool, cotton

TABLE 8.2

National and State Highways, Road Density and Vehicles

	('000km)	*1950-51*	*1995-96*
(i) Length of Roads			
Total	(-"-)	400.0	3,319.6
Surfaced	(-"-)	157.0	1,517.3
(ii) Length of National Highways	(-"-)		
Total (All surfaced)	(-"-)	22.0	34.5
(iii) Length of State Highways	(-"-)	N.A.	135.2
Total (97% Surfaced)			
(iv) No. of Registered vehicles on road in Thousands			
All vehicles	(-"-)	306.0	33,558.0
Goods vehicles	(-"-)	82.0	1,785.0
Buses	(-"-)	34.0	449.0
(iv) Road Density			
(a) Per 100 sq. km.		12	63
(b) Road/Area density in Japan compared to India (as one)			12 times
(c) Road/Population Ratio in USA compared to India (as one)			33 times

4 Study Table 8.2 and answer the following questions:
(i) Find out whether the National Highways deserve the importance they are given by our national government.
(ii) How does India compare with Japan in road density?
(iii) How do we compare with the USA in Road/population ratio.
(iv) By how many times has the total number of vehicles on road increased since Independence?

TABLE 8.3

Changing Economic and Industrial Scenario As Reflected Through Bulk Goods Carried by Railways (1961-1998)

IN BILLION TONNE - KILOMETRE

Commodity	*1960-61*	*1997-98*
Coal	20.35	127.52
Raw material for steel plants excluding coal.	1.99	13.39
Pig iron and finished steel from steel plants	3.32	11.56
Iron-ore for exports	N.A.	6.81
Cement	2.47	20.95
Foodgrains	9.62	30.96
Fertilizers	Negligible	22.01
Mineral Oil	2.56	19.66
Other goods	31.65	31.39
Total goods traffic	72.33	284.25

5. Study Table 8.3 and answer the following questions:
(i) Which has been the most dominating commodity being carried by railways for the past 37 years?
(ii) Name the commodity which continues to rank second in importance over the same period.
(iii) In what two different ways do the Indian railways contribute to the growth of Indian agriculture?
(iv) In which three different ways do the Indian railways have been helping one of the heavy and key industries of India?

TABLE 8.4

Indian Railway Operations (1950-51 — 1996-97)

	1950-51	*1996-97*
Total Route Length (km)	53,596	62,725
Total Running Track (km)	59,315	80,754
Electrified Route Length (km)	388	13,018
Passengers Originating (millions)	1,284	4,153
Goods Originating (million tonnes)	93	423
Locomotives Total (Nos)	8,209	6,967
(a) Steam	8,120	85
(b) Diesel	17	4,363
(c) Electric	72	2,519
Coaching Vehicles (Nos)	19,628	39,257
Wagons	205,596	272,127
Earnings from Goods (Rs. crores)	98	7,509
Earnings from Passengers (Rs. crores)	130	19,595

9. Study Table 8.4 and answer the following:
   (i) Of the total route length and total running track which one shows a considerable increase? How do you explain this?
   (ii) Between the goods and passenger traffic which one is financially more significant for the Indian railways?
   (iii) Despite spectacular rise in Indian Railway Operations how is it that the number of railway engines has gone down considerably?
   (iv) How much of route length of Indian Railways has been electrified? What are its three most significant merits?

Early man, as a hunter and food gatherer had no other choice but to lead a nomadic life. Agricultural revolution some five to seven thousand years ago, opened up new possibilities of leading a settled life. It was a small step, but a big leap forward towards modern industrial civilization. The self-contained village economy so characteristic of India was a natural culmination of man's quest for such a life. It was indeed a high point of man's achievement. Today, however, we have moved to the other extreme where the whole country has become a single market, and the world has been moving towards interdependent, if not integrated, global economy. In this chapter you would see how the modern means of transport and communication serve as life lines of our nation and its modern economy. A dense and efficient network of transport and communication is a pre-requisite for local national and global trade of today.

TRANSPORT

Roadways

Roads have proceeded railways. Roads still have an edge over railways in view of the ease with which they can be built and maintained. They can be made to cross forests and pass through deserts. Bridges help them cross mighty rivers even in spate. More importantly, they can be brought to our door steps. Above all, they can negotiate higher gradients of slopes and as such can traverse mountains such as the Himalayas.

Roads are of two types according to their strength and make up : *surfaced* and *unsurfaced*. The best are the surfaced roads. They are also called *metalled roads*. Surfaced roads may be made of cement concrete or even bitumen or tar coal. The surfaced roads, therefore, are all-weather roads. Unsurfaced or kuchaha roads are of little use in the Indian rainy season.

Since Independence the surfaced roads have increased by more than eight times. All the national highways are surfaced roads and state highways are also surfaced to the tune of about 97%. The National Highways are the prime arterial routes. By 1997-98 they spanned about 49,600 km throughout the country. Despite their very small percentage of the total roads in India they alone account for the lion's share of 40% of the total road transport demand of the country.

The importance of unsurfaced roads however, cannot be minimised. These roads open up the countryside to the modern way

of living and vaflie system based primarily on money culture. Even today India has about 15 million animal driven carts. They carry nearly 900 million tonnes of farm goods of course over short distances. Bulk of this traffic is carried over unsurfaced roads.

Road Density

The length of the road per 100 sq. km. is known as density of roads. In 1951 the road density was 12 which had risen to 63 by 1997-98. But it is most uneven throughout the country. Look at Fig. 8.1. The lowest density of less than 10 is found in the mountainous states of Jammu and Kashmir, Himachal Pradesh, Arunachal Pradesh, Nagaland, Mizoram and Meghalaya. The next higher group with the density between 10 and 20 covers Rajasthan, Madhya Pradesh, Orissa, Bihar, Sikkim, Assam, Manipur and Tripura. The next higher group with density between 20 and 40 covers the states of Uttar Pradesh, West Bengal, Andhra Pradesh, Karnataka, Maharashtra and Gujarat. Finally the group with the density of 40 and above consists of the states of Punjab and Haryana in the north and Tamil Nadu and Kerala in the south.

The road density of Japan is 14 times that of India. And the ratio between the length of the roads and total population is 33 times higher in the U.S.A. compared to India.

The socio-cultural significance of road density can be understood from the case of Kerala. Easy accessibility of rural areas has resulted in quick spread of universal literacy, low infant mortality, higher longevity and a very low birth and growth rate of population. In fact in Kerala it is very difficult to find out where habitation of one village ends and that of the other begins. They are almost linear and continuous.

Government of India is responsible for building and maintaining national highways as the state governments are responsible for state highways and district and village roads. However, Govt. of India has yet another very important assignment of constructing and maintaining border roads. Our borders are located on the most harsh terrains consisting of high mountains, deserts, marshy and rainy lands and dense forests. It is only through these border roads that a continuous supply line can be maintained for the jawans defending and guarding our international land frontiers. Our Border Road Organization has built Manali-Leh road the highest in the world. Its average height is 4,270 metres above sea level. It negotiates four high passes ranging between 4,875 and 5,485 metres above sea level.

Transformation of our Roads

With the new policy of globalisation of our national economy and emphasis on promotion of exports of agricultural and industrial products a dense and efficient road network is a must. The Government has opened up road construction and its maintenance to private sector including joint ventures with foreign collaboration. One of the policies is to invite private parties to "build", "operate" and "transfer" (BOT) roads decided upon by the government. The parties would bear cost of construction, operate roads for stipulated period, collect road taxes from users and return the roads to government at the end of the contracted period. Various International agencies have given funds for this specific purpose.

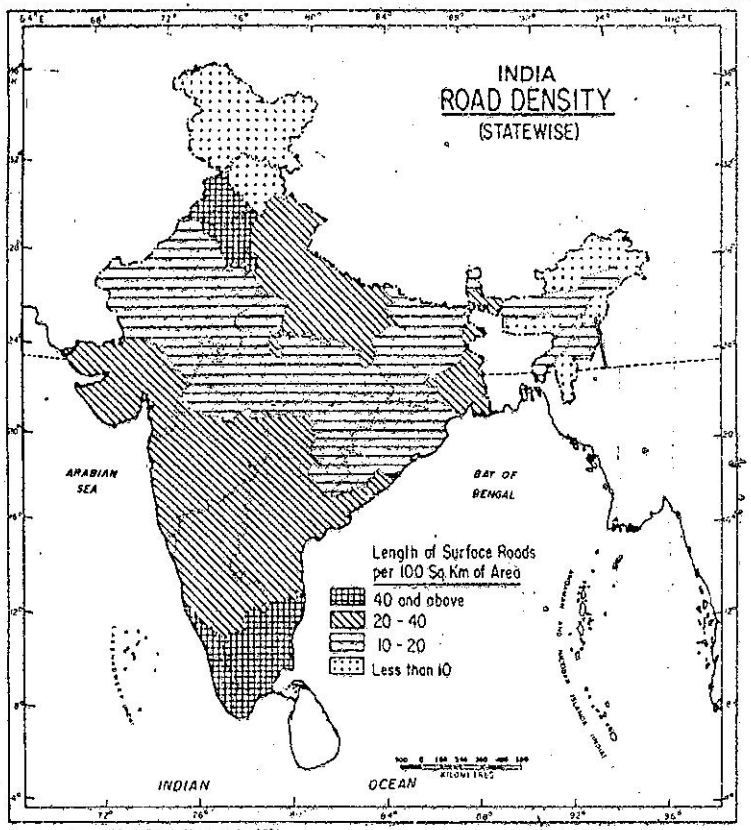


Fig. 8.1 India—Roads Density

Note the states having the road density 40 and above and less than 10 sq.km. respectively. Give reasons for low density of roads in some states.

Railways

Railways were introduced in India by their imperial power to serve its own military and economic interests. It was also an attractive investment for British capital. Today, however, they have become more important in our national economy than all other means of transport put together. Indian Railways have indisputably become today the national

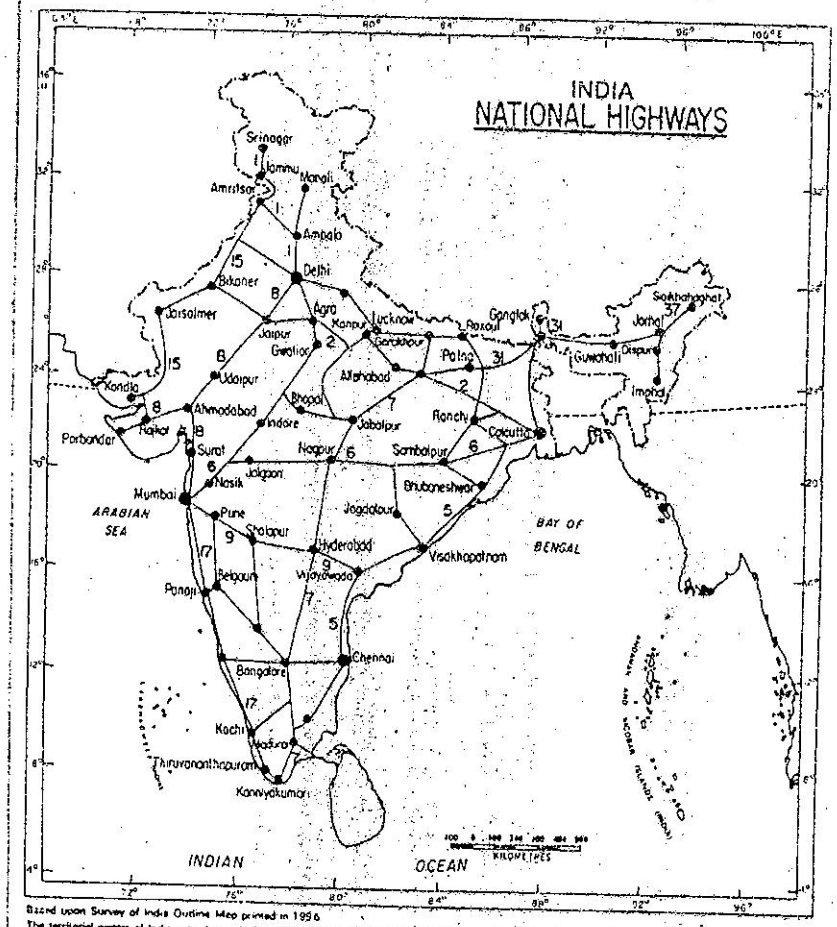


Fig. 8.2 India—Major Highways

Name the largest National Highway in India as also the places connecting them. Note the extreme points in each direction i.e. east, west, north and south connected by roads.

network of transport in India. They are the largest public undertaking with 1.6 million regular employees.

Trunk Rail Routes

Let us have a glance at the skeleton of the trunk rail routes spread over the length and breadth of our country. The cities of Delhi, Calcutta, Chennai and Mumbai act as the pegs around which this skeleton revolves. Of these four cities, Delhi in its own right has been an ancient capital city that served the entire subcontinents during its long past. The British also had to heed to this fact, grudgingly though, when they shifted their capital from Calcutta to Delhi first and then to New Delhi. The latter they built to show off their imperial pomp and prestige. However, the remaining three cities of Calcutta, Chennai and Mumbai are essentially the creations of the British. It is through these cities that they spearheaded their imperial march to claim the entire subcontinent to themselves. Today they are the four largest metropolitan cities of India. They are also the terminals or *hubs* of national transport, be it land or air travel. Barring Delhi the remaining three are also the leading port cities of India. This incidentally explains why the Govt. of a India was assigned Delhi the status of a dry port for the northern parts of the country. These four cities are the leading centres of trade and commerce, both national and international.

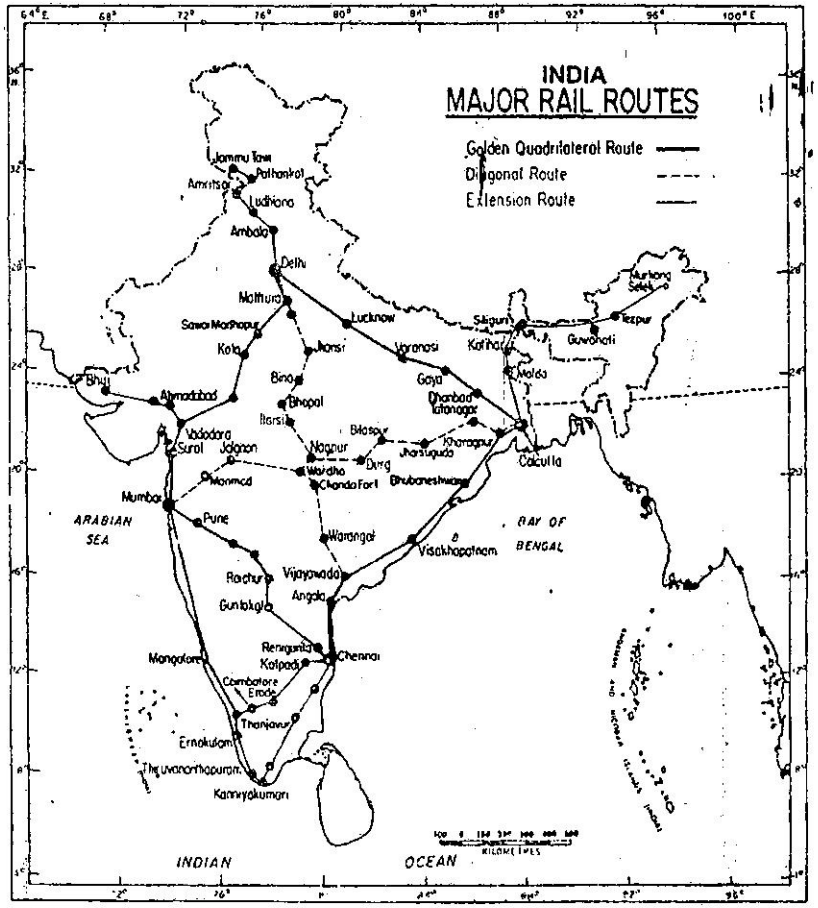
Thrust Areas of Indian Railways

The study of various statistical data provided to you will reveal the following thrust areas of Indian Railways.

i) In view of the lack of fresh investments, the railways are concentrating more on the maximum utilisation of its existing capacities. Instead of adding new routes the railways try to increase running track as it requires moderate investment and the pressing demands of trade, commerce and passenger traffic are met quickly and effectively. For instance most trunk routes have double and at places triple tracks. The number of coaches and wagons have not increased lavishly but through better and computerised management systems they are put to their maximum use economically.

ii) The railways prefer to use efficient fuel or energy resources. Instead of using coal and hauling it over long distances the diesel and electricity are preferred. This is a clear from near complete withdrawal of steam engines and almost total electrification of trunk routes, where the traffic happens to be the busiest. It also ensures very fast speed with which passengers and goods traffic is handled. Electrification has further ensured neat and clean travel free from pollution.

iii) Railways are committed to provide more and faster passenger trains with increased travel amenities in order to cope with growing travel demands. However, the major part of its revenue receipts are derived from goods traffic. Railways have specialised themselve in carrying over long distances heavy and bulky goods including containers. Its major bulky goods include coal, mineral ores, mineral oil, pig iron finished steels, raw materials of heavy industries



Based upon Survey of India Outline Map printed in 1986
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
Responsibility for correctness of internal details shown on the map rests with the publisher

Fig. 8.3 India–Major Rail Routes

Which parts of India are well connected by railways? State the rail routes having maximum rail traffic

and their finished products, foodgrains, fertilizers and cement.

iv) Railways are committed to provide mass rapid transport system to its huge suburban clientele living around metropolitan cities. Their seasonal tickets are highly subsidised. The local trains of Mumbai and Chennai and Subway Metro system of Calcutta have been rendering valuable service to its daily commuters.

v) Railways are committed in principle to have a uni-gauge railway network all over the country by converting metre gauge into broad gauge. This would enhance transport capacity and avoid delay and wastage involved in transshipment from one gauge terminal to another.

vi) Indian railways seek modern technology from anywhere in the world but insist on its indigenous production and multiplication.

vii) Indian railways undertake turnkey projects abroad for laying railway lines etc. and providing consultancy services to Afro-Asian countries on a fairly large scale.

Pipelines Transportation

Pipeline transport network is a new arrival on the transportation map of India. Pipelines provided a very convenient mode of transport to connect oil and natural gas fields, refineries and the markets. The far inland locations of refineries like Barauni, Mathura and Panipat and gas based fertilizer plants could be thought of only because of pipelines. Initial cost of laying pipelines is high but subsequent running costs are minimal. It rules out transhipment losses or delays. At present there are pipelines between Naharkatiya oil fields to Guwahati and Barauni, Guwahati to Siliguri, Koyali-Ahmedabad, Haldia, Barauni, besides a network of pipelines from Gujarat oil fields to Koyali. A new pipeline was laid from Salaya in Gujarat to Mathura via Viramgam covering a distance of 1,220 km. From Barauni the pipeline was extended to Kanpur and Delhi to carry the petroleum products. Likewise, another such line was laid from Mathura to Jalandhar via Delhi and Ambala. Mumbai-Pune products pipeline was laid to serve the market in parts of Maharashtra, Karnataka and Andhra Pradesh.

A pipeline to carry natural gas connects Hazira in Gujarat to Jagadishpur in Uttar Pradesh via Bijaipur in Madhya Pradesh. This HBJ pipeline of 1,730 km in length supplies gas to six fertilizer plants and two thermal power plants based on natural gas. Its initial capacity is to carry 18.2 million std cubic metres per day. Owing to these facilities Delhi has decided to gradually switch over to natural gas for producing electricity.

Waterways

In the past, India was one of the seafaring countries. Its seamen sailed far and near, carrying Indian commerce and culture. India was a major ship-building country even at the time of Napoleanic wars. It was only during the British rule that it lost its standing. India after Independence has been trying to recover the lost ground. It has to protect its long coastline and islands in the Arabian Sea and the Bay of Bengal. It has to protect and develop coastal land deep-sea

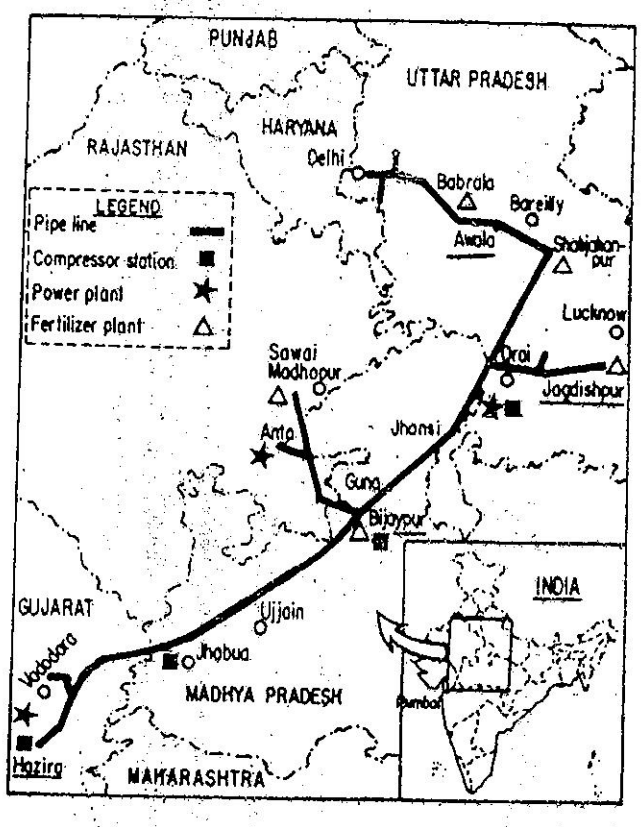


Fig 8.4 India — HBJ Pipelines

Note the route of the Hazira-Bijaipur-Jagdishpur (HBJ) Pipeline which has been constructed to transport natural gas covering a distance of 1,700 kilometres. Find out the names of six proposed fertilizer factories based on this gas.

fisheries. India's territorial waters extend up to twelve nautical miles. It has some of its rich oil fields in the deep sea away from the coastline. Bombay High oil field is 115 km west of the coast. Our economic zone extends over two hundred km into the sea along the coastline. It is nearly 2 million sq. km in area and needs to be protected.

Major Ports

Nhava Sheva is the latest addition to our major port taking their tally to eleven. This is a port across the Mumbai harbour and is meant to relieve the heavy congestion at Mumbai Port.

Kandla in Kuchchh was the first port developed soon after Independence to ease the increased pressure on Mumbai port in the wake of loss of Karachi Port to Pakistan. In order to cater to the northwestern part of the country namely Rajasthan, Haryana, Punjab, Jammu and Kashmir and Himachal Pradesh, Kandla was developed as a major port. Kandla is a tidal port. A free trade zone has also been developed to accelerate its growth. It handles crude oil, petroleum products, fertilizers, foodgrains salt, cotton, cement, sugar and edible oils. Mumbai is the biggest port with a very spacious natural well-sheltered harbour. It also handles between a quarter and fifth of the country's foreign trade. Its major imports are petroleum and petroleum products, machinery and other dry cargo.

Marmagao in Goa is another important major port ranking fourth in terms of total volume of trade. Iron ore is exported from this port in a very large measure. New Mangalore located in the state of Karnataka is yet another addition to the list of major ports. It caters to the export of Kudremukh iron-ore and iron concentrates. It also handles fertilizers, edible oils and polished granite stone. Kochi is the sixth major port on the western coast. It is located at the entrance of a lagoon (salt lake) and is a natural harbour. It handles petroleum products, fertilizers, raw materials and other general cargo.

Tuticorin is a new major port in Tamil Nadu located at the south eastern extremity of the country. It handles a variety of cargo including coal, salt, edible oils, chemicals etc. Chennai is one of the oldest but artificial port on the east coast. It handles general cargo and ranks next only to Mumbai. The trade of this port comprises petroleum products, crude oil, fertilizers, iron-ore and dry cargo. Visakhapatnam in Andhra Pradesh is the deepest landlocked and protected port. An outer harbour has been developed for exporting iron ore and petroleum products. It also handles general cargo.

Paradeep in Orissa is a newly developed port and specialises in exporting iron ore. It also handles coal and other dry cargo. Calcutta is an inland riverine port, some 125 km away from the sea. It serves a very large and rich hinterland of Ganga-Brahmaputra basin. It is a tidal port and needs constant dredging of Hoogly. For maintaining a minimum level of water in the river to ensure its navigability, water is supplied from Farrakka Barrage on the Ganga. In order to relieve the growing pressure on Calcutta port, a new subsidiary port has been developed down stream at Haldia. It supplements the facilities available at Calcutta. Calcutta-Haldia together handle

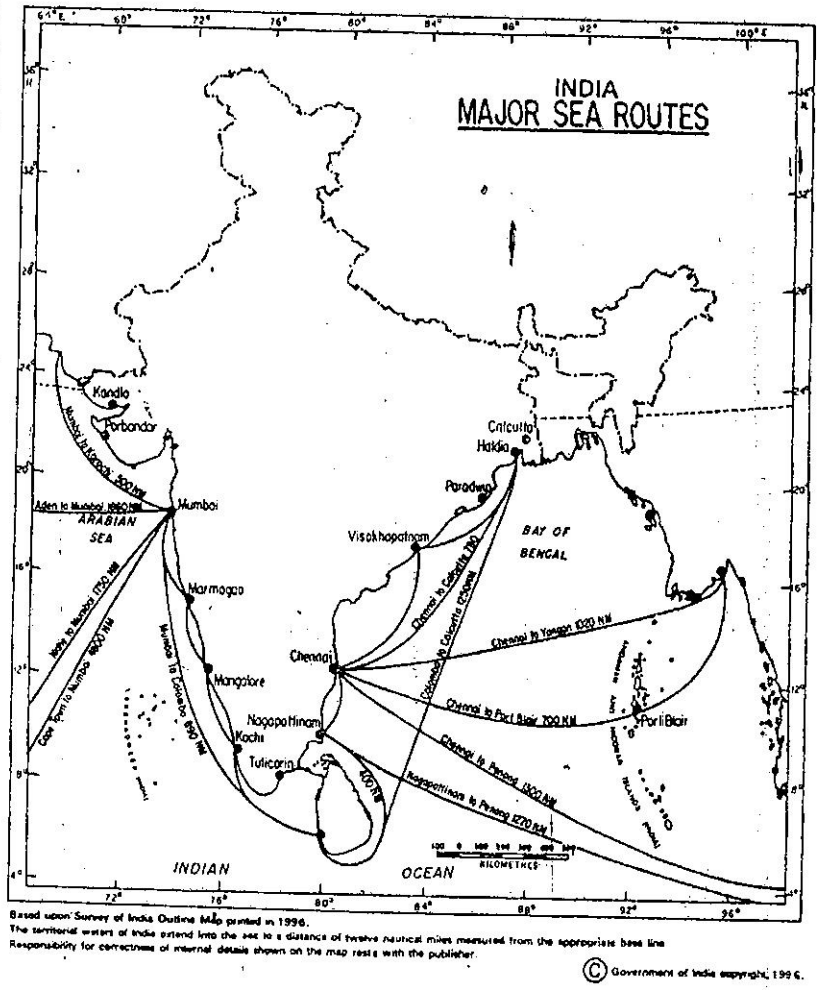


Fig 8.5 India — Major Ports and Sea Routes

Note the major ports of India lying on eastern and western coasts respectively.

mineral oil, petroleum products, fertilizers and other dry cargo.

Minor Ports

India has 139 minor and intermediary ports along its 5,700 km long coast line. There are 244 ships in our coastal fleet with 6.2 million tonne weightage.

Our Ocean Going Shipping Fleet

In 1947, the total weight of India's ocean going ships was not even 200,000 tonnes. By 31st March 1998, it had risen to 6.8 million gross tonnage—a 34 times increase. India has now the largest merchant shipping fleet among the developing countries of the world. India now ranks 17th in the world's shipping tonnage.

Inland Waterways

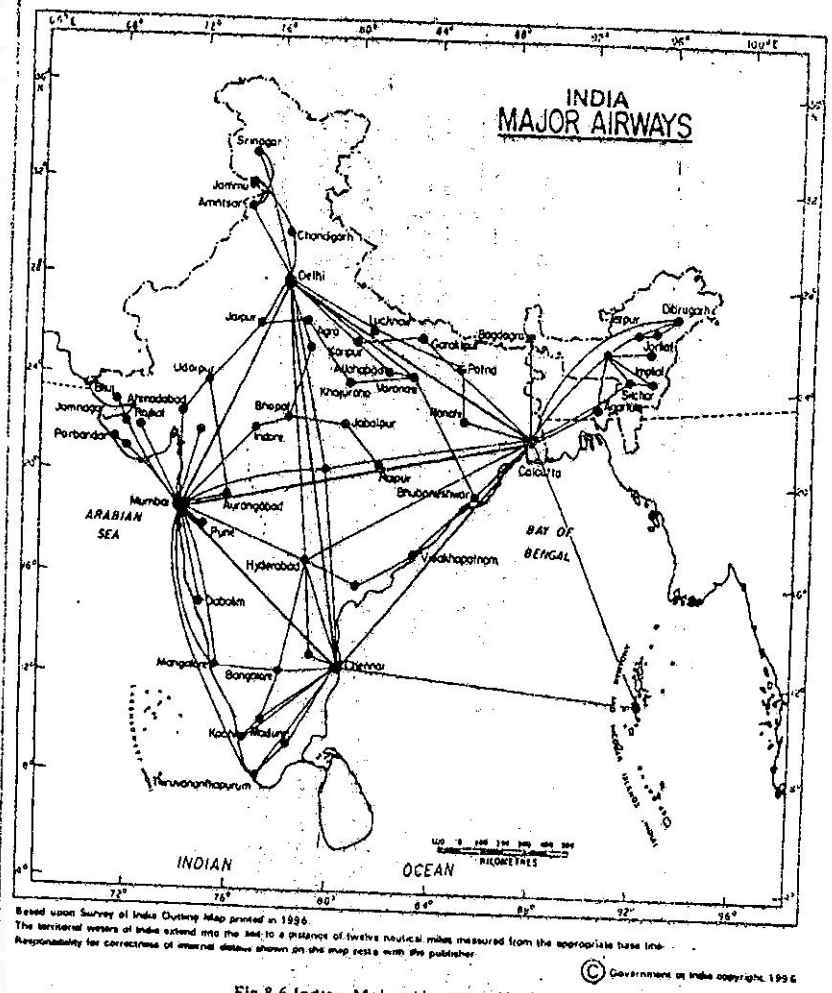
Inland navigation is a fuel efficient, environment friendly and inexpensive mode of transport. India has nearly 14,500 km of navigable waterways comprising rivers, canals, creeks and back waters mainly from Kerala. Out of 3,700 km of major river waterways only 2,000 are being utilised. Nearly 16 million tonnes of goods are carried through inland waterways. Currently a few stretches in Ganga Bhagirathi and Hooghly (West Bengal), Brahmaputra and Barak (Assam), Mandvi in Goa, backwaters of Kerala and deltaic regions of Krishna and Godavari in Andhra are being utilised. Ganga between Farrakka and Patna and then upto Allahabad is to be utilised in near future.

Airways

Our world has all of a sudden become a small place to live in. There was a time when it would have taken months and months to go from one end of the country to the other. With the advent of motor cars and railway trains, things have changed dramatically. It now takes only seventeen hours to reach Delhi from Mumbai or Calcutta by Rajdhani Express. How wonderful it must be when you can now cover the same distance in less than two hours by an air service. The air travel today is not only the fastest mode of travel but also the most comfortable and prestigious.

In our country air travel is useful for one more reason. It can cover very difficult terrains like high mountains, dreary deserts, thick forests and long stretches of seas with great ease. Think of the north eastern part of the country with big rivers, frequent floods, thick forests, high mountain ranges and international frontiers raising barriers in surface travels. But air travel has made things far more easy than one could hardly imagine. Suppose you are in Calcutta and want to go to Agartala in Tripura by road or rail, can you work out the time and money you would require in such case? But by air it would take not only less of your precious time but also be more economical.

Of late the Government of India have adopted a new "Open Skies" policy. The private parties in India, with stipulated foreign collaboration, if necessary, can now compete with two major public undertakings — Indian Airlines and Air India. Besides Indian Airlines, now there are two schedules private airlines providing regular domestic air services. Also there are 31 air taxi, operators who operate non-scheduled flights like private taxies. Mumbai Delhi is



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
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Fig 8.6 India—Major Airports and Airways

Note the cities where air traffic is high. Also note those area which do not have air connection. Can you reason out why is it so?

the busiest air route in the country. In 1997 the private parties carried nearly 37% of the Indian domestic air traffic. In 1997 the private air service lines carried 4.2 million passengers.

In 1997-98 Air India had 26 craft and Indian Airlines had 54. In 1980-81, Air India carried 1.4 million passenger to different parts of the world. By 1997-98 the figure crossed 3 million mark. Likewise Indian Airlines in the same period increased its tally from 5.4 million to 8.3 million passengers. The cargo handled at Indian air ports rose from 178,000 tonnes to 705,000 tonnes in the same period. This speaks of our growing high priced exports including perishables flowers and vegetables etc.

Airport Authority of India look after all the 92 civil airports in India. Pawan Hans Helicopters Ltd. provides services in remote areas such as the northeastern sector. Providing safe, efficient air traffic services and aeronautical communication services in the job of Airport Authority of India.

COMMUNICATIONS

Transport and communication moved hand in hand and were totally interdependent. In fact it was very difficult to say where one ended and the other commenced. But today communication has overtaken transport comprehensively and conclusively. The modern instant communication system in place is a pre-requisite for the rapid development of economy. Man being a social being communication is not a luxury but the barest of the bare necessity. It helps in promoting cultural unity. National and international spheres of communication strengthen each other and are thus complementary to each other. Their importance is realised easily during accidents, natural calamities and flare up of human conflicts.

Postal Services

Despite tremendous explosion of knowledge and information technology the age old postal system has not only survived but is also in greater demand. In 1837 the postal services were thrown open to the public in India. By 1854 there were 700 post offices. At the time of Independence we inherited over 23,000 post offices. By 1997-98 their total number rose to over 153,000. Of these over 137,000 are in rural areas. It is noteworthy that today a post office on an average serves a population of about 5,500 and an area of twenty one and half sq.km. The post offices in rural areas are subsidised to the extent of 66% and in inacessible parts by or much as 85%.

Telegraph and Telephone Services

Telegraph services were introduced at Calcutta in 1851 and a telephone service began also at Calcutta in 1881-82 soon after their invention in the United States of America. Today there are over 40,000 telegraph offices. There were over 23,000 telephone exchanges in the country by 1997-98. Ours is the largest telecom network in Asia. There were nearly 18 million working telephones in India, STD and ISD services have become highly popular in India despite their high charges. Cellular and mobile phones and radio paging are new developments in this field. Mahanagar Telephone Nigam is an autonomous body looking after telephone services in Delhi and Mumbai. Telex services help send information in printed

form very quickly. Over 200 cities in India enjoy this facility. Electronic or E-mail is very inexpensive and hence becoming very popular.

Radio, Television and Cinema

Radio, television and cinema (films) are the electronic media of mass communication, unlike postal, telegraphic, telephone and telex services which are essentially of personal nature. Unlike telephone, radio is a means of wireless communication. It is a very powerful medium to transmit and receive useful information, news and variety of entertainment programmes not excluding sports.

At the time of Independence there were six radio (Akashwani) stations. On 1st April 1998 they were 195. AIR (All India Radio) is accessible to 97.3% of Indian population and 90% of the area. It now puts out over 300 news bulletins each day.

Doordarshan is the national television service of India. It started in 1959. It is one of the largest and essential networks in the world with 897 transmitters. It is accessible to 87% of population. It uses a large number of transponders of Indian National Satellites. Its programmes are watched by 350 million viewers in their homes. Its commercial ads brought in a huge revenue of Rs. 5,000 million in 1997-98. It has its own production facilities in 42 big cities across the country. Now under the open skies policies a large number of private channels have been assigned to private parties registered in India. Prasar Bharati is an autonomous body. It manages radio and television services under the supervision of a Parliamentary Committee

Cinema is the most popular means of entertainment in India. It is the largest producer of feature films in the world. Hindi films are by far the most dominant section. Almost all the regional languages bring out their own films almost continuously. Personal computers and Internet services have brought about a fresh revolution in the age of explosion of information technology.

Print Media

On 31st Dec. 1997 the total number of newspapers and periodicals being published was over 41,000. They were printed and published in 100 languages and total number of copies run into 105 million. Hindi publication has a share of around 40% of the total. Books are an equally important means of communication for preserving and propagating knowledge, information and entertainment to posterity.

INTERNATIONAL TRADE

Trade also forms part of the tertiary sector of economy as it renders valuable services to the people. However, we have seen that for any flourishing trade dense and efficient network of transport and communication is an indespensable pre-condition.

India has a long tradition of trading with countries located far and near. Today we are living in a fast shrinking world mainly because of tremendous advances in both transport and communication as seen earlier. We are living in an inter-dependent world, where the world itself has turned into a global village with a self contained economy. Or else how will you explain that India conducts international trade with about 190 countries with an endless list of around 7,500 commodities?

As already seen oceans no more divide people or nations. They provide most economic links and act as lively bridges between far-off continents. Major ports act as gateways of international trade and commerce. Small international navigation canals such as the Suez, Panama, Kiel and Soo have gained much more in importance than the open seas themselves. They do so by reducing distances. For instance the Suez Canal reduced the distance between Mumbai and London by as much as 7,000 km.

There was a time when things were imported only for domestic consumption. But now more and more countries, not excluding India, have been importing certain raw or semi-pressed materials, not for their own domestic consumption, but to process them further and export them after value addition. Indirectly what the country exports are its human skills. For instance Japan exports cotton and woolen textiles although it imports all its requirements of raw materials from other countries. The same is true of mineral based industries. We in India import raw cashew nuts only to reexport them after they are further reprocessed. More importantly, we import crude diamonds and other precious stones only to process them further and reexport them as highly finished fine products at a considerable upward margin. Importing gold and exporting it in the form of tantalising ornaments is another point in the same sequence.

With the help of these minimum of figures we can see the trends spread over the past half a century. In the first post-Independence decade (50 to 60) the exports were small and almost stagnant, indicating very slow economic growth, if at all. And yet the imports had started rising as country had to import machinery and even food to meet its requirements. It was a preparatory period for the quick progress that really started around 1990. The rapid growth of imports by nearly 32 times during the same period was mainly to quicken the pace of industrialisation. Self-reliance was the key word during that period. It was in nineties that the exports were being promoted in big way. Export oriented growth was the new direction imparted to our economy in general and industry in particular. During the past four decades the deficit (unfavourable balance of trade) has increased by over six and a half times. We must note that only

TABLE 8.5

India: Exports, Imports and Balance of Trade
(in Million U.S. Dollars)

A (50-60)	*Exports*	*Imports*	*Balance of Trade*
1950-51	1,269	1,273	- 4
1960-61	1,346	2,353	- 1,007
B (90-97)			
1990-91	18,143	24,075	- 5,932
1997-98	33,980	40,779	- 6,799

those countries become rich in course of time that have a favourable balance of trade i.e. who export much more than what they import.

Our Exports

We have seen the value of our trade and unfavourable balance of trade in dollars — the dominant currency in the global market. In international trade transactions in our national currency is of little use. Moreover, the exchange rate of national currency, the rupee also keeps on fluctuating very widely.

We need to know what are our major exports and whether they keep on changing or remain the same over decades. Besides volume and value of exports we also like to know their nature. There was a time when our exports consisted almost entirely of agricultural and mineral raw materials. Our traditional agricultural exports consisted of jute, the golden fibre of India, cotton, tea, spices, oil seeds—particularly groundnut and groundnut cake or shell, hides and skins. They were supplemented by minerals such as iron-ore, mica, manganese, and bauxite. Even now we continue to export these commodities, but mostly in a different form—semi-processed or processed.

Instead of exporting raw jute and cotton we now export jute packing materials e.g. gunny bags, linen and carpets. In place of cotton we now export cotton in various semi-processed or processed forms. We export quality yarn, cotton fabrics including hosiery and now even readymade garments. In other words we provide millions of people with jobs of spinning, weaving, dying, sewing, tailoring and packaging etc. Thus we now export not only raw materials but also our skilled labour which is paid for by the money we earn in exchange of our finished goods. In the process they help themselves to raise their standards of living. We also export silk, woolen and synthetic textiles and mostly in a processed form. We now export packed tea bags in "a-ready-to-use-form." Likewise, coffee is our yet another plantation crop. Like tea it also now fetches us handsome foreign exchange. We now export processed marine products and manufactured leather goods. We also export on a large scale sports materials like bats and hockey sticks. We now export light engineering goods like fans, sewing machines, bicycles, three wheelers, scooters and the like. We export chemicals and allied products. We have started exporting cars and commercial vehicles, though on a small scale. Even traditional handicrafts inclusive of *Khadi* and handloom are exported to a number of countries. Export of carpets is also important. Cement is yet another important item of our export.

Our Imports

By far the most important item of our imports is mineral oil. A dozen of our mineral oil refineries are busy in processing mineral oil into various petroleum products like kerosene, diesel, petroleum and cooking gas etc. The other items of import include papers and newsprint. We import pearls, precious and semi-precious stones and gold for domestic consumption. However, much of it is re-exported after processing them in the form of industrial diamonds, jewellery and ornaments bringing in fine returns for our traditional skills in this area. Major chunk of our imports consists of modern high tech

machinery to boost our production of new items with an eye on promoting their exports. We import chemicals and medicines. Despite our growing production of chemical fertilisers we also have to import them to meet its growing consumption. Our imports include pulses, edible oil, wood and synthetic pulp non-ferrous metals such as copper. We also import coking coal as we are short of quality of it.

A large number of measures and policy decisions are continually taken keeping in view the new and emerging trends in international market. Export promotion is our major plank of rapid industrialisation.

It must however, be noted that inspite of our continuous unfavourable balance of trade we have been able to make our both ends meet through three specific ways. Firstly large number of Indians now work and live abroad in the countries like, the USA, the United Kingdom and Middle East. Most of them send their savings to support their families in India in foreign exchange like dollars, sterlings, marks etc. It is indeed a sizeable amount.

Secondly we receive annually a very large number of international tourists including our non-resident Indians. They come with foreign exchange, spending it here merrily. This also is a very big source of foreign exchange and is indeed an invisible kind of international trade. Thirdly in recent years we have been exporting software electronic goods to countries like the USA in a big way. These exports are treated as non-mercantile items. But the foreign exchange they earn helps us in meeting our foreign exchange deficit considerably. All these sources of Gross National Product need to be cultivated and promoted through enlightened fiscal and monetary policies and suitable measures.

Our Trading Partners

Our major trading partners are the USA, Germany, the United Kingdom, other West European countries, Russia and Japan more or less in this order. For importing mineral oil we depend upon gulf countries like Saudi-Arabia and Iran. We are trying to diversify our trade and promote exports to South Asian (SAARC) countries—Bangladesh, Bhutan, Nepal, Maldive, Pakistan and Sri Lanka. We are also promoting trading ties with ASEAN or South-east Asian countries, China and other Indian Ocean Rim countries like South Africa, Kenya, Tanzania, Middle East, Singapore and Australia. Our trade with East European and Central Asian countries is also on increase.

EXERCISES

Review Questions

1. Answer the following questions briefly:
   (i) What is the significance of unsurfaced roads in India?
   (ii) How does road transport score over railway transport?
   (iii) What compels India to have a strong naval fleet?
   (iv) In which part of India is air travel found more economical than road or rail transport.
   (v) Distinguish between (i) metalled and unsurfaced roads: (ii) state highways and National highways.
2. Give reasons for the following statements :
   a) There is a steep fall in the sugarcane freight carried by railways.
   b) But for the spectacular achievements of the Border Road Organization, the defence of the country could have been in jeopardy.
   c) Some items like gems and cashewnuts appear both on the import and export list.
3. Why are means of transport and communications called the lifelines of a nation and its economy?
4. Write a critical note on the changing nature of the international trade of India.
5. Prepare a comprehensive note on the progress made by Indian railways covering the following points :
   a) intensive utilization of track and wagons ,
   b) a large government organization
   c) economy in energy consumption
   d) suburban railway traffic in cities like Mumbai and Calcutta.
   e) contribution to the growth of agriculture and industry
   f) promotion of national integration and modernisation.
6. Have a realistic peep into the future to visualise what kind of exports India is likely to have by the year 2010 A.D.

Topic for Class Discussion

7. a) The tourism potential of India for selling our culture and buying currencies of other countries.
   b) How best can we export our abundant human skills.

Map Work

8. In an outline map of India where state boundaries are shown show the following correctly: (i) Golden Quadrilateral, (ii) National Corridors, (iii) Konkan Railway. (iv) Major railway junction between Chennai and Delhi and Mumbai and Calcutta, (v) Four International Airports, (vi) Jawahar Port.

UNIT FIVE

Nurturing Human Resources

Like many other animals, human beings also must have started as docile creatures of their environment. However, they soon developed abilities to observe, think, plan, communicate and cooperate with their fellow beings. As a result of this "band" characteristic, today they have emerged as the most dominating species ever born on this planet. They are no more simply a part and parcel of the surrounding ecosystem. In fact they now aggressively manipulate various elements in the environment, drastically changing their nature. Sometimes for their good and sometimes not.

Man tamed and domesticated certain wild animals. He put them to the best of his services. Men have developed carefully high-yielding and early maturing varieties of cereals, vegetables, flowers, fruits and several other crops. Poultry, fish, cattle, pigs and other farm animals have now been turned into machines, as it were, to give more eggs, protein, meat, milk, wool etc. Man has developed intelligent and powerful machines with the help of which he could land on the moon. Now he has a dream to find out what lies beyond his solar system.

This all calls for the humans to equip their coming generations with literacy and basic education for life. Also important are health care, vocational, technical and technological skills. Adequate savings to invest in creating new jobs for every successive generation is another must. The human population is no more a mere bunch of consumers. They are also the producers. In this highly competitive world we the Indians have to nurture our human resources. With their help we can become a wealthy, prosperous and a high-tech industrial society. Our skills, we can export to the rest of the world bringing in precious foreign exchange, enabling us to lead a more comfortable and satisfying life to one and all. All this calls for sustained efforts.

CHAPTER 9

Human Resource Base

Gone are the times when the strength of human beings lay in their sheer numbers. Now the use of various kinds of tools, implements and machines backed by modern technology has reduced considerably our dependence on manual or unskilled labour. Mechanization brought in speed, efficiency and qualitative improvement in its wake. Consequently production has increased manifold per unit labour. We in India have already a long tradition of skilled and artistic labour. For improving quality efficiency and productivity of our labour, we have to develop technical skills and constantly update them. The current liability of our huge and unmanageable human resources be turned into a big potential resource. Let us try our best to benefit from our skilled labour force and a huge potential market.

It is against this background let us have a close look at our population. It is indeed a potential resource base for our all round development. Such a study would be useful as we now enter the new millennium with immense possibilities, high hopes and a firm resolve to reach the top.

We Are All Indians

India is a country inhabited by people of several races, coming from far and near. Over the ages they intermingled with one another. In the process they may have lost many of their original traits and acquired new ones from others. And yet we notice a great diversity which is so characteristic of we, the Indians. In fact, beauty, richness and strength of Indian culture lies in its diversity. Its spirit of tolerance, gives and take and assimilation makes it one of the distinctive cultures of the world. Besides being a single nation we are known for Indian civilization unique in many ways.

The Indian people follow different faiths, cutting across castes, regions, languages and political views. Indian people consist of several religious communities like Hindus, Muslims, Christians, Sikhs, Buddhists, Jains, Zorastrians and Jews etc. Indians use different languages out of which 18 are scheduled languages. Hindi is the official language of the Union Government and English is an associate language of the Union Government. States use their own languages to run their governments. India has a single unified judiciary and a single citizenship. Ours is also a single common market economy with uniform currency all over the country.

Using more than one language in every day life is a very common phenomenon in India. There are wide zones running across the country where bilingualism is a common feature. It has been so far generations. Inter-lingual marriages are a common

FOR DOING IT YOURSELF

1. Study Table 9.1 and answer the questions that follow:

Population of India 1901 to 1991

Year	*Total Population (in Million)*	*Net Difference (in Million) over previous decade*	*Growth Rate for a Decade in per cent*	*Average Annual Growth Rate in per cent*
1901	230.3	—	—	—
1911	252.0	+13.7	+5.75	0.56
1921	251.3	−0.7	−0.31	−0.03
1931	278.9	+27.6	+11.00	1.04
1941	318.6	+39.7	+14.22	1.33
1951	361.0	+42.4	+13.31	1.25
1961	439.2	+78.2	+21.51	1.96
1971	548.1	+108.9	+24.80	2.20
1981	683.3	+135.2	+24.66	2.20
1991	846.3	+163.0	+23.85	2.14

(i) In which decade (i.e. a period of ten years e.g. 1901 to 1911) did the population of India decline?
(ii) Was it an exception or a general rule?
(iii) From what year has been the population of India growing progressively without a break?
(iv) In what year was the Decadal Growth Rate of Population at its highest?
(v) What actually happened in the next two decades?
(vi) Of late despite a fall in population growth rate how is it that the population in absolute numbers has been growing even faster?

2. Study Table 9.2 and answer the questions that follow:

TABLE 9.2

Big seven countries of the world–Their Area, Population and Average Density of Population in 1991

Rank	*Country*	*Area in sq. km.*	*Population in millions*	*Average density of population per sq. km.*
1.	Russia	17,075,000	148.5	12
2.	Canada	9,976,000	26.5	3
3.	China	9,597,000	1,134.0	118
4.	USA	9,373,000	249.9	27
5.	Brazil	8,512,000	150.3	18
6.	Australia	7,687,000	17.0	2
7.	India	3,288,000	844.3	267

(i) Verify if the following statement is an exaggeration. The five countries, all of them bigger than India, namely (i) Russia (ii) Canada, (iii) USA, (iv) Brazil, and (v) Australia together have an area over seventeen times of India but their combined population is smaller than that of India.
(ii) Find out the implications of this high density of Population in India.

3. Study Table 9.3 and answer the questions that follow:

TABLE 9.3

Some Demographic Indicators of a few countries including India

S. No.	*Country*	*Adult Literacy Rate*	*Infant Mortality Rate*	*Birth Rate*	*Death Rate*	*Natural Increase*	*Life Expectancy Male*	*Life Expectancy Female*
1.	Bangladesh	36.4	82	27	8	1.9	59	58
2.	China	68.5	31	17	7	1.0	69	73
3.	India	49.9	72	27	9	1.8	59	59
4.	Japan	99.0	3.8	10	7	0.3	77	84
5.	Sri Lanka	89.3	16.5	19	6	1.3	70	74

(i) Find out the highest and the lowest natural increase rates and on what do they depend. Compare India with Sri Lanka, China and Japan.
(ii) Identify the highest and the lowest infant mortality rates (IMR). Compare India with other countries.

phenomenon since long. We are all committed to the uplift of people belonging to scheduled castes and scheduled tribes enabling them to achieve their rightful place in the Indian society. While scheduled tribes constitute 8.08% the scheduled castes form 16.48%.

Notwithstanding such social, religious, linguistic and regional diversities and identities we are all Indians first and Indians last. Ours is a secular and plural society with a composite culture. It is a garden or a mosaic of flowers of various colours, shades, hues and fragrance adding beauty to the whole and in the process, deriving strength from the same.

Our Population : A World Perspective

In this world, ours is neither a very small country nor a very large one. We have only 2.42% of the world's total land area. Compared to this area of ours we indeed have a very large population. In population size we stand next only to China. On March 1, 1991 our population stood at 846.3 million. The Indian population constituted one–sixth or 16% of the world's humanity. In other words every sixth person in the world is an Indian, as very fifth is the Chinese. As it is, already too large to be catered to adequately, keeping in view their legitimate needs, hopes and aspirations.

India stands seventh in area in the

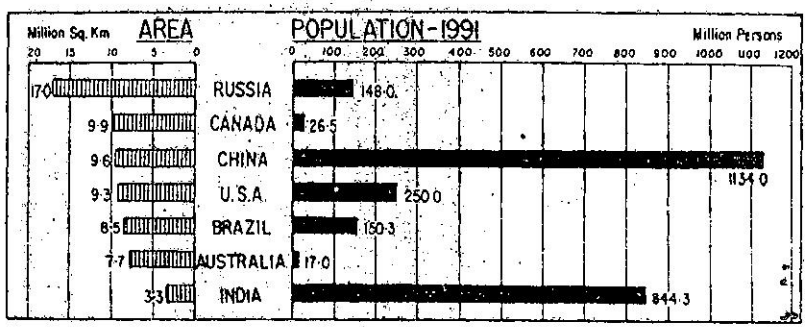


Fig 9.1 Seven Largest Countries of the World (Areawise) and their Population

Note the ranking of the seven countries based on population. Name the countries which are bigger than India in size but have less population

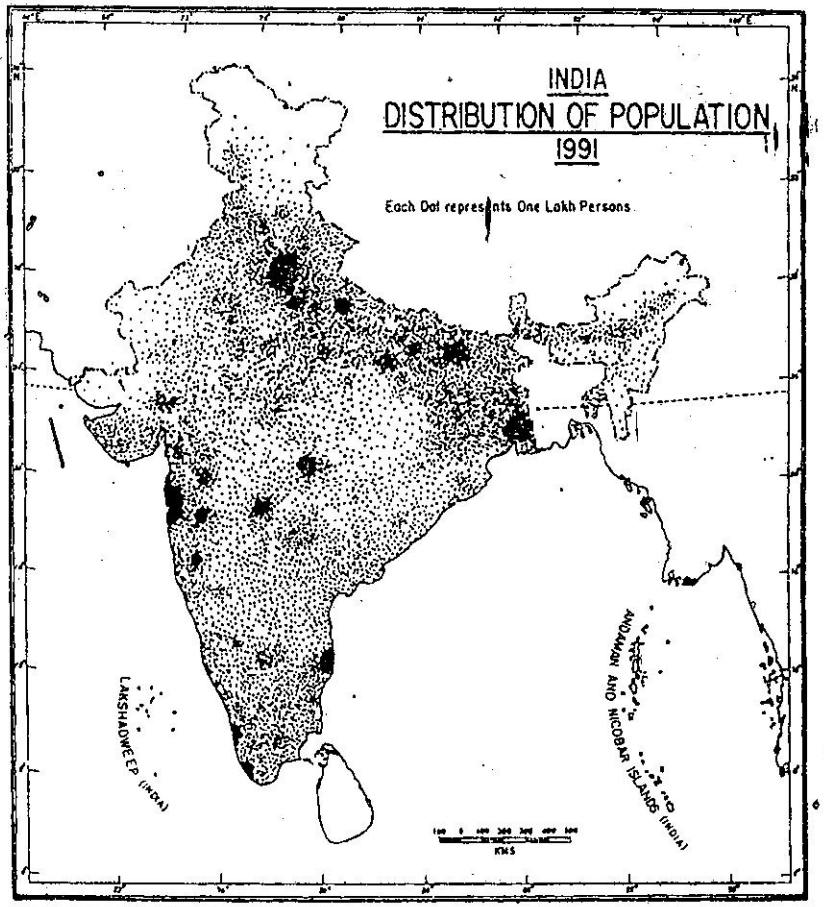
following order : (i) Russia, (ii) Canada, (iii) China, (iv) the United States, (v) Brazil, and (vi) Australia. Barring China, if we add up the population of these 'larger than India countries' it is still much less than even 600 million, compared to 846 million of our population. Together, their area is bigger by as many as 16 times. Even China has an area three times that of India and although its cultivated area is a smaller than that of India, its area under irrigation is twice as large as India has. And yet it has a grudge that with only 7% of the world's fresh water resources it has to sustain 22% of the world's population. It therefore, wants to stabilize its population at around only 700 million people.

Uneven Distribution of Our Population

In the year 1991, the average density of population in India was 267 persons per sq. km. By now it is around 300 persons per sq.km. Keeping this round figure we may broadly divide the country in three parts. The regions having a density of population ranging between 0 and 100 are the regions with sparse population. Regions having density of population between 100 and 200 persons per sq km are with moderate density of population. Lastly the region with 200 persons and above per sq km are thickly populated regions.

Sparsely peopled parts of India

Let us study the map of density of population in India. Look at the international borders of the northern half of the country. In the west, the whole of Kutchh in Gujarat, followed by the western half of Rajasthan are the regions of low to very low population. Barring the valley of Kashmir along the Jhelum river and the valley of Tawi in



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
Responsibility for correctness of internal details shown on the map rests with the publisher.

Fig 9.2 India—Distribution of Population, 1991

Note the densily populated parts of India. Which areas are least populated and why?

Jammu, the whole of the Jammu and Kashmir state is very sparsely peopled. Moving further along the international borders of Himachal Pradesh and Garhwal and Kumayun Himalayan region in Uttar Pradesh we pass through the same category of the region namely the sparsely peopled parts of India. Skipping our neighbouring country of Nepal we move into Sikkim which too is a very sparsely peopled part of our country. Leaving another of our close neighbours Bhutan behind, we enter our eastern most state—Arunachal Pradesh. This whole large state of India has very sparse population in India. There are only 10 persons per sq. km. in this state.

Moving southwards along the border of Myanmar we come across the states of Nagaland, Manipur and Mizoram — All of which have low to very low density of population. There are some pockets of dense population in these states. While moving towards the Bangladesh border the State of Meghalaya marks the region of low density of population.

It is however interesting that the reasons for these regions to have a very low density of population are extremely varied. Very low density of population in Kutchh and the Thar desert of Rajasthan is ascribed to its intense aridity. The rainfall in these parts is scanty and very uncertain. This is a typical hot desert land with very little vegetation to support life.

The parts of Jammu and Kashmir, Himachal Pradesh, Uttarakhand region of Uttar Pradesh are all regions of most uneven and rocky terrain and very high altitude. They remain under snow for major part of the year. As such these regions fail to support life worth the name. Life is most difficult in these highly mountainous regions. The same holds good of the Sikkim and Arunachal Pradesh where the rains are more heavy for several months in a year.

The regions lying along the borders of Myanmar and Bangladesh do not suffer so much from high altitude of presence of snow as from heavy and fairly prolonged rainfall. As a result very dense forests and floods make the life very difficult.

Areas with such low density of population are also found as relatively small pockets in the northern parts of the peninsular block of India. Prominent among them is the Bastar district of Southeast Madhya Pradesh. Chhotanagpur plateau and hills of Eastern Ghats in Western Orissa and northern tip of Andhra Pradesh are such other pockets.

Regions with moderate density of Population

This covers the bulk of the peninsular block of India barring the plateaus of Tamil Nadu and western Karnataka. It includes south and southeast Rajasthan lying east of Aravallis. Barring a couple of pockets referred to in the previous category the bulk of Madhya Pradesh falls in this zone of moderate density of population. It also covers plateau of Western Orissa and Telangana in Andhra Pradesh, and some parts of eastern slopes of Sahyadri in Maharashtra.

The western half of this region is characterised by low rainfall and black soils of uneven depth intervened by rocky outcrops. The eastern half is more dissected and undulating and covered with red soils rather shallow in depth. In both these parts the terrain is rocky and soils are shallow and far from fertile. Thus the density of population

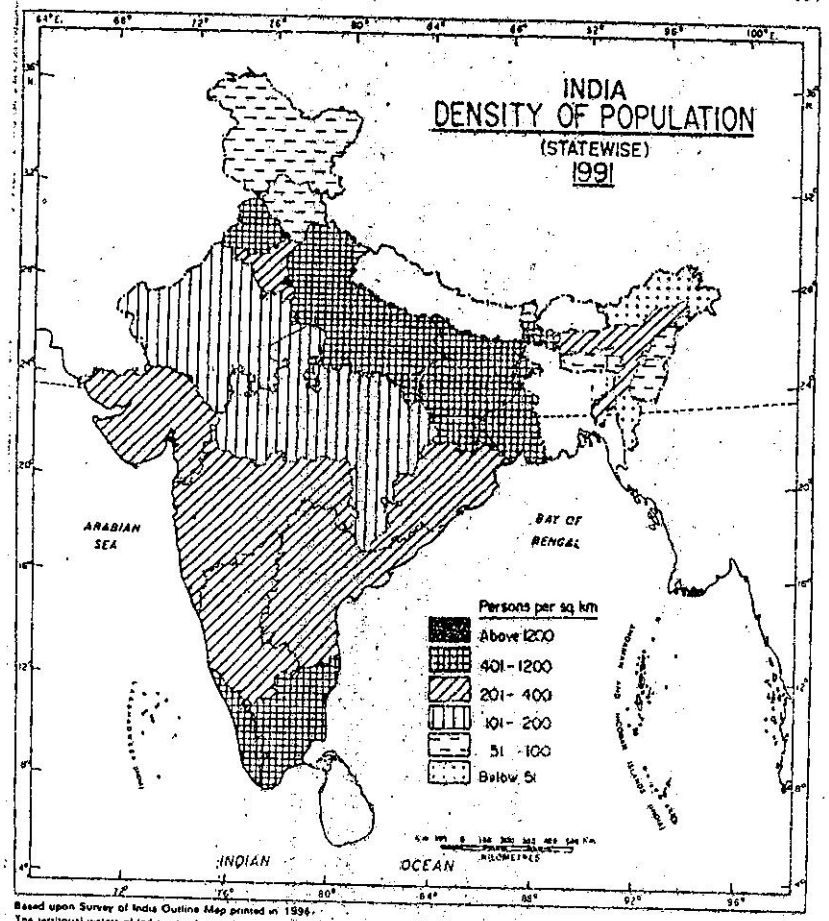


Fig 9.3 India—Density of Population (Statewise)

List out the states having population density of more than 400 and less than 100 persons per square kilometre respectively. How many states are in each category? Also note the states/union territories having a population density of above 12,000 persons per square kilometre. What pattern do you notice?

is influenced by low to moderate rains, a rocky mature of the terrain and presence of soils mostly in shallow pockets.

Regions of high density of Population

This region broadly coincides with Northern plains. It stretches from Punjab and Haryana in the west to Brahmaputra valley, in Assam in the east, covering in between the plains of Uttar Pradesh, Bihar and West Bengal. The region also includes the plains of Gujarat, North Konkan and Malabar coastal plains covering the whole of Kerala. The plateaus of Tamil Nadu, and Karnataka and coastal belts of Andhra Pradesh and Orissa finally merging into the Ganga plains.

This region as a whole receives a fair amount of rainfall. It is also bestowed with rechargeable ground water reserves. The rivers draining these regions also help in irrigating large tracts with relative ease as the region is extremely flat and is made of very deep and fertile alluvial soils. The entire region forms a granary of India. The region is also known for its agrobased industries like textiles, sugar and edible oils. It is also served by a fine network of communication. Abundance of inexpensive labour is its yet another asset.

The state of West Bengal now tops this region with the highest density of population per sq km It is as high as 767 persons. It is then followed with Kerala (749), Bihar (497), Uttar Pradesh (473), Punjab (403), Haryana (372), and Assam (286).

Distribution of Population Among Males and Females

All animal populations consist of males and females. They are indispensable and equal partners for the perpetuation of their respective species. Human population is in no way an exception to this law of nature. On March 1, 1991, the total population of India was 846.3 million. Of these 439.2 million were males and 407.1 million were females. It means males outnumbered females by as much as 30.1 million. It is double the total population of Australian continent. Think over the magnitude of this disparity between the numbers of the two.

This fact becomes more clear with the help of a ratio between males and females. In India this ratio is expressed in terms of number of females per every 1000 males. In 1901 there were 972 females per 1000 males. The sex-ratio in India has been steadily dropping down over the decades. In 1991, it was as low as 927 females per 1000 males. This persistent unfavourable trend is adverse to the females in India. In fact, by and large, the developed countries of the world show that females enjoy greater longevity than their male counterparts. For instance, in Japan sex ratio is 1038 per 1000 males. The Japanese female has an average longevity of 84 years as against only 77 for males. Even in our state of Kerala known for the better status of women the sex ratio is almost the same as in Japan.

In India the adverse or unfavourable sex ratio is a clear indication and a consequence of very low social, economic and political status of women. The low literacy figures for females is yet another evidence as well as the contributory cause of their over all low status. It is only very recently that female life expectancy has marginally improved over that of the males. If this trend continues and gets accentuated the sex ratio may begin to improve, although very slowly.

The sex ratio in rural areas is somewhat higher than the one in urban areas. This is because of the modern trend of migration of labour from rural to urban areas. It is a male who generally migrates elsewhere in search of a job leaving behind the family, while he earns his living in the town or city he sends part of his earnings to the family living in villages.

The women in India also deserve an equal status with males in the family and the society. As educated women begin to participate in the organised labour force—outside the home and farm—they would be free and better motivated to have a small family so that every child in the family is looked after with due love, affection and opportunities to grow to their maximum ensuring all sided growth of their personality.

Distribution of Population in Urban and Rural Areas

Ours is an agrarian society where bulk of the population lives by agriculture and related occupations in rural areas. Generally the urban areas is one in which 75% of the population lives by non-agricultural pursuits. At the beginning of the 20th century i.e. in 1901, only one out of every nine Indians lived in towns or cities. After nine decades the situation has undergone tremendous change. Now every fourth Indian is a city dweller. In 1901, the total number of people living in urban areas was just 26 million. By 1991, the number of people living in urban areas shot up to 218 million. This figure far exceeds the total population of Russia, Canada and Australia put together. More disturbing is the fact that two-thirds of our total urban population lives in class I cities i.e. those with a population of 100,000 (or One lakh) people. This ever growing population is mostly unskilled and puts tremendous pressure on our existing fragile civic, social and sanitary services.

Today in India, the ten very heavily populated urban districts are Calcutta, Chennai, Greater Mumbai, Hyderabad, Delhi, Chandigarh, Mahe (North Kerala), Howrah and Kanpur city. These ten city districts alone account for country's 5% of the total population. The average density of these districts is 6888 persons per sq.km. Compare this figure with the average density of population firstly with India (267) and secondly with Arunachal Pradesh (10).

Among the large states Maharashtra, Gujarat and Tamil Nadu are the most urbanised states. 38.69% of the total population of Maharashtra now lives in urban centres. It is followed by Gujarat and Tamil Nadu with similar percentage of 34.49% and 34.15% respectively.

Yet another fact of great significance is the rapid growth of "Million plus" cities. Each of such cities has more than one million (i.e. ten lakh) people. In 1981 there were 12 such cities. They were Calcutta, Mumbai, Delhi, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Kanpur, Nagpur, Lucknow, and Jaipur. By 1991, their number has risen to 23 with the additions of Surat, Kochi, Vadodara, Indore, Coimbatore, Patna, Madurai, Bhopal, Visakhapatnam, Ludhiana and Varanasi. While the population of Mumbai metropolitan city is 12.5 million, the population of Varanasi is 1.3 million only.

Over a period of 90 years the rural population has hardly increased by three times—from 213 million to 629 million. During the same period the urban population has increased by more than eight times–from 26 million to 218 million! Today's urban population in India is even larger than the total rural population of India, as it was in 1901.

TABLE 9.1

Distribution of Population in Major Age Groups

Age Group	*1981 (In %)*	*1991 (in %)*
0-14	39.5	37.25
15-59	54.3	55.99
60 and above	6.2	6.76
Total (%)	100	100

When population in India was exploding very fast the percentage of young population accounted for as much as 44% of the total population. By 1981 it dropped down to 39.5% and in 1991 it was further reduced to 37.25%.

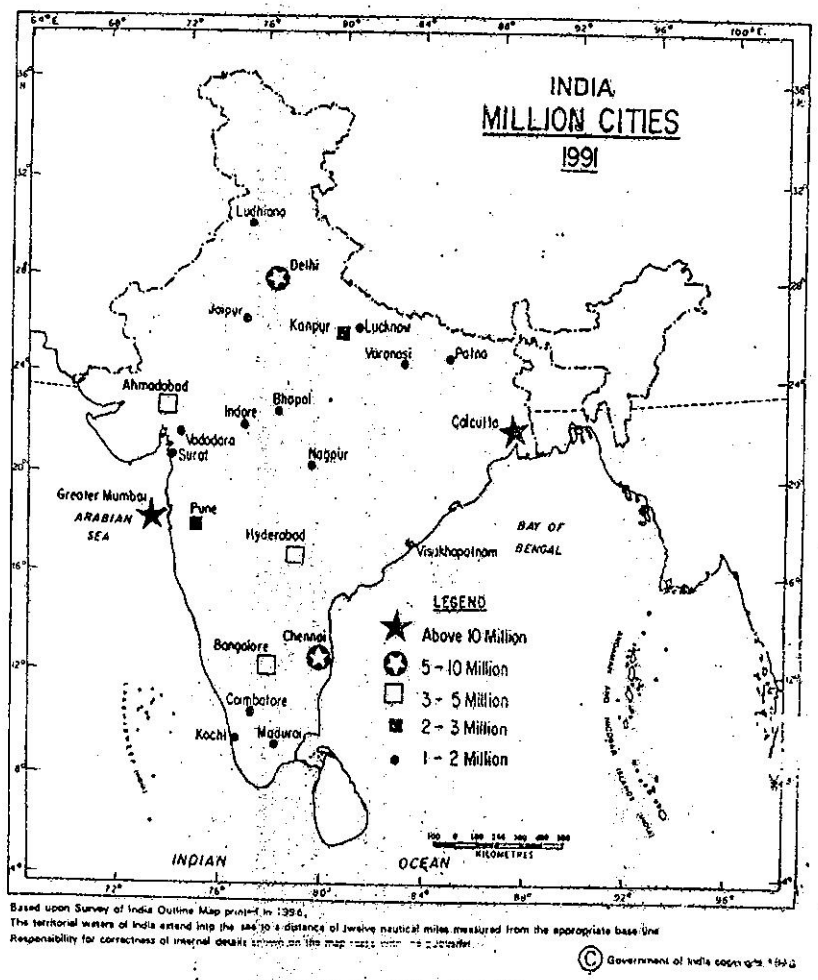
The old population over the last decade has increased from 6.2 to 6.76%. This is an indication that owing to spread of education and enlarged and improved health services the general longevity has been steadily increasing. The average life expectancy has now almost doubled since 1951 and now has just crossed 60 years for both males and females.

The age groups of the young and the old are alike in making special demands particularly in health and medical care. The education of the young also makes a pressing demand on the resources of the economically active population. Further more both the groups are dependent on the population of mid-age group. The dependency ratio is calculated by dividing dependent population by the active population and multiplying it by 100. Thus the dependency ratio in India in 1981 was 83 as against 48.8 in Japan. By 1991 the situation in India improved a bit as the dependency ratio has come down to 78%. This ratio can further be reduced as our birth rate would belowered over a couple of decades. We must now provide more resources for the old whose proportion in the total population is bound to increase with steady growth in life expectancy.

Literacy: Its Significance and Distribution

Literacy is a key to acquire information and knowledge. It is a gateway to bring about a change in One's Value system and life styles, particularly in regard to sanitation and nutrition. It is also a means through which vocational, technical and technological skills can be acquired, to improve one's economic and social productivity.

In 1951 the total literacy rate in India was just 18.33%. By 1991 it rose to 52.21% showing an increase of little less than three times. If we look at only the male literacy during the same period it has risen from 27.16% to 64.13%. In other words now out of every three males, two are literate. The situation in regards to females has improved during this period by five times—i.e. from 8.86% it has moved to 39.29%. But much more remains to be achieved. Today only two females out of every five are literate. It is the female literacy which has far reaching implications than that of the males. Mahatma Gandhi used to say if you make a female literate you make the whole family



Based upon Survey of India Outline Map printed in 1996.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line
Responsibility for correctness of internal details shown on this map rests with the publisher.

Fig 9.4 India—Million Plus Cities

Write the name of the cities falling in each five categories of million plus cities. How many cities are in each category? Which state has the highest number of million plus cities?

literate, which is not necessarily true of males.

Even in literacy it is the rural area which suffers from lack of motivation and adequate resources. In Kerala as a whole there is not much of a difference between male literacy rate and female literacy rate. Even the difference in rural and urban areas in this regard is not significant. On the other hand, look at the States like Bihar and Rajasthan which stand at the bottom. For instance in Bihar while male literacy is 52.49% the female literacy is as low as 22.89%. And in rural Bihar it is further disappointing as only 17.95% of the females were literate in 1991. In Rajasthan the female literacy is as low as 20.44%. That means every four females out of five do not know how to write their names. The situation is further pathetic in rural Rajasthan where it drops down to 11.59 as per 1991 census.

Increase in female literacy and length of schooling of girls leads to the rise in age at marriage. This reduces chances of maternal and infant mortality—a precondition for planning a small family.

Three-fold Occupational Distribution

The occupational structure of our country is lop-sided. 64% of our population still lives by agriculture which includes fishing, forestry, animal grazing, breeding and rearing etc. In countries like the United Sates the people engaged in such activities are hardly 5% of the total population. In Japan this figure is larger and yet it is less than 10%. This sector deals directly with the natural resources. The secondary sector of economy converts natural resources in manufactured goods. Advanced countries have about a fourth of its labour force engaged in manufacturing industries. This sector is rather strategic because it alone is directly concerned with value addition raising thereby the national wealth and income considerably. India has only 10% of its labour force in this crucial sector of economy. Lack of capital and modern technology are the hindering blocks. The remaining quarter of our total labour force is engaged in tertiary social services like health, education, transport, communication, banking, insurance, entertainment and arts etc.

Thus it is clear that we have to divert a large chunk of labour force still engaged in agriculture and is somewhat underemployed. Then only our gross national product, the total wealth generated by the society, will increase. This is the only way to raise level of living standards of our people.

What makes Population Grow Fast

In a given territory population may remain stable if both the birth rate and death rate balance each other; and migrations, both ways, are kept out. This has happened in several developed countries. In some countries the birth rate has fallen below the level of death rate. It means there are more deaths than births. Such countries register a fall in natural growth rate of population. However, in many developing countries like India the birth rate is still higher than the death rate and as such they display a higher natural growth rates of their populations.

In India, between 1901 and 1921, the birth rate as well as death rate were very high, cancelling each other out. In 1911-1921 the natural growth was as low as 0.09% per annum. However, by the time we

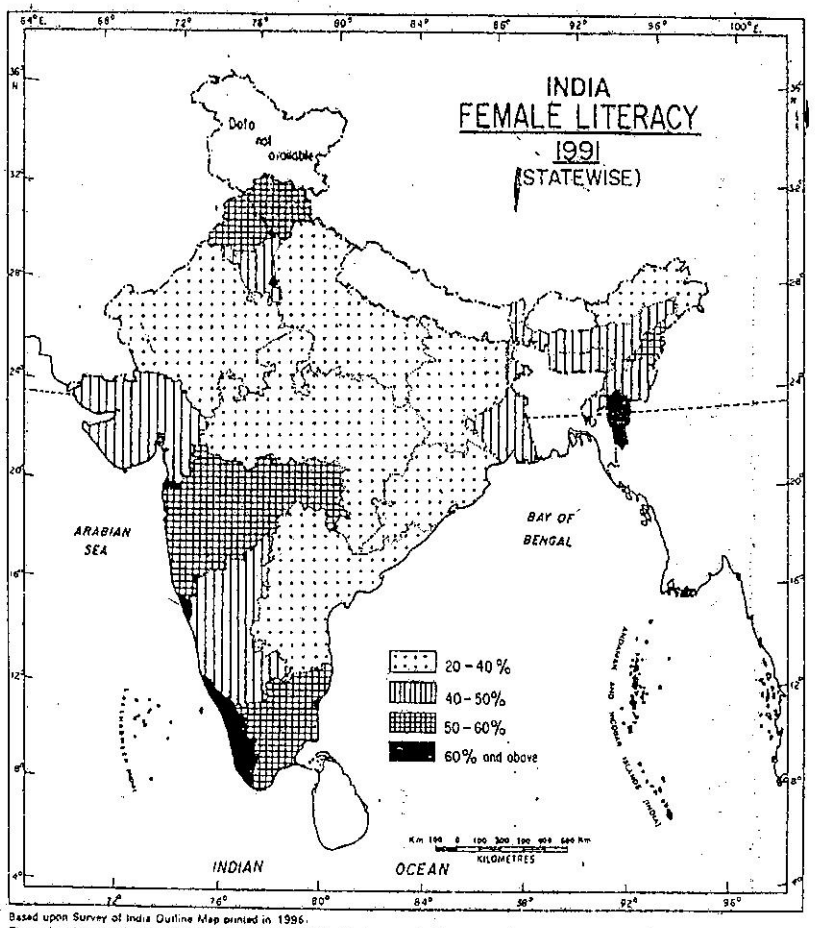


Fig 9.5 India—Distribution of Female Literacy (Statewise)

Note the states/union territories having a female literacy rate of 60% and above. Also name the states/union territories having female literacy of less then 40%.

come to the latest figures we see the death rate falling very rapidly. It stood at as low a figure as 8.9 per thousand population. However, during the same period, the birth rate has also been coming down but with a much slower pace. From 49.2 it come down; but not even by half as it still stood at 27.2 in 1997. The gap between the two was at its widest in 1961-71 decade. Then the natural growth of population was 2.22% per annum. From 1961-71 to 1991-97, the natural growth of population has slowly come down to 1.83 per annum. It may be noted that the rapid fall in death rate is because of our success on health front, along with spread of education, and efforts towards mass awakening.

Now a trend has been set which shows that the absolute population of India has been growing and would continue to grow for a few more decades. However, the place of its natural growth has been somewhat slowed down. This natural growth rate stood at 1.83 by the year 1997 as against 2.22% in 1971. With the growth in absolute population at the end of each decade the base of population has been getting enlarged and hence even with lower growth rate actual addition to total population has been growing unabated. In 1981-91 decade we had a net addition of 163 million people as against 135.2 million in the earlier decade inspite of slight fall in growth rate.

Population Vis a Vis Environment

As a huge and fast growing population our First and foremost concern is to feed every belley both young and old alike. We have to plan and provide for adequate, nutritious and balanced diet in tune with modern trends all over the world. It is a daunting challenge to our hard working farmrs, farm scientists and administrators. Not mere more production but a continuous increase in our yields

TABLE 9.2

Birth Rates, Death Rates and Natural Increase in India — 1901 to 1997

Decade	*Birth Rate per thousand*	*Death Rate per thousand*	*Natural Increase over Decade*	*Annual Growth Rate (%)*
1901-11	49.2	42.6	6.6	0.6%
1911-21	48.1	47.2	0.9	0.09%
1921-31	6.4	36.3	10.1	1.01
1931-41	45.2	31.2	14.0	1.4
1941-51	39.9	27.4	12.5	1.25
1951-61	41.7	22.8	18.9	1.89
1961-71	41.2	19.0	22.2	2.22
1971-81	37.2	15.0	22.2	2.22
1981-91	29.5	9.8	19.7	1.97
1991-97	27.2	8.9	18.3	1.83

per unit land is the prime need of the hour. We are hardly left with any additional area to be brought under cultivation. Infact large chunks of farm lands are being convected into residential and other kinds of areas in view of the changing nature of our society, aiming to industrialise itself as fast as it could. We need to develop varieties of seeds which are high-yielding and early maturing. They need to be improved genetically which is a time-consuming process.

We are almost one billion strong and not before long we would be crossing a "One-and-a-half billion mark", in another four decades or so. From 50-55 million tonnes since Independence was have increased our food production to around 200 million tonnes. To meet the current population explosion we need to raise this production by another 100 million tonnes. This would only enable us to maintain the level of nutrition that we somehow have today.

We need increased production and yield per hectare in every kind of food and other crops—cereals, pulses, oil seeds, vegetables, fruits, sugarcane, beverages, fibre crops, rubber and what not. We have to plan for greater consumption of poultry, meat, milk and several other animal products including fish. In turn they also need higher amounts of feed.

We need to bring under irrigation more and more of our land when we are now very close to the saturation point, both in surface and ground water resources. This would call for more dams, more wells and tube wells. New and imaginative farming practices—tools, implements and manageable machines will have to be developed and popularised. This would call for more incentives and huge investment. Better pest management, enlarged storage and cooling facilities, avoidance of wastage during past-harvest stages, provision of better credit and marketing facilities to the farmers, assurance of letter remunerative prices are some of the tasks that continue to await us.

Our per capita share of cultivated land has been dwindling very fast from one generation to another. More and more people are becoming landless. Our encroachment on pasture and forest lands has already caused immense damage not only to our economy but even to the ecological balance, which is already highly fragile. Our fast urbanisation and industriali-sation have been causing pollution, of every sort—soil, water, air and noise. Our land and water resources are far from infinite. They have a limit, which we have been approaching very fast. We are likely to be in for diminishing returns from our land. Development of our mineral resources calls for a more scientific and enlightened deal. Reserves of known fossil fuels particularly natural oil and gas are almost exhausted forcing us to go back to the consumption of coal. We are in for a severe industrial pollution.

Our rising expectations and changed life styles have been fast converting us into a society infested with the germ of consumerism and wasteful life styles. In the long run-in another couple of decades—they may prove harmful to our environment and its ecological balance. The need of the hour is to nurture leadership of both males and females, and start planning to the extent possible from local grassroots level upwards, protecting our fragile environment in every possible way.

EXERCISES

Review Questions

1. Compare India with China in respect of their (a) total area, (b) total population, (c) share in world population and (d) average density of population.
2. How is China placed in regard to its share in world's fresh water resources and population?
3. Give three examples of areas with very sparse population in India, each one having a distinct reason of its own.
4. What makes West Bengal the most thickly peopled state in India? State three reasons.
5. State in millions the exact difference between in total population of males and females in India as per 1991 census.
6. Compare the percentage of urban population as it was obtained in 1901 and 1991.
7. Name three "million-plus" cities each from Tamil Nadu, Gujarat and Uttar Pradesh.
8. What is the impact of fast growing cities of India on the environment and available civic amenities?
9. What is dependency ratio? What does the comparison of such ratios between India and Japan reveal to us?
10. How does rise in female literacy help in planning a family?
11. Why is the expansion of manufacturing industries a must in raising the standards of living of our people?
12. Complete the following statement by choosing the correct ending : India's population has been growing rapidly because of our
    (a) ever growing high birth rate
    (b) ever growing million plus cities
    (c) mismatch between high birth rates and low death rates
    (d) very low infant mortality rates.
13. Give three examples from your own every day experiences, how growing population affects nature and quality of environment.
14. Give a technical term for each of the following statements :
    (i) number of females per 1000 males
    (ii) average number of persons per square kilometer of total surface area
    (iii) number of infants dying under one year of age per thousand live births in a year
    (iv) a city with more than ten lakh people
    (v) deaths per 1000 population in one year.

Map Work

15. On a map of India show the following :
    (i) the largest State in terms of area
    (ii) the largest State in terms of population
    (iii) the State with the highest density of population
    (iv) the State/Union Territory having the highest growth rate of population
    (v) the State/UT with the highest literacy rate.

Appendix I

GLOSSARY

Afforestation: The process of transforming an area into a forest, usually when trees have not previously grown there. Afforestation is done with a view to checking soil erosion and conserving water.

Agricultural resources : Gifts of nature that include fertile soils, water for irrigation and favourable climatic conditions for the growth of plants.

Agriculture : The science and art of cultivation the soil, raising crops and rearing livestock. It is also called farming.

Alluvial plain : A level tract of land made up of alluvium or fine rock material brought down by a river.

Arable land : Land currently ploughed and cultivated with crops..It is also called cultivable land and includes both cultivated and temporary fallow land.

Atomic energy : Power obtained by splitting the atom under controlled conditions. As the power is derived by bringing about a change in the nucleus of an atom, it is also known as nuclear energy.

Balance of trade : The difference between the total value of a country's exports and imports. An excess of export over import makes a favourable balance of trade and the converse an unfavourable balance.

Basic industry : Industries such as iron and steel and chemicals like sulphuric acid that are fundamental to other industries. Sometimes the term is also used to include heavy industries of national importance. It is also called key industry.

Birth rate : The number of live births for every 1000 persons.

Bunding : The practice of construction embankments of earth or stone for conserving water and soil to increase crop production.

Census : Official enumeration of population along with certain economic and social statistics in a given territory and carried out on a specific day. It is generally conducted periodically.

Chemical fertilizers : Substances of natural or artificial origin containing chemical elements such as phosphorus, potassium and nitrogen that are necessary to plant life. They are added to the soil for increasing its productivity.

Climate : The average weather conditions of a sizeable area of the Earth's surface over a period of time (usually spread over a span of at least 30 years).

Climatic divide : A bold relief feature seperating distinct regions lying on either side

Consolidation of holdings : Combining of smaller plots of agricultural land to make them economically viable.

Contour ploughing : Tilling or plugging hillsides or sloping lands along the contour lines, that is, around rather than up and down a slope mainly with a view to conserving soil and water.

Cosmopolitan city : A city where people of different nationalities live side by side.

Death rate : The number of deaths per every 1000 population in a year.

Density of population : The average number of persons per unit area. Such as a square kilometre.

Dry farming : A method of farming adopted in certain regions of inadequate rainfall and devoid of irrigation facilities by conserving moisture in the soil and by raising drought enduring crops.

Environment : Surroundings or the conditions under which a person or thing exists and develops his or its character. It covers both physical and cultural elements.

Exports : Goods despatched from one country to another.

Fallow land : Arable land lying uncultivated for one season or more.

Foreign exchange : The mechanism or process by which payments between any two places operating under different national currency systems are effected without passing of actual money or gold etc.

Glacier : A river of mass of snow and ice that moves slowly away from its place of accumulation carrying gradually a broad and steepsided valley on its way.

Gradient of slope : A ratio between the vertical fall in elevation and the given horizontal distance.

Green Revolution : Recent developments in agriculture in our country which have led to a considerable increase in agricultural yields in certain cereals especially wheat mainly as a result of new seeds, application of manures and chemical fertilizers, and the provision of an assured water supply.

Ground Water : The water held in the pores and crevices of soil and in its underlying bedrock.

Growing Season : Part of a year in a given region when the growth of vegetation or crops is made possible by a favourable combination of temperature, precipitation, and freedom from harmful frost.

Harbour : An extensive stretch of deep water where vessels can anchor securely to obtain protection from sea and swell either through natural features or artificial works.

Heavy industry : An industry characterized by the heavy and bulky nature of raw material and finished products and as such much concerned with transport costs.

Hectare-meter : Volume of a metre-deep water standing over a hectare of level land. It is 10,000 cubic metres.

Hydroelectricity : Electricity produced by the application of the force of falling or running water.

Imports : Goods brought into a country from other countries.

Indian Standard Time (IST) : The local time along the Standard Meridian (82°30'E) which serve as the standard time for the whole of India. It is five and a half hours ahead of Greenwich Time.

Industrial revolution : The change in manufacturing from hand operated tools to power driven machinery began in England during the middle of eighteenth century.

International trade : Trade carried on between nations primarily to exchange their surpluses and makeup their deficits.

Irrigation : The distribution of water on Agricultural land by artificial means in order to enhance the growth of crops.

Kharif : Crop shown soon after the onset of the southwest monsoon in India (June & July) and harvested in autumn.

Large-scale Industry : An industry which employs a very huge number of labour in each unit.

Light industry : Industries whose raw materials and finished products are not heavy and can possible employ female labour as well.

Lumbering : A basic occupation of cutting timber in forest. It includes varied activities such as logging-splitting and hauling.

Manufacturing industry : Systematic production characterized by division of labour and extensive use of machinery.

Metropolis : A very large city or agglomeration of population in a district or a country and is often a chief centre or seat of some form of activity—administrative, commercial or industrial. It generally serves a large metropolitan area or hinterland.

Mineral : A substance that is found in the earth's crust and which generally has a definite chemical composition-unlike most rocks.

Mineral fuel : Non-metallic minerals such as coal and petroleum which are used as fuel.

Mineral oil : A mixture of hydrocarbons in solid, gaseous or liquid form found in the earth It is commonly known as petroleum.

Mineral ore : Metals in the raw state as extracted from the earth.

Mining : An economic activity concerned with the extraction of commercially valuable minerals from the bowels of the earth.

Mixed farming : A type of farming in which cultivation of crops and raising livestock go hand in hand. Both these activities play an important part in the economy.

Monsoon : A complete reversal of winds over a large part leading to a change of seasons.

National park : A reserved area for preserving its natural vegetation, natural beauty and wild life. People visit these places to see wild animals in their natural surroundings.

Natural gas : Free hydrocarbons in a gaseous state usually associated with crude mineral oil and found in the earth's crust in a natural state.

Natural growth rate of population : Gap between birth rate and death rate over year per 1000 population of a given region.

Natural resources : Wealth provided by nature—mineral deposits, soil fertility, timber, fuel, water, potential water-power, fish and wild life etc.

Off-shore drilling : Digging deep bores into the bed of shallow seas near the coast for extracting mineral oil.

Plantation agriculture : A large scale one-crop farming resembling factory production. It is usually characterized by large estate, huge capital investment and modern and scientific techniques of cultivation and trade.

Port : The commercial part of a harbour containing facilities for embarking and disembarking passengers, loading and unloading and some facilities for the storage of cargo.

Public sector : That part of economy in which the state or its agency undertakes economic activities and control the means of production and distribution.

Rabi : Crop sown in India in winter and harvested in spring.

Rotation of crops : A systematic succession of different crops on a given piece of land carried out in order to avoid exhaustions of the soil.

Secondary industry : Industry which transforms the material provided by primary industry into commodities more directly useful to man.

Sex ratio : Number of women per 1000 of men population.

Shaft mine : An underground excavation made deep into the earth for digging minerals and mineral ores like coal, precious stones and iron. Such mines contain vertical and inclined shafts and horizontal tunnels at various levels.

Shifting agriculture : A method of farming in which a patch of ground is cultivated for a period of few years until the soil is partly exhausted or overrun by weeds, and after which the land is left to natural vegetation while cultivation is carried elsewhere.

Small scale industries : Industries employing a relatively small number of employees in each unit, or in which the capital investment is relatively small.

Sub-continent : A big geographical unit which stands out distinctly from the rest of the continent.

Subsistence agriculture : Farming in which its produce is mainly consumed in the farmer's household-unlike commercial agriculture whose products enter into trade on a very large scale.

Textile industries : Manufactures of fibrous raw material which is processed through spinning and weaving.

The lifelines of a country : The modern means of transport and communication which bring people close to one another and help in economic development, national and international trade and in the defence of the country.

Thermal electricity : The electricity generated by burning coal, petroleum or splitting atomic minerals in controlled conditions.

Tube well : Deep bore well, lined with pipes or tubes used for drawing up water from big reserves of sub-soil water with the help of electricity.

Urbanization : A general movement of people from small rural or agricultural communities or villages to larger towns engaged in varied activities such as government, trade, transport and manufacture. It also indicates the concentration of an increasing proportion of total population in towns and cities.

Young mountains : The fold mountains formed during the most recent major phase of folding in the earth's crust, for example the Alps, the Himalayas, the Andes and the Rockies.